ASSESSING THE IMPACT OF QUALIFIED MATHEMATICS AND SCIENCE TEACHERS IN THE BUFFALO CITY AREA

BY

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1. Research Proposal
Background and Introduction

My observations as an educator who has been in the teaching profession for the past twelve years inform my deep concern over the plight facing many African high school learners in and around the Buffalo City area. Buffalo City is my place of birth and also where I obtained my high school education. These schools still experience problems getting qualified and therefore competent mathematics and science educators. Hofmeyer & Hall as cited by Lemmer and Badenhorst (1997:19) attribute this shortfall to various causes such as deaths, retirements and mathematics and science educators leaving the teaching profession for better paying jobs in other fields.

According to Lemmer and Badenhorst (1997), who write within the South African context, even with the recent innovation in this country's salary structure; teaching still remains a low-paid profession. They further state that an education graduate's salary package continues to compare unfavorably with that of other graduates in fields like economics and the natural science. This view is supported by Gray (2006: 100) where she states that statistics will reflect high numbers of young classroom teachers leaving the profession. She goes on to state that relatively low salaries seemed to be a significant factor in low status accorded teachers.

In line with the statements given above, the tendency for some schools is to ask educators who have not majored in mathematics and science to teach these subjects, with this being done out of a sense of desperation. This view is supported by Lemmer and Badenhorst (1997:22) whose opinion is that South Africa is indeed faced with the challenge of unqualified and underqualified teachers. These co-authors describe the concept of unqualified teachers as those who do not have a certificate in teacher preparation, they may, for example, have degrees but not a teaching qualification, and underqualified teachers as those whose teaching qualifications are not adequate for the position they hold. According to them an example is that of a teacher with primary school qualification but teaching at secondary school level. According to Baine and Mwamwenda (1994), the

employment of unqualified or underqualified teachers perpetuates the vicious cycle of poor teachers producing poor students, with this resulting in high failure rates.

1. Preliminary Literature Study

According to Lemmer and Badenhorst (1997:30) there is a great demand for Black science teachers in schools, more so in township and rural schools. These authors blame the problem on the former Department of Education and Training (DET) and homeland education, both of which they accuse of having failed to promote the study of natural science. In terms of their investigation science subjects were not even offered beyond standard seven or eight in some schools falling under these departments. According to them few teachers were asked to help teach these subjects, despite their having limited knowledge or qualifications in the field in question. Even fewer were the teachers who were fully qualified to teach those subjects; such teachers always having been sparsely scattered. The situation described above is said to have resulted in poorly trained Black science educators who promoted rote learning by learners, because of the latter's lack of knowledge. Nkabinde (1997:37) argues that as a result of poor training many educators cannot devise teaching aids to fit the conditions found in their schools. Rather, these teachers have been known to rely heavily on prescribed textbooks. Consequently, they are forced to neglect the development of mental abilities, promotion of reasoning and problem-solving powers, or creative imagination in their teaching. The above is in sync with what Mumba, Rollnick & White (2002:153) believe. It is these researchers belief that effective teaching does require both subject knowledge as well as pedagogical skills. Lack of knowledge according to them affects the actual teaching process.

In terms of the interviews conducted by Mumba et al. (2002), first-year university lecturers were said to unanimously expect of their students, the knowledge and the understanding of basic chemistry concepts as outlined in the high school physical science syllabus, of their students. Previous experience has however taught these lecturers to live with the opposite.

Commenting on shortages of engineers in South Africa, Mdakane (2007), a managing director of the National Society for Black Engineers, traced the problem of skills shortages back to secondary school education. Secondary schools are said not to feed universities with pupils who qualify to enter the profession, because of the poor matric pass rate in mathematics. Fricke, Horak, Meyer & van Lingen (2008) support this viewpoint. According to them international benchmark studies confirm that school mathematics and science in South Africa is weak and suffers from systemic problems. Fricke et al. suggest that the most cost effective and sustainable support for mathematics and science learners can be achieved by mentoring teachers in their work environment, using experienced teachers as mentors.

A survey by Eiselen, Stauss & Jonck (2007:38-39) suggests that increasing the number of science-orientated graduates to meet the technological challenges of the 21st century is imperative for the economic sustainability and growth in South Africa. According to them, this is highlighted by the demand in the labour force for graduates in science, engineering and technology (SET) and the fact of it being a key objective of the South African Plan for Higher Education (SAPHE), is to shift the balance of enrollment in tertiary studies from the humanities to business and commerce, and SET in particular. This is also supported by Kistan (2002:169) who sees a need to address diverse knowledge and skills requirements or South Africa. These are needs that are relevant for the different occupational or professional categories. This shift towards knowledge and skills production is according to Kistan (2002:115) urgently required in order for South Africa to become globally competitive enough to be able to address the socio-economic development within its boundaries.

3. Statement of the Problem

Mathematics and science form an integral part people's daily lives. South African people suddenly find themselves on a technological highway, where mathematical, scientific and creative thinking as well as problem solving skills take centre stage. However many people fear these, and believe that they are unable to tackle them. Mathematics and science educators therefore have need to have knowledge and understanding regarding

the foundation of the teaching of these subjects in the intermediate and senior phases at schools. This should enable them to contribute positively towards changing people's perceptions about these subjects. Based on the above information I felt it imperative for me to investigate the impact of shortages of maths and science educators with special reference to the Buffalo City Area.

4. Purpose of the study

4.1 To determine whether schools are able to attract and retain qualified maths and science educators,

4.2 To identify the quantity of quality maths and science learners schools are able to produce for tertiary education,

4.3 To investigate the rate of turnover of maths and science educators,

4.4 To identify the number of maths and science learners who are willing to study maths and science at tertiary level and thereafter join the teaching fraternity.

5 Research Questions

An analysis of the main problem as outlined in paragraph 1 above should enable the identification of the following sub-problems:

5.1 What strategies can the Department of Education employ to address the shortages of specialist educators in mathematics and science;

5.2 Which approaches suggested by the literature, could enhance the management of the shortages of mathematics and science educators, and in the process enhancing skills in mathematics and science.

6 Research Methodology

6.1 Research Design

The term research design is used in this section as defined by Thyer (1993) as quoted by De Vos (1998:77) where he states that the research design is a blueprint or detailed plan for how a research study is to be conducted. This is supported by Leedy and Ormrod (2005:85) who describe the research design as providing the

overall structure for the procedure the researcher follows, the data the researcher collects, and the data analysis the researcher conducts. These co-authors further explain the research design as planning. This study will use quantitative research methods to assess the impact of shortages of mathematics and science teachers on some grade12 learners in the Buffalo City area. The nature of this study demands the researcher to engage with the following aspects:

6.1.1 Population and Sampling

In terms of the above, this study will focus on getting responses from mathematics and science educators, grade 12 learners as well as Department of Educations' officials who are directly concerned with maths and science subjects. Grade 12 learners have been selected for scrutiny because their grade suggests they have been engaged for at least two years with the crucial learning areas forming the focal point of this thesis. They should also be mature enough to understand the consequences of not having a teacher in front of them even if it is just for a single day.

The research component of this special study is to be conducted in eight high schools which fall under the Buffalo City area. For the purpose of confidentiality they will refer to as school A, B, C, D, E, F, G and H. Two schools (A and B) will be the multi-racial, English speaking, ex model C schools, situated in fairly wealthy suburbs and mainly attract learners from middle to upper socio-economic income families.

The other two schools (C and D) will be coming from townships in lower to middle socio-economic income families. Schools E and F will be from rural areas where most of the learners are coming from socially and financially disadvantaged families. School G will be a formerly Indian school and H will be a formerly Coloured school.

The above exercise will attempt to provide the major variations in responses with regards to the learner's and educator's experiences in as far as maths and science

are concerned. This will also attempt to measure the different problems which are experienced in such schools in as far as mathematics and science teaching and learning are concerned.

For this purpose, proportional stratified sampling will be employed in this study. According to Struwig & Stead (2001:113) stratified sampling is a sampling technique that is designed so that a predetermined number of items are chosen from each stratum (or section). This view is supported by Leedy and Ormrod (2005:203) who state that in the proportional stratified sampling, the sample is chosen in accordance with the proportions of each group. In this study three groups will be used and these are learners, educators and the officials from the Department of Education.

The officials from the Eastern Cape Department of Education will have to respond to the following:

- What are they doing to improve the performance of the schooling system in respect of maths and science?
- What are they doing to improve the supply of maths and science teachers?
- What measures are they taking for the poorly perfoming schools?
- They will also have to explain the effectiveness of maths and science teachers
- They will also have to supply the summary of results for the previous year-2008 in respect of maths and science and also comment on these results and consequently give a clear indication of their future plans.

These Department officials will have to respond to the above because they are after all the people who have the final say in all schools in this province. The people whom I will be contacting for the above are

- Deputy Chief Education Specialist (DCES) Maths and Science at East London and King William's Town District.
- A senior official at provincial level in the Maths, Science and Technology department in the Eastern Cape Provincial office in Zwelitsha.
- The subject advisors for maths and science in both districts for the foundation phase, intermediate phase, (GET) phase and for (FET) phase.

6.2 Data Collection Method

6.2.1 Questionnaires

A questionnaire has been defined by De Vos (1998:89) as an instrument with open or closed questions or statements to which a responded must react. This has been confirmed by Vogt, (1993) as cited by Terre Blanche *et al* (2006:484) who state that a questionnaire is a group of written questions used to gather information from respondents, and it is regarded as one of the most common tools for gathering data in the social sciences. The types of questions to be used for learners and educators will be closed questions while for the Department of Education officials the combination of closed and open ended questions will be employed. According to Struwig & Stead (2004:92), open ended are useful when a person requires further clarification. These questionnaires will be hand delivered to the participants with a covering letter explaining what the research is all about as well as consent forms.

6.2.2 Documentary analysis

The grade 12 mid-year and trial examination mark schedules in mathematics and science for 2009 of the eight schools that have been selected will be used to compare their performance.

6.2.3 Literature study

A literature study will be done to determine the views of different authors on the shortages of mathematics and science educators. Of great importance will be the perceived long term effects of the prevailing circumstance on both the individual learner and our developing country as a whole. Foreign and local writers will be consulted in this study to compare the findings in other countries with the findings by the South African writers.

7 Definition of key concepts

7.1 Mathematics

According to Curriculum 2005, mathematics is a powerful tool for describing the numerical world, a world in which numbers and quantitative methods are used to describe the world are used in attempts to exercise control over the world, nature, risk and even life itself. Laidlaw brothers (2000:10) add on by describing this subject as similar to exquisite, finely woven rug made up of different interwoven strands. These co- authors go on to explain that each strand on the rug adds to its strength and beauty and combines with other strand to make the total rug.

7.2 Sciences

McGraw-Hill Concise Encyclopeadia of Science and Technology as cited in Curriculum 2005 describes Science as a subject that has its roots in African, Arabic, American and European cultures. This document goes on to state that science has been shaped by the search to understand the natural world through observation, codifying and testing ideas , and has evolved to become part of the cultural heritage of all nations. Amos and Boohan (2002:43) describe science as the subject that consists of the body of knowledge about the world where the facts that comprise this knowledge are derived from accurate observations and careful experiments that can be checked by repeating them.

7.3 Buffalo City Municipality

Buffalo city is a municipality situated on the east coast of Eastern Cape province, South Africa. It was established in 2000 after South Africa's re-organisation of municipal areas, and includes East London which is34 kilobyte (kB), Bhisho, 476 Kb and King William's Town which is 594 Kb, as well as the large township of Mdantsane and Zwelitsha. Buffalo City Municipality consists of two districts, such as, East London and King William's Town. In the East London district there are 87 high schools and 111 in the King William's Town district.

8. Proposed structure of the thesis

Chapter 1- Introduction

Chapter 2- Literature study

Chapter 3- Research Methodology

Chapter 4- Research findings and analysis

Chapter 5- Conclusions and Recommendations

Chapter 2

Literature Review

This chapter will give a literature overview of the impact of shortages of qualified maths and science teachers in general and within the South African context. The reason for this is that there is no literature at present which is specific to Buffalo City which is my area of study. Over and above it will deal with the theoretical perspective and the previous research findings regarding this problem.

2.1 The nature of a teaching profession

Gray (2006: 100-101) believes that teaching profession has become unattractive due to the fact that a lot of people are being turned away from teaching because of lack of financial incentives. She goes on to state that teaching for the white middle class in London is a lot of a dropout's job in many people's eyes where people would ask a qualified teacher why is he/she not in banking or in the media. However, in a study conducted by Barmby (2006) about the shortages of teachers in England and Wales particularly in subjects such as mathematics, science and English, a group of 71 teachers was asked an open-ended question as to why they were considering leaving teaching.

Their responses were cartegorized, as presented in Table 1, and again, counted the number of responses, in each category. Workload/marking was the most frequently cited reason, followed by having a family, stress and pupil behavior. Some of the reasons given did not preclude returning to teaching, for example, 'Have a family' and 'Travelling/gap year/teaching abroad'. When these 71 teachers were asked whether they could envisage returning to teaching later on, 29 replied that they could and a further 23 were uncertain either way as to whether they would (Table 2).

Table1. Reasons for teachers considering leaving the profession

Reasons	Number giving reason
Workload/marking	22
Have a family	18
Stress/exhaustion	17
Pupil behaviour	14
Travelling/gap year/teach abroad	9
Change jobs/do something different	8
Admin./paperwork	8
Government initiatives	6
Long hours	5
Lack of status/respect	4
Salary	4
Further study	3
Lack of resources	2
Had to move to different region	2
School management	2
Lack of support	2
Staff politics	2
Retirement	2

(Source: Adapted from Barmby 2006: 12)

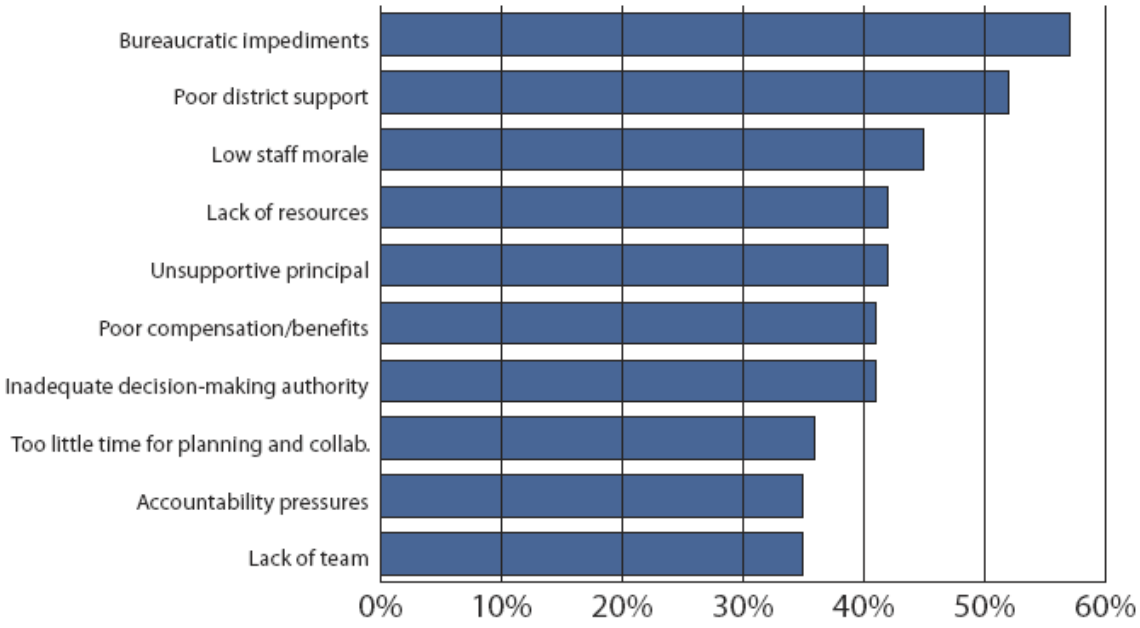
Table2. Teachers envisaging returning to teaching

Envisage returning?	Number of teachers
Yes	29
Possibly/maybe/it depends	20
Don't know	3
No	15
Unclear from response	2

(Source: Adapted from Barmby 2006: 12)

In addition, in a study conducted by Futernick (2006) of the California State University's Center for Teacher Quality, dissatisfied teachers who left the profession cited serious problems with their working environment. More than half of these teachers according to him expressed concerns over inadequate support, such as lack of time planning or professional development, and bureaucratic impediments such as classroom interruptions, unnecessary meetings, and too little say over the way schools are run. Futernick further states that teachers also pointed frequently to a lack of collegiality as a key reason for leaving the classroom or transferring to another school. Figure 1 below indicates the specific conditions cited by dissatisfied leavers

Figure 1: Dissatisfied Leavers



(*Source: Adapted from- The Centre for the Future of Teaching & Learning 2006:2*)

The above views are supported by Kyriacou (2000:34) who states that most teachers are stressed due to poor conditions such as lack of adequate resources and materials, poor physical conditions of the school buildings, inadequate level of support from clerical and administrative staff, lack of preparation, and a lack of opportunity for professional development activities.

Steyn and Mentz (2008:679) are also in line with the above authors by stating that the capacity of teacher education in South Africa is under pressure because teacher shortages are looming and the quality of a large number of practicing teachers is under suspicion. This view is supported by Simkins, Rule & Beinstein (2007:35) who state that most studies point to an impending shortage of teachers, although its exact magnitude and timing is a matter of debate. These authors believe that there is a lack of fit between demand and supply, with an oversupply in some subject areas and undersupply in others, and also imbalances in the deployment of teachers. Simkins *et al* also pointed out that these shortages are being experienced in scarce skills areas such as maths, science and technology; languages; arts; economics; and management sciences. Further, there is an inability of rural schools to attract good maths and science teachers because of the general population shift to urban areas. For probably a decade or more the teacher graduation nationally has been around 5000 to 6000 per year, while the loss of teachers to the profession through death, resignation and retirement is estimated between 15000 and 20000 per annum. These co authors also investigated that in 2007 there has been a particularly low enrolment of African student teachers as indicated by table 3 below.

Table 3

	Maths	Physical science	Maths literacy	Biology
Nelson Mandela Metro University	9	6	13	9
North-West University	50	77		50
Rhodes University	2		4	5
University of Cape Town	11	2		40*
University of Fort Hare	19**			
University of Johannesburg	8	6		
University of Limpopo	27	23	104	1
University of Pretoria	24	21		
University of Stellenbosch	29	16		
University of the Western Cape	3	2		
University of the Witwatersrand	45***	3		
Total	227	156	121	105

(Source: Adapted from Simkins, Rule & Beinstein, 2007:36)

**At Cape Town, these figures included natural science, technology and biology*
***At Fort Hare, the 19 honours graduates were qualified in both maths and science teaching.*
****At Wits it was not possible to disaggregate graduates into subjects owing to varying combinations of subjects in different teacher's degrees*

Steyn and Mentz (2008) also believe that the above is based on challenges faced by teachers such a their responsibilities within the context of outcome based education as well as social issues such as lack of discipline in schools and classrooms, the increase of violence on school grounds, learners and parents

with HIV/AIDS, unemployment, poverty and society's demand of the school system that has increased dramatically. These co-authors also believe that the provision of qualified teachers and the manner in which training takes place are priorities of all education interest groups such as education departments, professional educational bodies and parents. Brownell *et al* (2004) argued that the yearly supply of teachers would be increased if attention would be given to the factors related to attrition given the fact that young, inexperienced teachers are a high attrition risk. Over and above these DeJaeghere *et al* (2006) believe that attrition can be reduced by teacher mentoring programmes, increased teacher-teacher interaction, bonus pay and by making head teachers more responsible for teacher supervision. They go on to state that mentoring is one method for helping new teachers understand and adapt to the realities of teaching so that they can be more successful. They further state that there is also the hope that if teachers are more successful they will remain in the profession longer. They also argued that the concern about retention is important because based on the study they have conducted where they found that about a quarter of the teachers (23 percent) said they would leave teaching if they found a similar paid job.

Khalema (2006) the director at Centre for the Advancement of Science and Mathematics Education (CASME), believes that skilled mathematics and science teachers are the catalyst for change in rural schools. He further points out the grade 12 pass rate in mathematics and science remain low especially in disadvantaged and rural schools and also believes that this is due to lack of resources, but is severely compounded by under-qualified educators. Based on the above information, a partnership between CASME and Sasol has resulted in the establishment of the Sasol Teacher Development Training Project in January 2008. Its main aims are to provide science and mathematics teachers with weekend and school holiday training to equip them with the knowledge to teach the new curriculum and provide them with the teaching and assessment skills required by the changes in the curriculum. The above statement is inline with what Fricke et al. (2008: 72) is saying where he states that the new curriculum

introduced by the Department of Education known as National Curriculum Statement (NCS) requires extra content knowledge to be mastered as well as bringing with it a need to re-structure the school timetables.

2.2 Primary school numeracy and literacy is critical for further learning

If mathematics is viewed as a language as outlined by (Pimm, 1987), then strategies associated with the teaching of the language arts may be adapted to teach mathematics. Bickmore-Brand (1993) identifies such strategies as immersing students in the environment of the language, encouraging the use of the language in appropriate context, and careful modeling of the language by teachers. The immersion according to this author is achieved by encouraging discussion between the students and the teacher whilst the teacher models appropriate language skills and encouraging students to use clear, precise and meaningful language.

In South Africa, many teachers are teaching in a language which is not their first language therefore they may not be able to model appropriate language skills in learners as suggested by the above author especially the content subject's teachers. In this case the language teachers who have been trained to excel in teaching the language skills would have to do so in their language classes and subsequently this would have to be applied in the content classes, therefore integration would have to take its course.

The language-based learning environment is based on a model outlined by Bell (1993) developed for teaching mathematics to ESL (English as a Second Language) students. Bell goes on to state that this model is also particularly useful when working with students whose mathematical experiences have not led to robust feeling of success.

According to Kellough (1996:192) effective mathematics teachers are those who can stimulate students to learn mathematics. He further states that their talk is essential to learning, whether they are arguing, seeking solution, or just chatting

about what they are doing. The process of speaking and listening according to him is the first step in the representation of mathematical ideas through language. Johnston et al (2002:81) support this view and are of the opinion that teachers need to develop skills of reading between and beyond the lines of arithmetic calculation, just as pupils need to learn to extract inferences and implications, as well as information, from a written text.

Seefeldt (1999:125) believes that curriculum focusing on mathematical ideas and problem solving needs resources for realistic, engaging problems. She goes on to state that the best resources are the experiences of the children, either planned experiences occurring in the school setting or experiences outside the classroom that are common to all the children. Campbell & Langrall as cited by Seefeldt (1999) concur with the above statement by stating that mathematics classroom may be a place where ideas are accepted, where suggestions are investigated, and where meaningful problems are solved. For this to concur preschool and primary classroom must be places where each child's thinking is valued, where the involvement of each child is expected, where sufficient time is permitted for investigation, and where questioning and listening are the norm. They further state that when this occurs, the classroom becomes a powerful force in a young child's life, where knowledge is continuously recreated, recycled and shared.

However the concept of ethnomathematics is also important to note. For Barton (1996:196) ethnomathematics is the field of study which examines the way people from other cultures understands, articulate and use concepts and practices which are from their culture and which the researcher describes as mathematical. D'Ambrosio (2001) explained the notion of culture as the everyday life of groups, families, tribes, communities, associations, professions and nations that take place in different regions of the planet in different ways and at different paces, as the result of certain priorities, among many factors, due to environmental conditions, models of urbanization and production, systems of communication, and power structures. Kaleva (1995) believes that, using

ethnomathematics as a solution involves two processes. The first process involves the identification (mathematicising) of the traditional culture. Secondly, a decision needs to be made on how to include the mathematics from traditional cultures in the teaching of mathematics.

In line with the above statements, Bishop (1988:182) argued that there are six fundamental activities, which he suggests are common to all cultural groups and asserts that from these basic notions 'western mathematical knowledge' can be derived These fundamental activities are: *counting,* (which forms the basis of, for example, number systems, algebraic representation, probabilities); *locating,* (orientation, coordinates bearings, angles, loci); *measuring,* (comparing, ordering, measurements, approximations); *designing*, (projections of objects/shapes, geometric shapes, ratio); *playing,* (puzzles, paradoxes, models, games, hypothetical reasoning) and *explaining*, (classification, conventions, generalizations, symbolic explanations).

Kellough (1996) states that during the concrete operational stage (7or 8 to 11 or 12), children continue to expand logico-mathematical thought; they are operational in their thinking and still need objects to handle and manipulate as they think. Seefeldt (1999) on the other hand thinks that young children understand number and solve problems without using written symbols. She further states that children are introduced to the use of symbols to represent mathematical concepts so they may develop meaning for written symbolic representations. According to Hiebert (1988) as quoted by Seefeldt (1999) the process of connecting written symbols according to him with real-world referents, such as objects or actions on objects, develops meaning for symbols. He also thinks that the links young children have established between a symbol and its referent need to be transparent before young children can be expected to manipulate symbols as abstract quantities. Based on the above statement, if a maths or science teacher is not fully equipped in teaching the subject, then it would be difficult for him/her to instill to learners the strategies of learning the subject.

Reynolds and coworkers (1996) suggested that preschool participation at ages three or four was significantly associated with higher reading achievement, higher math achievement and with lower incidence of grade retention. The authors investigated the effect of parent involvement on level of kindergarten readiness of low-income, mostly black children. The authors suggested that parent involvement in school activities mediated cognitive readiness and these two factors (that is, parent non-involvement and cognitive non-readiness were found to be closely related to school underachievement and grade retention later in the children's school career. Ross and Roe (1990) are in synch with the above authors by stating that children from homes where reading and writing are priorities develop literacy skills more readily than do children from homes where literacy is not valued. They further suggest that parents can support emerging literacy during the preschool phase by reading to children. These authors also think that informal reading activities should be interactive in nature, implying that parents should discuss the stories, ask questions about the books and stories, and respond to children's comments.

The above statements would be helpful in countries such as South Africa to improve the language skills because as indicated earlier most teachers are not teaching with their first language and literacy is imperative in the teaching of numeracy.

Heugh (2001) as cited by Pretorius and Naude (2002) postulated that recent international studies show that South Africa pupils compare most unfavorable with other countries with regard to literacy and numeracy development. This author further states that the level of school drop-outs, the repeating of grades and failure rate in the National Senior School Certificate examination taken in Grade 12 at approximately 18 years of age, all indicate considerable underachievement amongst black scholars. Inline with the above statements, Howie and Plomp (2003) concluded that in a study conducted by the Third International Mathematics and Science Study-Repeat (TIMSS-R) about the South African pupils in which pupils wrote tests in mathematics and science, but

in South Africa pupils also had to write an English test as a national option. The research reported here concentrated on the final outcomes of the exploration of the performance of the South Africa pupils in mathematics and the relationship between mathematics achievement and proficiency in English. The factors relating to the performance in mathematics and language proficiency were explored. Results of mathematics tests; results of the English language tests; and contextual factors on students, classroom, and school are reported. This research shows that in South Africa, pupils tended to achieve higher scores in mathematics when their language proficiency in English was higher.

According to Human Science Research Council (HSRC) most young people in South Africa are unlikely to matriculate and be eligible for university entrance because of lack of a solid primary school foundation that allows learners to grasp the basics of numeracy and literacy. A report by the Common Public Accounts Committee (PAC) reveals that around five per cent of children starting secondary school had the maths skills of a seven-year-old. This report further states that the Department for Children, Schools and Families' (DCSF) launched a National Strategy to improve standards in 2007 but currently very small improvements are being made to pupil attainment.

This view is supported by Pretorius and Machet (2008) who are of the opinion that in South Africa, as in many developing countries, successful literacy accomplishment is not something all learners find easy, especially those learners from socio economically disadvantaged areas. This was after the study performed in the rural areas of kwa Zulu-Natal.

According to Television news (2009) a recent study on basic education released indicates that, roughly two-thirds of junior primary school children are being functionally illiterate and innumerate, a statistic that grows to 73 percent innumerate when pupils reach Grade four. Pandor (2006), the minister of education, commenting on the Eastern Cape Provincial Summit, agreed that it is

impossible to achieve sustained success at grade 12 if there are primary schools that do not teach reading, writing and numeracy.

2.3 Rural schooling

According to Diorio (2008) there are often misconceptions about rural education by those in urban or suburban environment. She believes that they imagine students deprived of the latest in modern educational commodities, taught by teachers unable to gain positions in better schools, struggling to grasp basic concepts, unaware of the complexities of the larger world around them. However she also believes that many rural schools lack the financial and other resources to offer the variety of specialized classes often found in suburban schools. Similarly, she further states that by nature of geographical location and community resources, rural schools face unique challenges not experienced by their suburban counterparts. Amongst these are teacher shortages, demographic poverty, serving students with disabilities, increasing number of English Language Learner (ELL) students requiring teachers certified in ELL programs, consolidation, transportation difficulties and funding considerations. Strange (2005) is in sync with this author by stating that apart from the troubles mentioned above, rural schools are the best success stories because they tend to be able to do more with less. According to her teachers tend to be closer to the child and have a greater sense of who the parents are. She further states that they are able to overcome the barriers of geographic isolation to do some amazing things with their kids and their kids can succeed like anybody else. Diorio (2008) believes that despite the challenges, many would say that the benefits of rural education outweigh the challenges and may even make rural schooling preferable over urban education. Silverman,(2005); Todd & Agnello, (2006) as cited by Diorio 2008 believe that among the specific advantages rural education holds over suburban and urban education are class size, community support, specialized educational opportunities, and innovation in resources use and administration.

In a study conducted by Abel and Sewell (1999) their conclusion was that urban school teachers experienced significantly more stress from poor working conditions and poor staff relations than did rural school teachers. They also believe that poor working conditions and time pressures predicted burnout for rural school teachers and poor pupil misbehavior and poor working conditions predicted burnout for urban school teachers. According to Gordon (2000) who writes within the South African context, rural schools (both farm and community) have less equipment, fewer teaching resources and fewer specialized rooms such as libraries and science laboratories than urban schools. Gordon goes on to state that more schools in rural areas are without water, electricity and telephones than in urban areas. The absence of the above in some rural schools is frustrating to teachers and results in poor quality of education in those affected rural schools. Gordon further states South Africa's constitution and the South African School Act passed in 1996 have heralded the beginning of a new era for school where all South Africans have a right to basic education, founded on principles of equity, redress, non-racism and non-sexism, but nevertheless he believes that it will take many years because of historically disadvantaged schools particularly those in rural areas.

Qiang (2000) believes that before 1949 education in China was extremely backward, especially in rural areas. The enrollment rate of primary school-age children according to this author was merely 20 percent and 80 percent of the population were illiterate. This author further state that since the founding of the People's Republic of China in 1949, the communist government guaranteed the education of the working class and the poor because the communist party developed amongst the class of workers and peasants as a results education developed at a very high speed by fast social and economic development as a result the primary enrollment was up to 80 percent.

Gordon (2000) on the other hand, who writes within the South African context, believes that education in rural areas has been shaped by the political and

economical goals of apartheid and colonialism. He believes that prior to the passing of the South African Schools Act, rural areas were serviced by schools in small towns, farm schools on farms and community schools in the former homelands. He further states that although schools on farms and on tribal trust land had many features in common such as isolation, infrastructural constraints and high levels of poverty, the politics framing the policies around these types of schools differed substantially from each other. This author also states that in the Bantustans the Education Departments administered resources for schooling building and equipping the various schools. In addition, according to him chiefs as local administrators had a marked affect on the school on their particular districts. He concluded that the paucity of the state budget directed towards education meant that a majority of farm and community schools services were poorly provided and the learning and teaching environment was deficient.

2.4 Challenges faced by mathematics and science learners

Bohlmann and Fletcher (2008: 556) argues that during the apartheid era there has been a disparity in the availability of educational opportunities for South African students resulting in the unreliability of matriculation as predictors of academic performance. This is supported by the Department of Education (2003) as cited by Eiselen et al. (2007) which states that admission requirements at tertiary institution based on achievement in the final school year alone has been and continue to be contentious in South Africa due to of historical differences in the education systems at school level during the apartheid era. During the post apartheid era according to them various admission routes to tertiary education have been explored to accommodate students who do not meet formal entry requirements.

Kloot, Case and Marshall (2008) point out that although the law-enforced apartheid education officially ended in early 1990s, the effects of unequal education provision are being felt throughout South Africa. Having said that these co-authors also believe that a backlog of dysfunctionality still plagues many secondary schools which means that many students wanting to study

science and engineering at tertiary level are not adequately prepared for the task. Subsequent to the above statement, even in this current ANC government, some schools are still dysfunctional because after gaining power this government had to start by fixing the backlog of improving the basic infrastructure in many schools. Therefore, critical resources such as fully equipped laboratories, science material are still not there in some schools. Gordon (2000) investigated that of all the schools in South Africa, 11 percent need structural repair and one percent of all schools are not suitable for schooling, 12 percent need some attention. Lack of these resources will make it difficult for educators to finish their syllabi.

Academic Support Programmes (ASPs) as indicated by Lazarus (1987) who has been quoted by Kloot et al. (2008) were a reactive response to the above problem of poor academic performance especially with black African students and they started with no or little underpinning. An example of the case above is the University of Cape Town (UCT) which launched the Science Foundation Programme (SFP) in 1986. This programme was more forward-looking than bridging programmes that simply aimed to improve an inadequate secondary education. In the early 1990's SFP courses at UCT were combined with the first-year mainstream courses in the extended curriculum mode combining the courses in this way meant that the first year was spread out over two years and this model is still operational at UCT as General Entry Programme in science.

Fricke et al. (2008:65) are of the opinion that South Africa has a dearth of learners matriculating with mathematics and science marks that qualify them for further study in Science, Technology, Engineering and Maths (STEM). This is supported by Muwanga-Zakhe (2003) who has been cited by Fricke et al. (2008: 65) by saying that limited numbers of those passing with accepted symbols continue their studies in medicine, engineering and science and the demographic distribution is still heavily biased towards white learners. The above mentioned statements leave the teaching profession particularly for subjects such as math

and science unattended whereas schools also need people who are qualified in mathematics and science to produce other graduates in these fields.

The Centre for Development and Enterprise (CDE) released a report in 2004 in the state of mathematics and science in South Africa. The report covers three years of research, analysis and discussions with over 1000 experts. The main conclusion was that despite efforts from the government as well as the private sector, the throughput of students with maths and science on higher grade level is far too low to provide the country with the necessary skilled workers to build the economy.

Simkins, Rule & Beinstein (2007:7) believe that higher grade (HG) maths was regarded as a difficult subject and many learners believed that they could not pass it. These co-authors further state that statistical analysis indicate that only about half the Senior Certificate (SC) candidates who could pass HG maths do so. Some according to them have chosen to do Standard Grade (SG) maths rather than HG maths, others have chosen not to do maths at all, even when they had the opportunity to do this at a higher grade; others have the ability but have been educated in schools that do not offer HG maths. Realising the potential for doubling the number of HG maths passes the above authors suggested two things: more learners must be persuaded to take this subject, and if it is not offered at schools close to where they live, they must be given the opportunity to attend schools where it is, or expertise should be shared where top-performing schools should accept the obligation of high potential learners, or assisting neighboring schools and they will be given increased resources such as, learning resources and better teachers in maths, science and languages of instruction.

Simkins *et al* (2007) also suggested that career counseling is essential to inform and guide learners about the tertiary level study options and career opportunities that open up if the pass senior certificate HG maths.

Below is the table that shows the difference in performance across school.

Table 4

HG maths passes as a percentage of total SC passes	Number of schools	Number of HG maths passes
20% or more	343	12 542
At least 10% but less than 20%	362	5 606
At least 5% but less than 10%	486	3 318
More than zero but less than 5%	1 629	4 162
None	3 444	0
Total	6 264	25 628

(Source: Adapted from Simkins, Rule & Beinstein, 2007: 27)

In order to increase the enrollment in STEM, the Department of Science and Technology (DST) in collaboration with the Department of Education (DoE) agreed in their Collaboration Agreement and Plan to use Olympiads, competitions and Camps as vehicles to identify and nurture learners (especially African and girl learners) with talent in STEM. Olympiads are defined by the DST as all-stand-alone and embedded-competitions that stimulate interest enhance development of critical skills and motivate learners to excel in demonstrating understanding and application of concepts and skills defined in the formal mathematics, science and technology syllabi/curricula.

According to Govender (2004), South Africa, the Africa's technological leader, pupils fall at the bottom of reputable international studies. He goes on to state that in the Third International Mathematics and Science study conducted in 1998 measured student performance in 41 countries across the world where South African pupils received an average score of 275 out of 800, well below the international average of 487. The reasons behind this according to Govender (2004) are that, teacher training programmes at African universities tend to draw poorest students, that is, those who fail to make it in medical or business

schools. In South Africa, a separate study in six of the nine provinces conducted by the World Bank showed that about 60 percent of the educators had not been trained in mathematics and science and the teaching force is largely inexperienced and have a limited understanding of science, maths and information and communication.

2.5 Skills shortages in South Africa

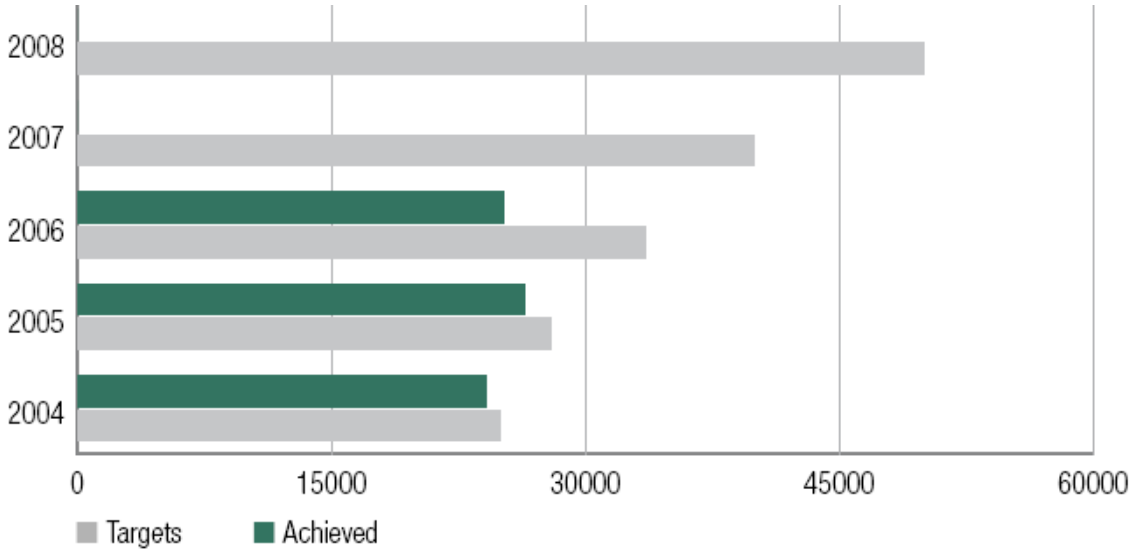
According to Betram, et al (2007) the international recruitment, by countries of the North, of teachers from less developed countries has become a controversial aspect of the problem of brain drain. They further state that as a political and economic issue, the argument is that it reduces human capital within the education system and leads to the movement of highly skilled teachers from countries that can least afford to lose them. This view is supported by Govender (2004) who suggested that special incentives are needed to stem Africa's very serious brain drain. He further states that South Africa saw to 17000 skilled people leave the country between 1994 and 2001. Most of them according to Govender were architects, executive and managerial personnel, those involved with natural sciences, the medical profession and education. He therefore believes that the brain drain has a damaging effect on a country's economy and a reduction in a nation's capacity to develop as a knowledge society and therefore compete effectively in the global economy. This view is also supported by Fourie (2006) the CEO of the National Business Initiative (NBI) speaking in a membership breakfast hosted by NBI was in sync with the above statement by stating that, the Accelerated and Shared Growth Initiative (ASGI-SA) shows a direct correlation between economic growth, job creation and skills level. He further indicated that the Joint Initiative on Priority Skills (JIPSA) has identified the key skills required to underpin sound economic and social development such as engineers and artisan, but also in the areas of mathematics, science and language competence at school level. The NBI according to him believes that improving maths and science skills at school level is imperative for employment generation, building human capacity and sustaining the country's economic

transformation. A study conducted by Metie *et al* (2007) concluded that the number of students continuing with their mathematics education post (GCSE) level has declined in recent years and hence students entering Engineering degrees are reducing. According to them, the University of Birmingham recognized this problem and introduced the Suit of Technology programme (STP) which no longer requires having A-level mathematics. These coworkers further state that lectures at university are now faced with teaching A-level mathematics in order to give the students the mathematical skills for their technology degree.

Simkins, Rule & Beinstein (2007:7) believe that, before the introduction of National Curriculum Statement (NCS) in schools where learners had to write their subjects in either higher grade (HG) or standard grade (SG), the South African schooling system continued to produce far fewer passes in maths and science –particularly in the higher grade- than the country's economy requires. They further state that the university degrees and professional and technical careers require grounding in maths and or science, and the critical shortfall in learners leaving the schooling system with HG maths and science was a significant constraint on growth.

Below is the Department of Education's stated targets for achieving the doubling goal of annual passes in HG maths, and from 2004 to 2006 they actually declined.

Figure 2: Government targets for doubling SC HG maths passes versus actual passes



(*Source: Adapted from Simkins, Rule & Beinstein, 2007:8)*

According to Naidoo (2008) (a communications manager at Business Systems Group (BSG), the Information Communication Technology (ICT) skills (of which maths and science form its basics) in South Africa is dwindling and one of the primary causes of this crisis can be traced back to secondary education, particularly the years in which scholars are required to choose the subjects they will carry through matric. On the other hand, Mdletshe (2008), Strategy Manager (BSG), Africa, believes that there is a general lack of interest in Mathematics and Science which is the result of variety of factors such as shortages of educators and limited access to essential resources like textbooks, calculators and well kitted science laboratories. Muwanga-Zakhe (1998) confirms this by finding out that in some previously disadvantaged schools science equipment was not even unpacked due to educators who were not able to use the equipment.

Mdletshe (2008) further states that when mathematics and science become optional, scholars are inclined to opt out of carrying them through to matric. BSG, as a member of various advisory committees, has observed the declining number of black South African graduates qualified to enter the ICT field. The universities, according to BSG, have indicated that one of the reasons for the declining number of graduates is that matriculants do not have necessary background, mainly in Mathematics and Science, to be accepted into ICT related fields of study as its requirements are Mathematics and Science are prerequisites for acceptance into related degrees. Consequently, as an investment in the future growth of the ICT skills pool, BSG established the promotion of Mathematics and Science Initiative. This initiative, according to Mdletshe (2008), is a career awareness campaign through which BSG strives to encourage learners to select Mathematics and Science as two of their matric subjects in order to increase their career options and opportunities for acceptance into ICT and other related careers.

According to Mdletshe (2008) the United Nations Educational, Scientific and Cultural Organisation (UNESCO) figures show that Japan, Europe and the US have two to five scientists and engineers per thousand people whereas Sub-Saharan countries on the other hand have fewer than one in 10 000. A recent published Centre for Development (CDE) report entitled Centre for Growth (2007) revealed that South Africa spends proportionately more on education than many other developing countries, yet its learners perform far worse than those of other developing countries-including African countries- in international tests. This document further reveals that twenty eight percent of the total population is in school, as compared to an average of twenty percent worldwide. However, for the past 16 years, fewer than seven percent of SC candidates have passed HG maths. In 2006, according to this document, some 33 percent (or 174 413 of 528 525) candidates failed the SC examination, and only sixteen percent (84 564) passed with grades needed to enter university. Only 4,8 percent (25 633) passed HG maths, and only 5,7 percent (30 174) passed HG science.

Chapter 3

Research Designs and Methods

Introduction

This chapter seeks to present the experiences the researcher experienced on the field during data collection exercise

3.1 The Participants

For the Department of Educations' officials, the researcher informed the participants of the study through letters via the District Manager in the case of those working in a district level. The letter requested the participation of an official who had been involved in the math and science department. The letter incorporated a consent form (see Appendices A & B).

For educators and learners, the researcher informed the participants of the study through letters via their principals at schools. For the Department of Educations' (DoE) officials, the letters were sent via their district managers and for those working for the provincial office letters were sent through their seniors.

3.2 Data Collection Method.

3.2.1 Questionnaires

According to Leedy & Ormrod (2005:185) questionnaires have an advantage of being sent to a large number of people, including those who live thousand of miles away. These authors further state that questionnaires therefore save the researchers' travel expenses and postage is typically cheaper than a lengthy long-distance telephone call. This view is supported by Hakim (1987:27) who believe that questionnaires require less of the researchers time to administer,

however it can be limiting as there are no opportunities for probing and explaining. Another setback in the use of questionnaires as indicated by Leedy & Ormrod (2005) is that the majority of people who receive questionnaires don't return them, in other words there may be a low return rate.

As indicated earlier on, three types of questionnaires have been used in this study, the closed ended questionnaires for learners and educators and the open ended questionnaires for the Department of Educations' officials.

3.2.1.1 Closed ended questions

Terre Blanche *et al* (2006:487) believe that closed questions do not allow the respondents to provide answers in their own words, but force respondents to select one or more choices from a fixed list of answers provided. They go on to state that closed questions have the advantage of eliciting a standardized set of responses from all the respondents, and thus allow for easier comparative data analysis.

In this study closed questions (see appendix 3) were designed to be completed by maths and science educators. The data from the questionnaire A was obtained from fifteen respondents. The respondents were generally from schools with different backgrounds that is; rural, township, former model-C, former Indian and former colored schools. The main objective of this questionnaire was to obtain data about whether these educators are comfortable in teaching these subjects and whether they intend leaving the teacher fraternity in the near future leaving the learners without any person to teach them maths or science.

3.2.1.2 Open ended questions

For Struwig & Stead (2004:92) these are questions that the respondents are free to answer in their own words. These co-authors also state that these questions are also useful when a researcher requires further clarification. Terre Blanche *et al* (2006:486) are in line with the above authors by stating that open ended questions allow respondents to communicate their experiences or opinions about

a specific issue in their own words, without any restrictions. Responses according to them can vary from a couple of lines to an essay of one or two pages.

In this study a combination of closed and open ended questions were used to collect data from both the maths and science learners, educators and the Department of Education's officials who are directly concerned with the maths and or science subjects.

For maths and science learners' questionnaire (see appendix 3), the data was obtained from fifty maths and science learners. The respondents were generally from different schooling backgrounds such as rural, township, former model-C, former Indian and former Coloured schools. The main objective of this questionnaire was to obtain data about whether these maths and science learners from different schooling background are experiencing similar or extremely different challenges in respect of maths and science. Also the data from this questionnaire was designed by the researcher to establish whether there are any of these learners who would want to pursue teaching as a career in the near future.

Also for the Department of Education's officials, a combination of closed and open-ended questions was asked (see appendix 4). These questions were designed to establish whether it was in the department of educations' interest to improve the high failure rate in these subjects by attracting qualified maths and science educators and by retaining those who are already in this field. The data from this questionnaire was obtained from twelve respondents. Four of these respondents were from the East London District, four from the King Williams' Town District and four officials were from the Eastern Cape Provincial Office.

3.3 Pilot testing

On finishing the questionnaire design, the researcher conducted a pilot study by selecting a small sample of respondents to complete the draft questionnaire. Struwig & Stead (2004: 89) believe that the sample should indicate any problems respondents may have with the instructions or the items (e.g. difficulty in understanding the meaning of the words or items. Saunders *et al* (1997:26) adds on to the above statements by stating that the purpose of the pilot test is to refine the questionnaire so that respondents will have no difficulties in answering the questions and that there will be no problem in recording the data These authors further state that pilot test will enable the researcher to obtain some assessments of the question's validity and reliability of the data collected.

For the pilot test conducted the researcher made use of the respondents from the neighborhood, three math and or science educators from different school backgrounds, six educators selected as such and one official from the Department of Education. On getting the responses few corrections such as unclear questions, some questions the respondents felt uneasy in answering were picked up and corrected immediately. After completing the pilot testing, the researcher wrote to the respondents thanking them for their help.

3.4 Administering the questionnaires

After the questionnaires have been designed, pilot tested and amended the researcher used them to collect data. The researcher had used the following two types of questionnaire administration, that is, physically distributed and e-mailed questionnaires.

3.4.1 Physically distributed questionnaires

According to Corbetta (2003:145), these are questionnaires that subjects fill in on their own, without the participation of an interviewer. In this study the researcher delivered and collected the questionnaires on the same day. This was done to eliminate the need for a follow-up. The advantage of this type is that the response rate is usually high. A total of 69 questionnaires were issued to various

respondents such as learners, educators and Department of Education's officials. Of this, 52 were issued to learners, 15 to educators and another 15 to Department of Education's officials. The response rate to the above was as follows: 50 (96%) learners responded, 12 (80%) educators and nine (60%) officials responded.

3.4.2 On –line questionnaires

For Saunders (2003:311), on-line questionnaires are usually administered in one of two ways: via email or via a web site. For the purpose of this study email questionnaires were employed by the researcher. According to Hair (2007:208) the advantages of using email surveys are that it is popular, inexpensive, can be completed in a short period of time and generally produces high quality data. The researcher conducted a pre-survey where recipients were contacted by email and be advised to expect a questionnaire. A questionnaire and a covering letter were emailed to the recipients who were also motivated to answer the questionnaire and to send it back. For the purpose of confidentiality and anonymity the researcher advised the recipients to make use of an anonymous server or mailbox that removes email addresses when returning the questionnaires. A total of eight questionnaires were emailed to various recipients such as DoE officials and educators. Of this, three were emailed to educators and five were emailed to DoE officials. The response rate was as follows: two educators responded (67%) and three official (60%) did so.

The total number of responses (both physically distributed and e-mailed questionnaires) was as follows: 50 for learners, 14 for educators and 12 for officials.

3.4.3 Follow-up on questionnaires

A week after the researcher has emailed these questionnaires, there was poor response and a follow up was done by the researcher. An email designed to thank early respondents and to remind non-respondents was sent to all the

recipients. A second follow-up was emailed to people who have not responded after three weeks and included another covering letter and a copy of the questionnaire. Even after the reminder by the researcher, the response rate did not change.

3.5 Ethical issues

For Struwig & Stead (2004:66) conducting research is an ethical enterprise. The ethical issues taken into consideration in employing questionnaires included having to obtain voluntary and informed consent of the research participants. The researcher assured the participants that anonymity and confidentiality were guaranteed.

Chapter 4

Research findings and analysis

Introduction

This chapter seeks to analyse the findings for the study in relation to the three critical subheadings

1. Aim of the study,
2. The purpose of the study as well as research questions and the as outlined earlier on and the
3. Research question.

The aim of the study was to assess the impact of qualified mathematics and science teachers in the Buffalo City area.

Its research purposes were as follows also wanted

- To determine whether schools are able to attract and retain qualified maths and science educators,
- To identify the quantity and quality of maths and science learners schools are able to produce for tertiary education,
- To investigate the rate of turnover of maths and science educators,
- To identify the number of maths and science learners who are willing to study maths and science at tertiary level and thereafter join the teaching fraternity.

The research questions were as follows

- What strategies can the Department of Education employ to address the shortages of specialist mathematics and science educators?
- What approaches are suggested by the literature, which could enhance the management of the shortages of mathematics and science educators and, in the process, enhance required skills in the two subjects?

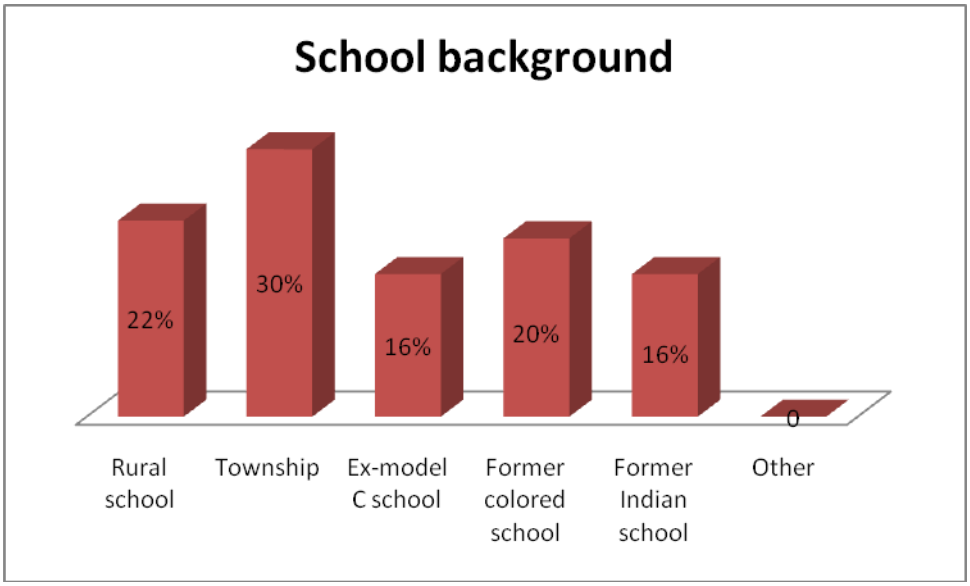
To achieve the above, three types of questionnaires were issued in this study, which were delivered by hand and some were e-mailed to the respondents. These

types of questionnaire were designed for different types of respondents that is, questionnaires for learners, for educators and for the Department of Education's officials. The reporting of the results will follow the format of the questionnaires administered (Babbie, 1990:45). As of De Vos and Fouche (1998:203) data analysis entails that the analyst breaks down data into constituent parts to obtain answers to research questions and to test research hypothesis.

1. What is your school background?

Answers	Frequencies	Percentages
1. Rural school	11	22
2. Township	15	30
3. Ex-model C school	8	16
4. Former colored school	10	20
5. Former Indian school	8	16
6. Other	0	0
Total	50	100

Figure 1:



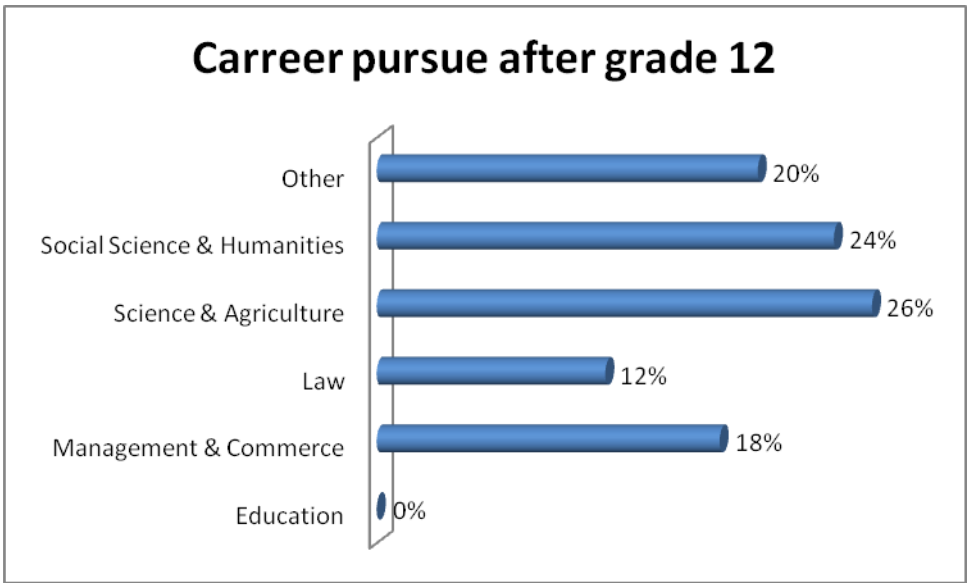
The study reveals that 22 percent of learners are from rural schools, 30 percent from township schools, 16 percent from ex-model c schools, 20 percent from Coloured schools and 16 percent from former Indian schools. The literature has highlighted that

different school backgrounds are experiencing different challenges in as far as maths and science are concerned. It revealed that before 1994, rural schools were faced by many challenges such as isolation, infrastructure constraints and high level of poverty and lack the financial and other resources to offer a variety of specialized classes often found in suburban schools. The nature of maths and science subjects needs resources such as laboratories and libraries which are not available in some rural and some township schools. This could be why most qualified maths and science educators are not willing to teach in rural schools.

2. Which career would you like to pursue after grade 12?

Answers	Frequencies	Percentages
a. Education	0	0
b. Management & Commerce	9	18
c. Law	6	12
d. Science & Agriculture	13	26
e. Social Science & Humanities	12	24
f. Other	10	20
Total	50	100

Figure 2:

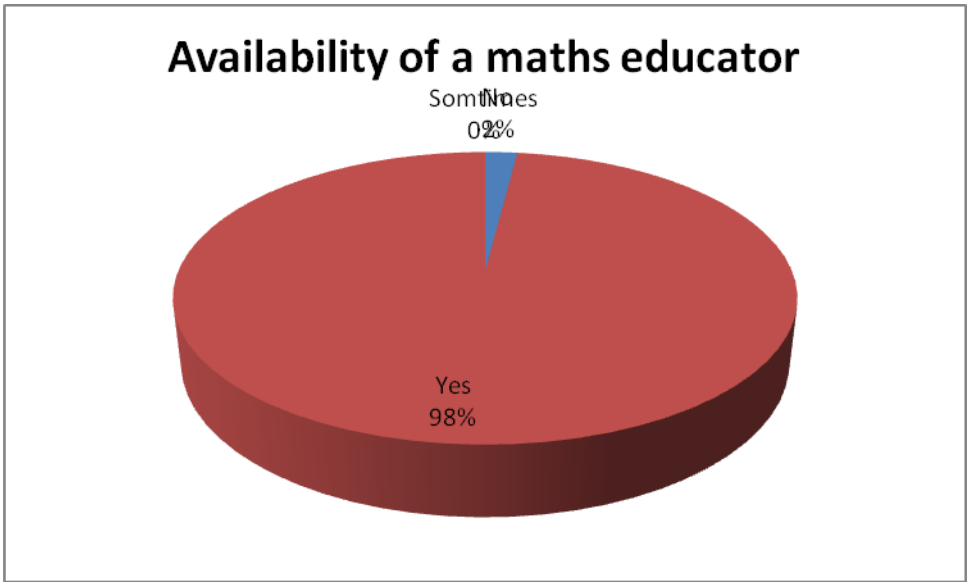


This figure indicates that 100% of respondents would like to pursue careers other than a career in education. According Gray (2006: 100-101) teaching in some western countries is seen as a dropout's job. This is a clear indication that people, including learners, are undermining this profession. This could be the reason why in this study no learners preferred to pursue it as a career. The above author also spelt out that the teaching profession has become unattractive due to lack of financial incentives. The Department of Education and other education stakeholders have a duty to make this profession more attractive so that good maths and science learners will have an interest in entering this profession. If that can take place the school classrooms will have quality maths and science educators who will be able to produce quality learners for tertiary education. The above can also help in the skill shortages highlighted in the literature.

3. **Did you have a maths educator at your school from the beginning of 2009 to date?**

Answers	Frequencies	Percentages
1. No	1	2
2. Yes	49	98
3. Sometimes	0	0
Total	50	100

Figure 3:

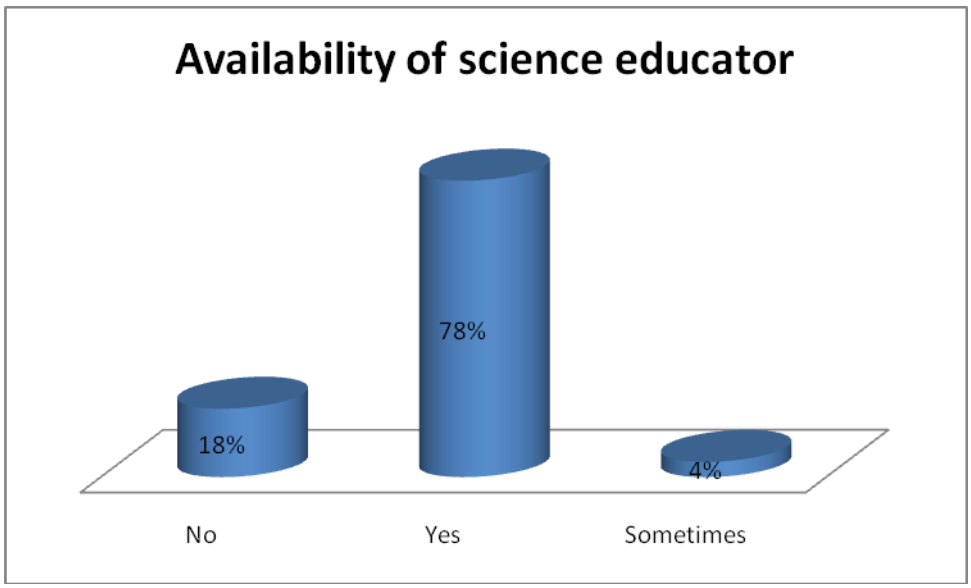


In this study, 98 percent of learners had a maths educator from the beginning of the year whereas two percent had no maths educator. A maths educator is a resource who is very important in all schools. However the literature believes that there are schools that still have problems in getting qualified maths teachers. Lemmer and Badenhorst (1997:19) concluded that there are various reasons for this to occur such as retirements, deaths and some educators leave teaching for better paying jobs. As a rule all learners should have teachers in front of them every working day and for seven hours a day. The two percent that didn't have a teacher will experience problems in passing this subject unless other arrangements have been made by the school. This will have a negative impact on the results and hence less maths output to tertiary institutions. In cases like these, schools have to inform the education department immediately and it must also play its part to look for qualified teachers.

4. **Did you have a science educator at your school from the beginning of 2009 to date?**

Answers	Frequencies	Percentages
1. No	9	18
2. Yes	39	78
3. Sometimes	2	4
Total	50	100

Figure 4:

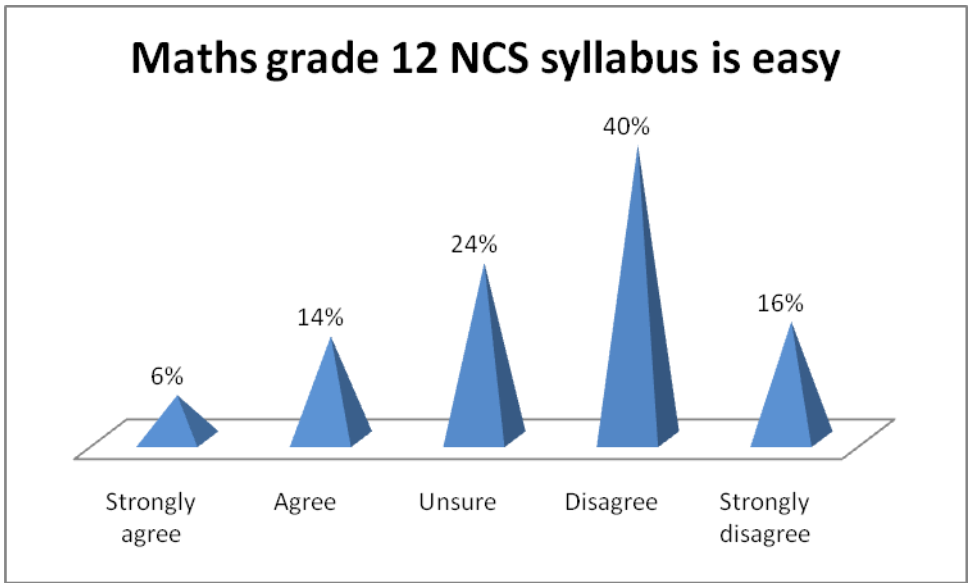


In this study, 78 percent learners had a science educator from the beginning of the year whereas 18 percent had no science educator and four percent sometimes had this educator. Science is another critical subject where absence of a teacher has a detrimental effect on learners and the country's skills. Mdakane (2007), a managing director of the National Society for Black Engineers commented that, lack of skills in South Africa is traced back to from secondary school education where secondary schools are seen as not feeding the tertiary institutions with pupils who qualify to enter those professions that require maths and science because of the poor pass rate in maths and science. Also the few who managed to further their studies in maths and science are recruited internationally and that has a damaging effect on a country's economy and a reduction in a nation's capacity to develop as a knowledgeable society. South Africa in general and Buffalo City in particular needs teachers who have these skills to produce greater output so as to increase its Gross Domestic Product.

5. **Maths grade 12 NCS syllabus is easy.**

Answers	Frequencies	Percentages
1. Strongly agree	3	6
2. Agree	7	14
3. Unsure	12	24
4. Disagree	20	40
5. Strongly disagree	8	16
Total	50	100

Figure 5:



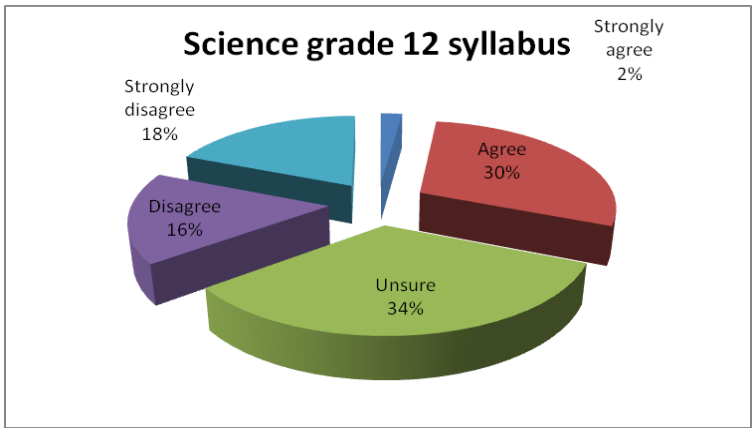
This figure showed that 20 percent of learners agree with the fact that maths grade12 syllabus is easy, 24 percent is unsure and 56 percent disagree with the above. Some schools and teachers are still uncertain about the National Curriculum Statement (NCS) or how best to cover the syllabus although they have been given training on it. Fricke et al. (2008: 72) indicated that the new syllabus requires extra content knowledge to be mastered by educators. Therefore if schools are asking educators who have not majored in maths and science to teach these as postulated by Lemmer and Badenhorst (1997:30), they are making this syllabus more difficult for learners. If there are no science educators at school who qualify to teach this subject, it would be better to take learners to neighboring schools where these subjects are offered by the specialist educators.

6. Science grade 12 NCS syllabus is easy

Answers	Frequencies	Percentages
1. Strongly agree	1	2
2. Agree	15	30
3. Unsure	17	34
4. Disagree	8	16

5. Strongly disagree	9	18
Total	50	100

Figure 6:



This study revealed that 32 percent are not sure whether the science grade 12 syllabus is easy whereas two percent strongly agree that it is easy. As it has been indicated above, no quality education will take place in this new syllabus if there are no qualified educators. Therefore, the Department of Education should focus on recruiting qualified maths and science educators. Nkabinde (1997:37) highlighted that some educators have no content knowledge and therefore rely heavily on textbooks to teach science. It also stated that these teachers are neglecting the mental development of learners and are actually promoting rote learning in learners. Learners in this case will feel that science is actually difficult because they do not attach meaning to what they are learning. Therefore according to the above author, promotion of reasoning and problem solving powers, creation of creative imagination which is very important in this subject are not encouraged. This will result in a fewer number of learners who will be able to continue with these subjects at tertiary level.

7. **Can learners start doing maths at grade 12 level?**

Answers	Frequencies	Percentages
1. Strongly agree	1	2
2. Agree	0	0
3. Unsure	2	4
4. Disagree	14	28
5. Strongly disagree	33	66
Total	50	100

Figure 7:

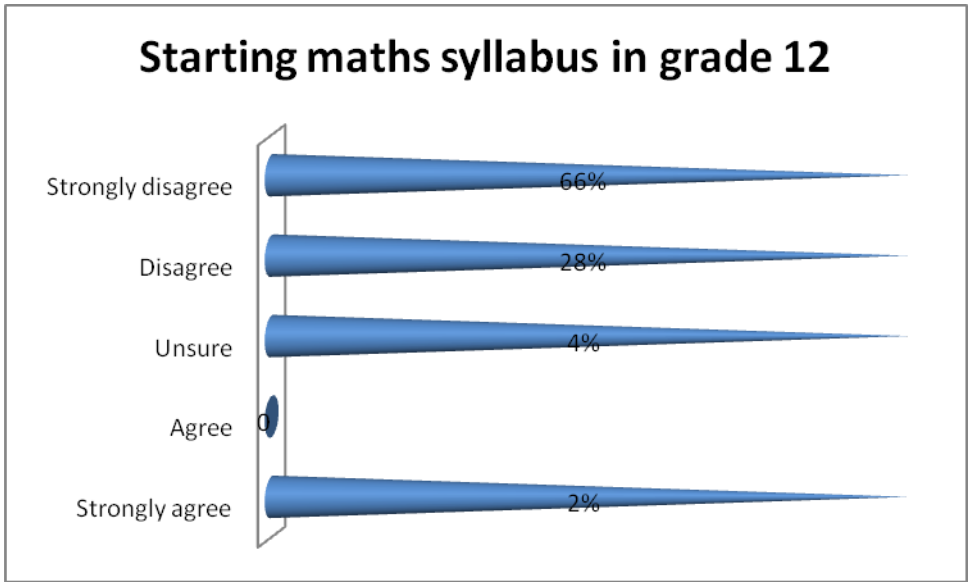


Figure 7 showed that 94 percent of learners disagree with the fact that people can start doing maths at Grade 12 level, four percent is unsure and only two percent agree with the above. Minister of Education, Pandor (2006) indicated that a lot has to be done in the teaching of maths at primary school because it would be unwise to start worrying about it at the secondary school level. She also revealed that it would impossible to achieve sustainable success at Grade 12 if there are primary schools that do not teach reading, writing and numeracy. According to the literature, a solid primary school foundation that allows learners to grasp the basics of numeracy and literacy is imperative if learners are to be able to matriculate with maths and be eligible for university entrance. The Education Department should ensure that all primary schools are putting more effort into their teaching because they are the ones who are laying the foundations.

8. People can start doing grade 12 science syllabus in grade 12

Answers	Frequencies	Percentages
1. Strongly agree	1	2
2. Agree	0	0
3. Unsure	4	8
4. Disagree	13	26
5. Strongly disagree	32	64
Total	50	100

Figure 8:

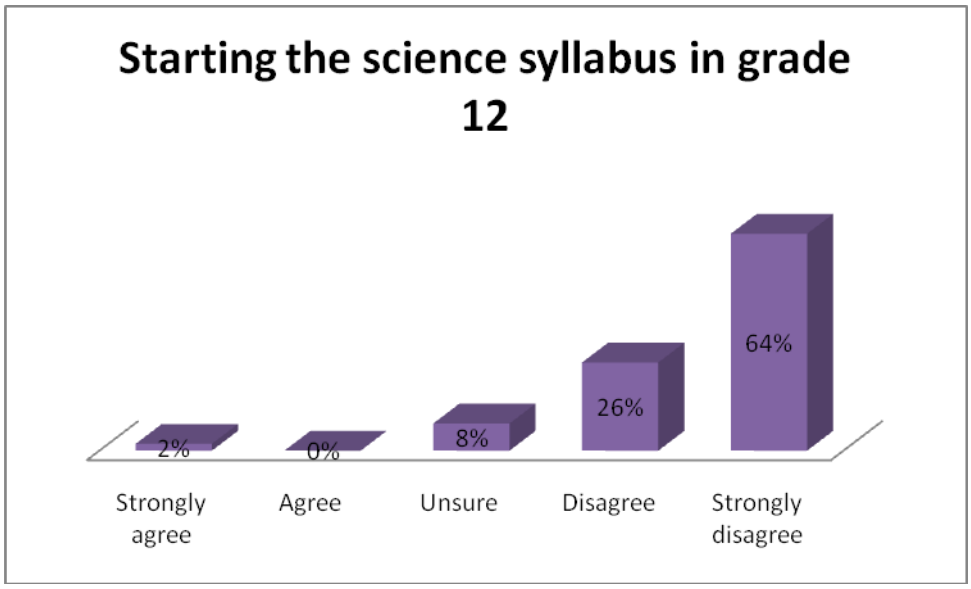
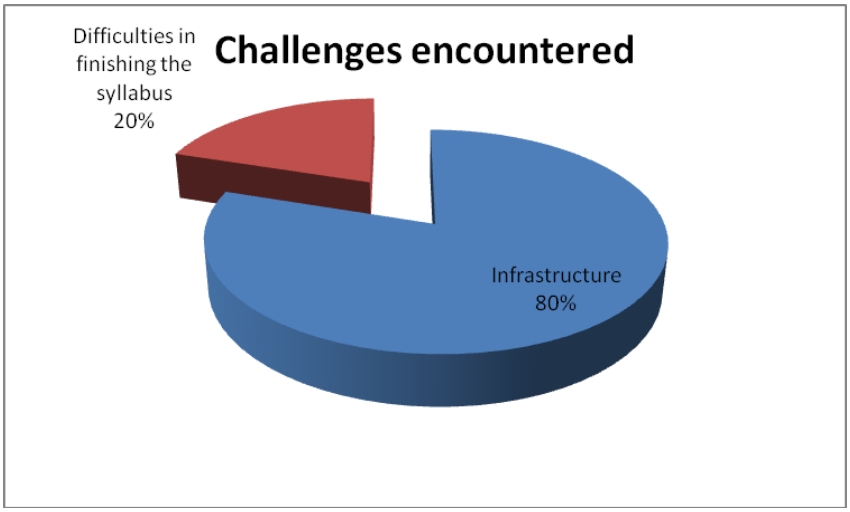


Figure 8 showed that 90 percent of learners disagree with the fact that people can start doing science in grade 12 level, eight percent is unsure and two percent agree. As it has been indicated earlier on, a solid primary school education is important if success will be the output. Education is like building a house where each brick will have to be put on top of the other in order to have a strong house. Science should be strong at primary schools so as to achieve best results at secondary schools. In order to achieve best results at primary school level, Reynolds and co-workers (1996) suggested that parent involvement is imperative where reading and writing should be priorities.

9. Which challenges are you encountering at your school in respect of maths and science subjects?

Answers	Frequencies	Percentages
1. infrastructure	40	80
2. difficulties in finishing the syllabus	10	20
Total	50	100

Figure 9:



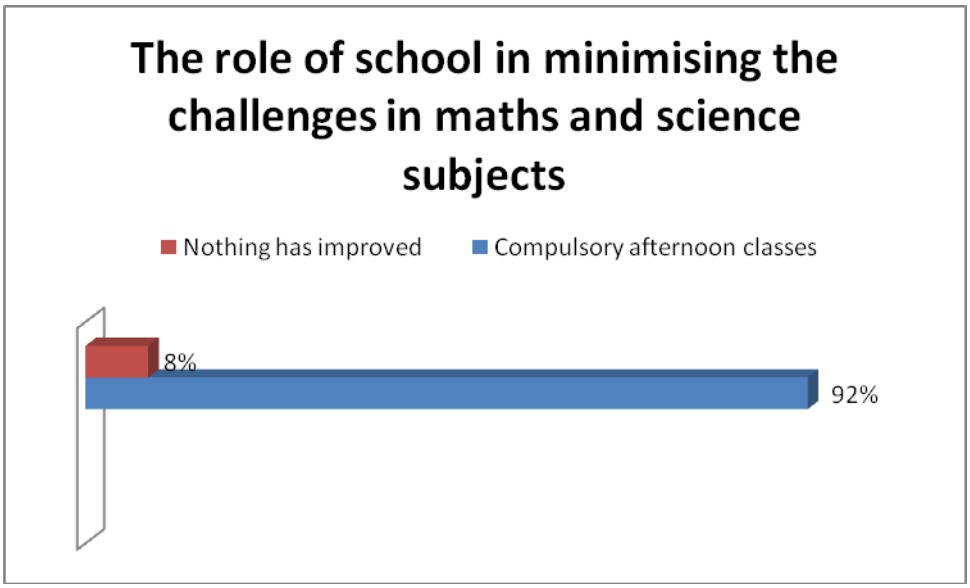
The study shows that 80 percent of the respondents find it difficult to cope with these critical subjects due to infrastructure at schools whereas 20 percent mentioned that it becomes difficult to finish the syllabus and do revision. Reynolds and coworkers

(1996) revealed that some schools in South Africa do not have the critical maths and science resources such as fully equipped laboratories, libraries and science material. Gordon (2000) investigated the situation and found that 11% of schools in South Africa need structural repair, 1% is not suitable for schooling and 12% need some more attention. For effective teaching and learning to take place the above resources are important. Most teachers are also discouraged when these resources are not there and end up looking for schools where these resources are available. The above schools will have a lack of these resources as well as of teachers who opted to go to schools that have these resources. This will have a negative impact on maths and science results. Mumba et al. (2002) revealed that interviews conducted with first-year university lecturers showed that some students enter universities without the knowledge and the understanding of basic chemistry concepts that are outlined in the high school physical science syllabus.

10. What has your school done to improve the situation mentioned in (9) above?

Answers	Frequencies	Percentages
1. Compulsory afternoon classes	46	92
2. Nothing has improved	4	8
Total	50	100

Figure10:



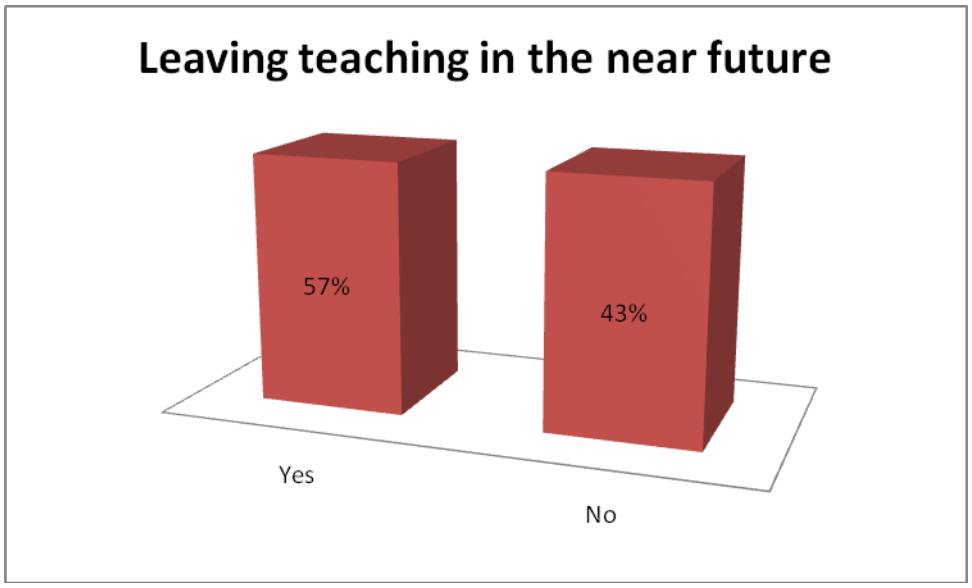
From the results of the survey it is evident that 92 percent of learners believe that their schools are holding afternoon classes to minimize the challenges the learners are experiencing in these subjects, but eight percent believe that there is nothing done by their schools to improve the situation. However, Simkins, Rule & Beinstein (2007:7) established that, to minimize the challenges mentioned above the government and the private sector were working together but the throughput of students with maths and science is still too low to provide the country with necessary skilled workers to build the economy. As indicated above Simkins et al (2007), revealed that some schools and teachers are still uncertain about the new curriculum, the National Curriculum Statement (NCS), or how best to cover the syllabus although they have been given training on it. The schools should start organizing compulsory afternoon classes for learners at the beginning of the year so as to finish syllabus in time and do revision because that is what matters most.

PART TWO: Educators

11. Do you consider leaving teaching in the near future? Why?

Answers	Frequencies	Percentages
1. Yes	8	57
2. No	6	43
Total	14	100

Figure 11:

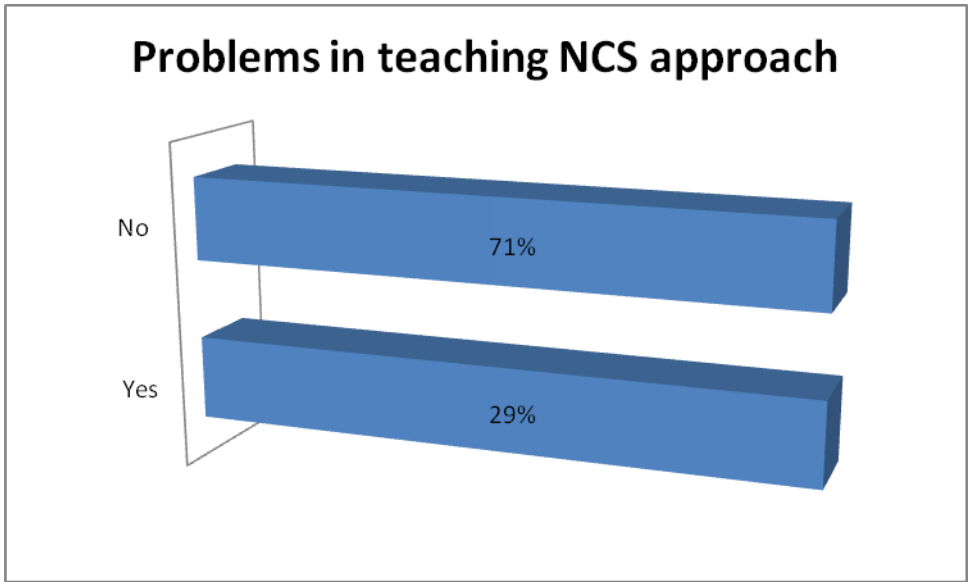


The results of this survey shows that 57 percent of educators would like to leave teaching in the near future and 43 percent agrees that they will not leave teaching fraternity. This is the matter that needs careful consideration because it clearly shows that teachers are not satisfied in their employment. Literature has revealed that in a study conducted by Barmby (2006) in England and Wales, a group of 71 maths and science teachers were asked as to why they were considering leaving teaching, they gave a lot of different reasons. Futernick (2006) highlighted that in a study conducted in California State University's Centre for Teacher Quality, dissatisfied teachers who left the profession cited serious problems with their work environment. As indicated above working conditions for teachers should be a matter of concern so as to retain them in this profession.

12. Do you have problems in teaching National Curriculum Statement approach? If yes, why?

Answers	Frequencies	Percentages
1. Yes	4	29
2. No	10	71
Total	14	100

Figure 12:

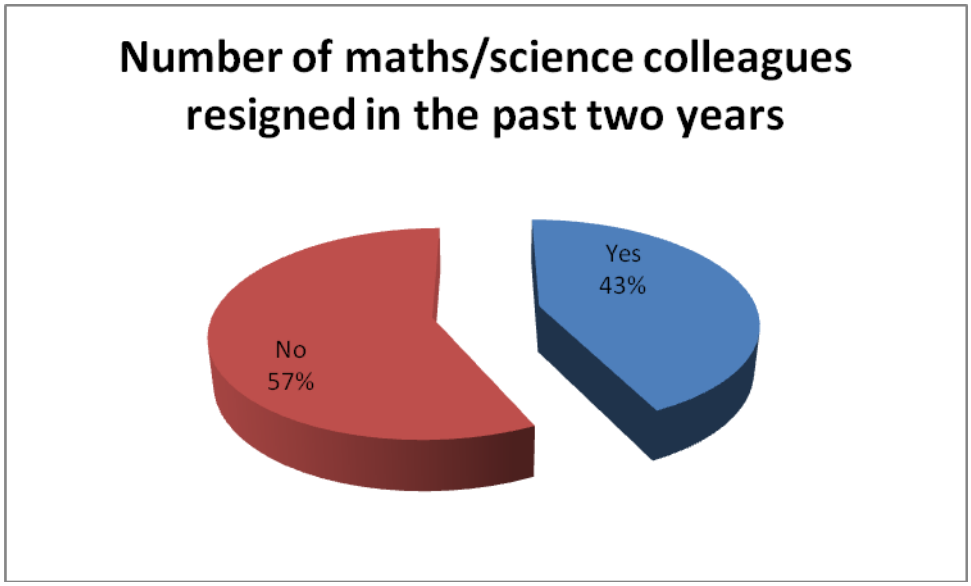


The study shows that 29 percent of respondents who participated in this study have problems in teaching the National Curriculum Statement approach and 71 percent do not have problems at all. The National Curriculum Statement is a new curriculum that has been recently introduced to South African Schools. Most of the teachers were not trained for it at the tertiary level. However in-service training has been offered. Whether this in-service training was adequate for them, that is another issue. Simkin et al (2006) highlighted that many schools and teachers are uncertain about the new curriculum and how best to cover the syllabus. To minimize the teacher exodus, the Education Department should communicate more effectively with schools as well as the public about this new curriculum and provide teachers with more detailed guidance on teaching it.

13. Are there any maths and or science colleagues from your school who have resigned in the past two years?

Answers	Frequencies	Percentages
1. Yes	6	43
2. No	8	57
Total	14	100

Figure 13:

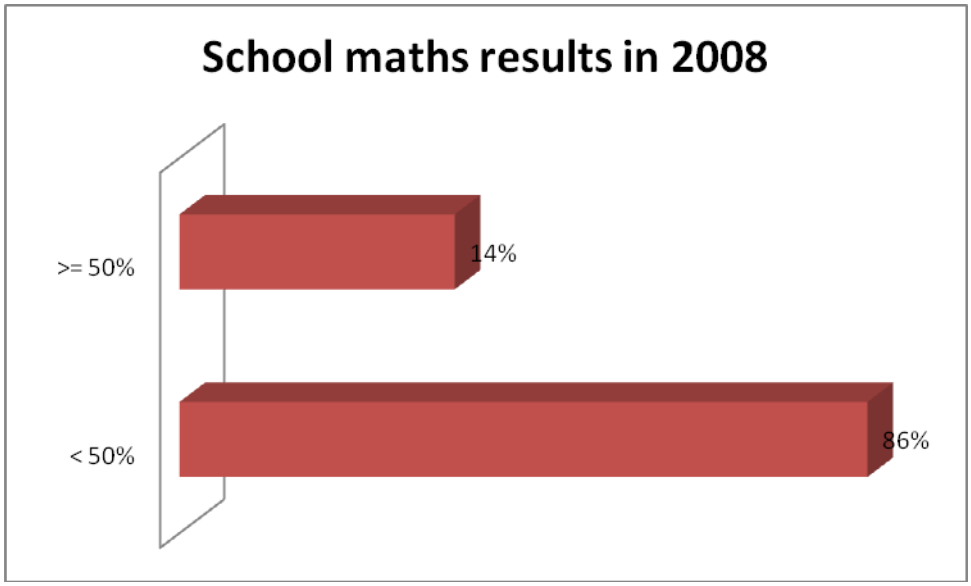


The survey indicated that 57 percent of the respondents show that there are maths/science colleagues who have not resigned from their schools in the past two years and 43 percent agree that there were maths/science colleagues who have resigned from their schools during the same period. The number of educators who have resigned is a large number and it explains why there were learners who were without maths and or science educators at the beginning of 2009. In study conducted by Barmby (2006) England and Wales particularly in subjects such as mathematics, science and English, 71 teachers who had resigned were asked whether they could envisage returning to teaching later on, 29 replied that they could and a further 23 were uncertain either way as to whether they would, whereas 15 said they will not return to teaching. The Department of Education should use all the strategies necessary to keep teachers in the classrooms.

14. How was your school's grade 12 maths in respect of 2008?

Answers	Frequencies	Percentages
a. Below 50%	12	86
b. 50 % and above	2	14
Total	14	100

Figure 14:

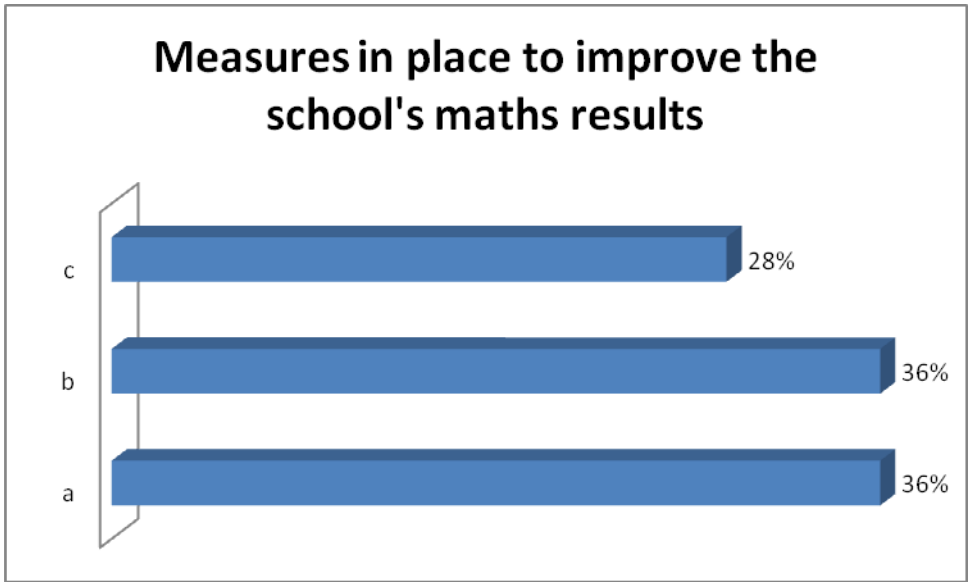


The study reveals that 86 percent of the respondents got below 50 percent maths results in 2008 and 14 percent got 50 percent and more. This is in line with what Simkin et al (2006) has identified, that before the National Curriculum Statement (NCS) was introduced, learners were expected to write their subjects in higher grade (HG) or standard grade (SG) and the South African schooling system continued to produce far fewer passes in maths and science such that the Education Department's stated target for achieving the doubling goal of annual passes in HG maths for years 2004-2006 actually declined. Improving school's resources will be part of the solution in achieving better maths and science results.

15. What are the measures in place to improve your school's results?

Answers	Frequencies	Percentages
a. Enrichment for teachers	5	36
b. Extra classes for learners	5	36
c. Practice more previous papers	4	28
Total	14	100

Figure 15:

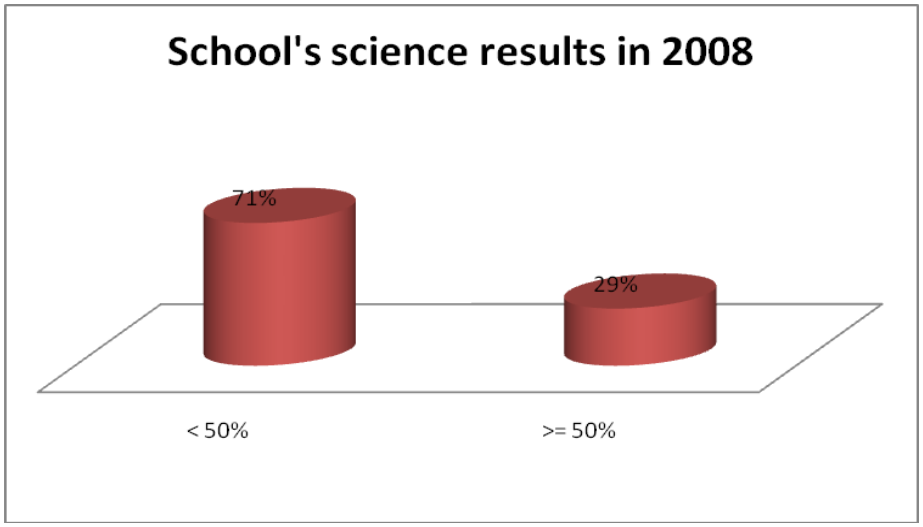


The survey shows that to improve the school's results, 36 percent of the respondents are focusing on the enrichment of educators, another 36 percent is conducting extra classes for learners and 28 percent are allowing the learners to practice previous question papers. As suggested by Simkin et al (2006), to improve maths and science results career counseling is essential to inform and guide learners about the tertiary level study options and career opportunities that are open up if they pass senior certificate maths. The above author also suggested that learners whose schools do not offer maths must be given opportunity to attend schools where it is offered. Close monitoring of schools by district officials from the beginning of every year to the end would be advisable.

16. How were your school's grade 12 science results in respect of 2008?

Answers	Frequencies	Percentages
a. Below 50%	10	71
b. 50 % and above	4	29
Total	14	100

Figure 16:

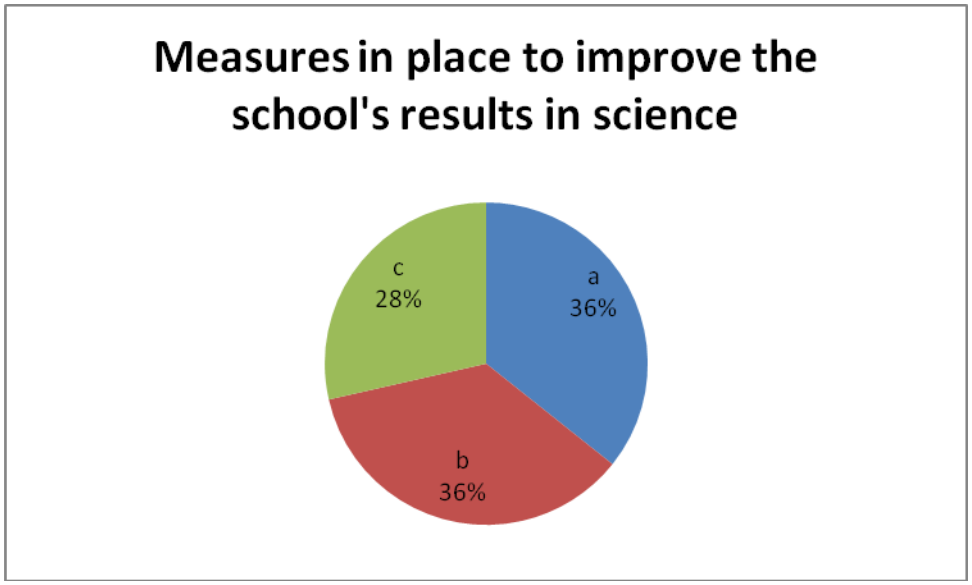


The study reveals that 71 percent of the respondents got below 50 percent science results in 2008 and 29 percent got 50 percent and more. For Khalema (2006), grade 12 pass rate in mathematics and science remain low especially in disadvantaged and rural schools and that, this is due to lack of resources, but is severely compounded by under-qualified educators. He further pointed out that the university degrees and professional and technical careers require grounding in maths and or science, and the critical shortfall in learners leaving the schooling system with HG maths and science was a significant constraint on growth. The above author further indicated that, a reactive response to the problem of Black African student, who started with no or little underpinning in science, is that the University of Cape Town (UCT) has launched the Science Foundation Programme (SFP) to improve an inadequate secondary education. More educator training and provision of required resources is necessary to improve the above situation.

17. What are the measures in place to improve your school's results?

Answers	Frequencies	Percentages
a. Giving extra classes	5	36
b. Practice more question papers	5	36
c. Giving more group works.	4	28
Total	14	100

Figure 17:



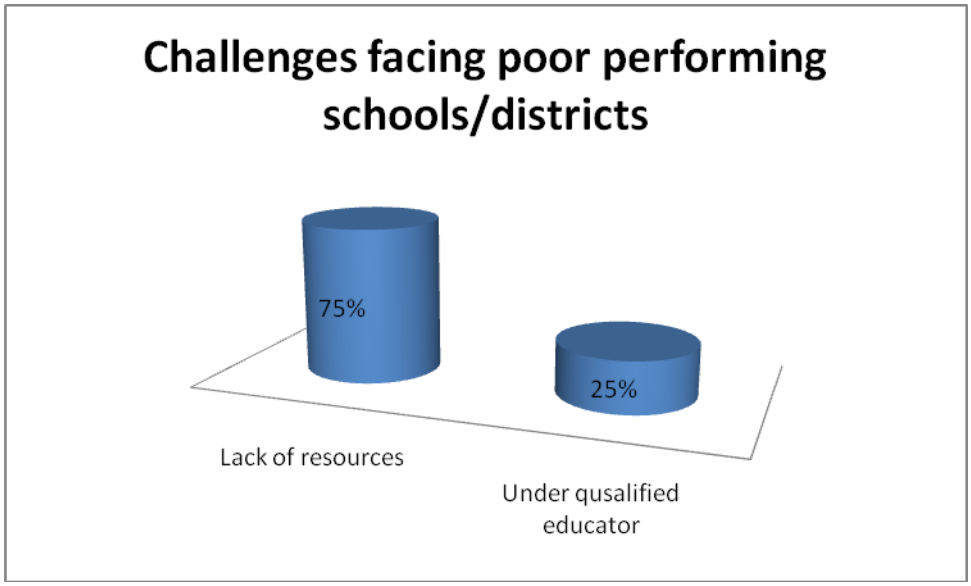
The survey shows that to improve the school's results, 36 percent of the respondents are focusing on conducting extra classes for learners, another 36 percent are focusing on practicing more question papers and 28 percent are giving more group work to learners. Giving extra tuition, as indicated above, is in line with what Lazarus (1987), quoted by Kloot et al (2008), has highlighted where (SPF) courses mentioned above at UCT were combined with the first-year mainstream to improve the secondary school results.

PART THREE: Officials

18. What are the challenges facing those poor performing schools/districts that are under your supervision?

Answers	Frequencies	Percentages
1. Lack of resources	9	75
2. Under qualified educators	3	25
Total	12	100

Figure 18:

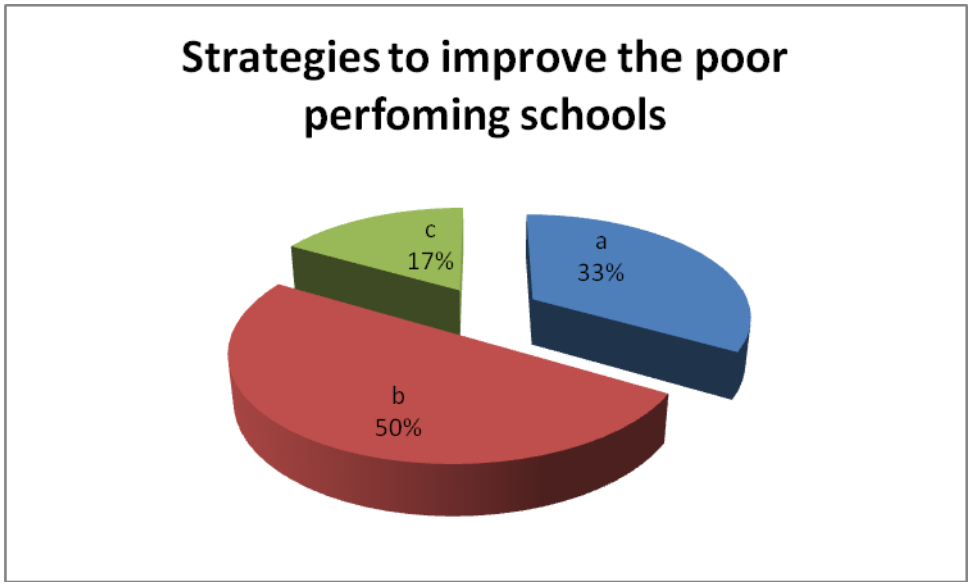


The study showed that 75 percent of the respondents believe that lack of resources is the cause of this problem of poor performance and 25 percent respondents think that under qualified educators is the source of the problem. Kyriacou (2000:34) highlighted that most teachers are stressed due to poor conditions such as lack of adequate resources and materials, physical conditions of the school buildings, inadequate level from clerical and administrative staff. Some schools especially in rural areas had do experience the shortages of qualified maths and science educators. These schools according to Lemmer and Badenhorst (1997) had a tendency of asking educators who have not majored in maths or in science to teach these subjects, with this being done out of sense of desperation.

19. What strategies are you employing to improve the situation mentioned in (18) above?

Answers	Frequencies	Percentages
a. Organize workshop	4	33
b. Support a monitoring visit	6	50
c. Encourage sponsors from private sectors	2	17
Total	12	100

Figure 19:



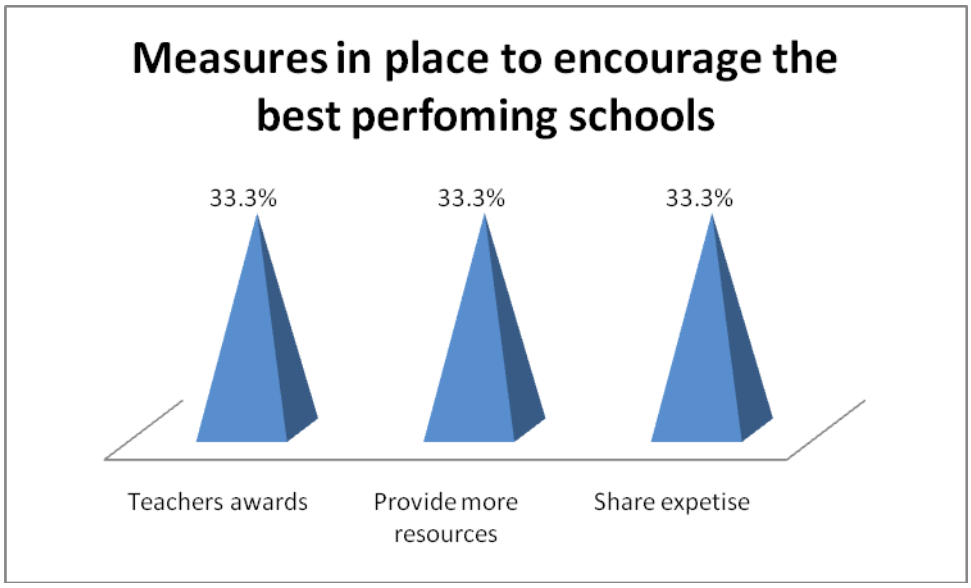
The study showed that 33 percent of the respondents are organizing workshops to improve the results, 50 percent do support and monitoring schools/districts, 17 percent are encouraging private sponsors to help the department. Literature revealed that in a study conducted by Futernick (2006), educators who leave teaching pointed out a list of reasons which includes amongst others poor district support and unsupportive principals. It also highlighted that, a partnership between CASME and Sasol has resulted in the establishment of Teacher Development Training Project whose aim was to provide science and mathematics teachers weekend and school holiday training to equip them with

knowledge to teach the new curriculum. To improve performance at schools, a close monitoring of schools by district officials is very important.

20. What strategies are you employing to encourage the best performing schools under your supervision?

Answers	Frequencies	Percentages
1. Teachers awards	4	33.3
2. Provide more resources	4	33.3
3. Share expertise	4	33.3
Total	12	100

Figure 20:



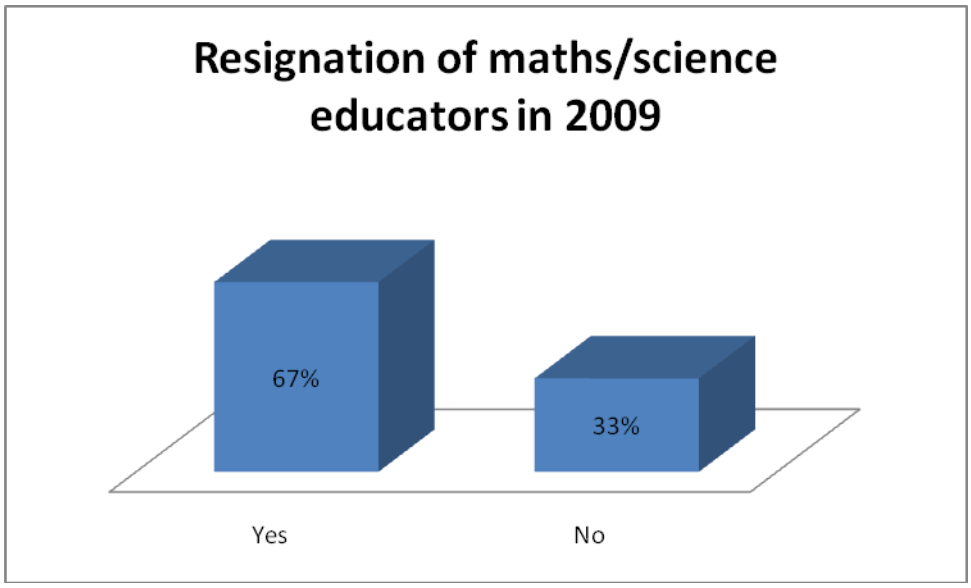
The results of the survey shows that to encourage the best performing school/districts, 33.3 percent of the respondents agree that teachers are given awards, 33.3 percent believe that more resources are provided and 33.3 percent also ensured that expertise are shared amongst schools/districts. Simkins et al (2006) suggested expertise should be shared. It has been highlighted that top-

performing schools should accept the obligation of high potential learners, or assisting neighboring schools.

21. Are there any maths and or science educators who have resigned from the schools/districts under your supervision in 2009?

Answers	Frequencies	Percentages
1. Yes	8	67
2. No	4	33
Total	12	100

Figure 21:

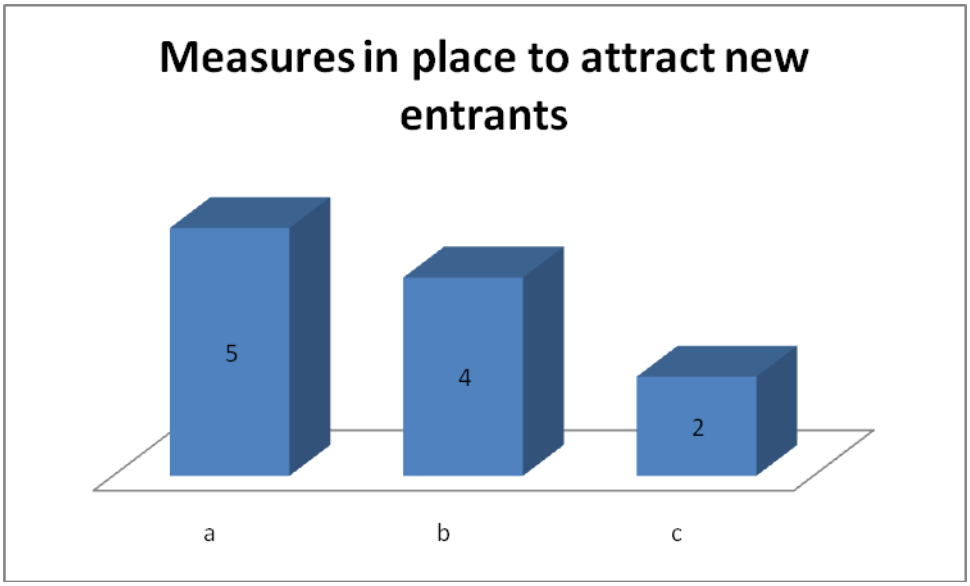


67 % of the respondents agree that, there are maths and science educators who have resigned from their post in 2009 and only 33% t said that no maths and science educators have resigned in 2009. As mentioned above, the resignation of maths and science teachers was according to Futernick (2006) due to various reasons which include inadequate support, such as lack of time planning or professional development, and bureaucratic impediments such as classroom interruptions, unnecessary meetings, and too little say over the way schools are run. The Department of Education should improve the working conditions for teachers so as to minimize the teacher resignations.

22. What is the Department of Education doing to attract new entrance in the teaching fraternity?

Answers	Frequencies	Percentages
a. Improving working conditions	5	42
b. Deliver teaching and learning material in time	4	33
c. Counseling teachers emotionally	3	25
Total	12	100

Figure 22:



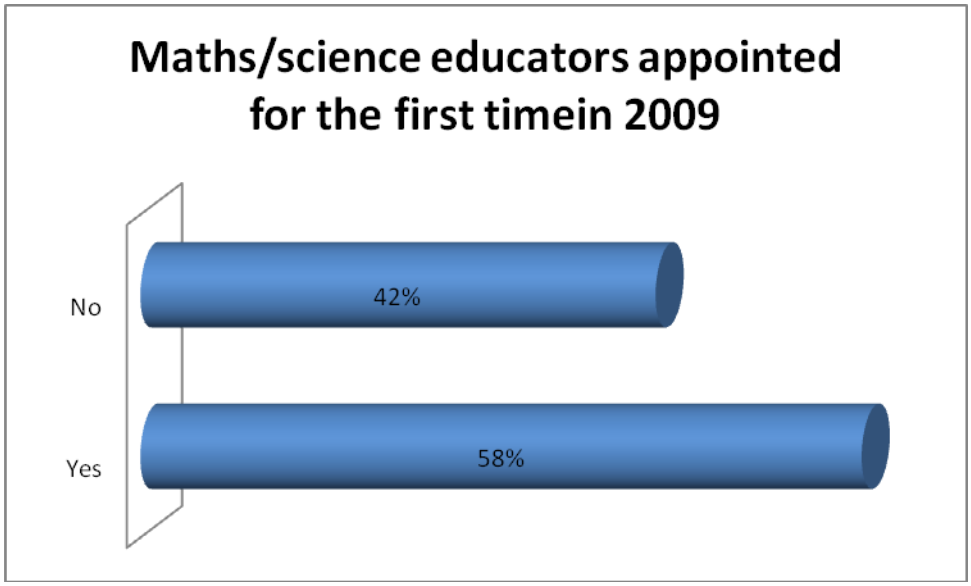
To attract new entrants to the teaching fraternity, 42% of the respondents agreed that working conditions need to be improved, 33% said teaching and learning material needs to be delivered on time, and 25% said teachers are counseled emotionally. According to Barmby (2006), a study conducted about the shortages of teachers in England and Wales particularly in subjects such as mathematics, science and English, a group of 71 who had resigned were asked whether they could envisage returning to teaching later on. 29 replied that they could and a further 23 were uncertain either way as to whether they would. The above could

be because teacher working conditions had been improved. The Department of Education in South Africa would have to do the same to attract new entrance.

23. Were there any math /science educators who were appointed for the first time in the teaching fraternity at your schools/district in 2009?

Answers	Frequencies	Percentages
1. Yes	7	58
2. No	5	42
Total	12	100

Figure 23:

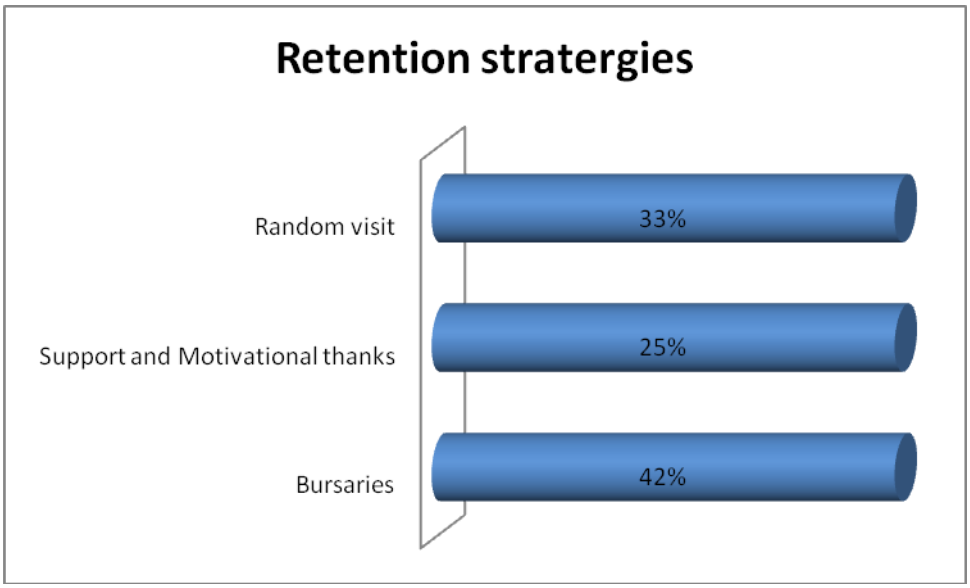


The results of the survey revealed that 58% of respondents indicated that there were maths and science educators who were appointed for the first time in the teaching fraternity at their schools and districts whereas 42% indicated that there were no new appointees. This is because the South African Education Department is improving the quality of education as indicated by Simkins et al (2006) that the Department is trying to increase its input in top-performing schools in various ways, including more learning resources and better teachers in maths, science and languages of instruction.

24. What is the Department of Education doing to retain those educators who are already in the field of teaching?

Answers	Frequencies	Percentages
1. Bursaries	5	42
2. Support and Motivational thanks	3	25
3. Random visit	4	33
Total	12	100

Figure 24:

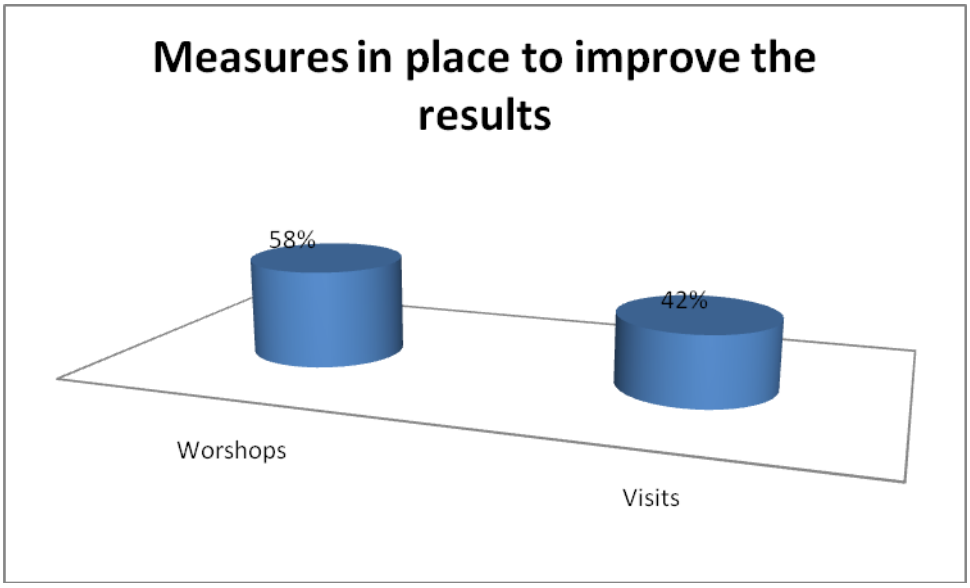


To retain those teachers who are already in the field of teaching, 42% of respondents said that bursaries are given to teachers, 25% agreed that support and motivational thanks are rendered to teachers and 33% agreed that random visits are done to school/districts. In a study conducted by Barmby (2006) about the shortages of teachers in England and Wales particularly in subjects such as Mathematics, Science and English the 71 respondents who had resigned were asked an open-ended question as to why they were leaving teaching and they gave a variety of reasons which included further study, salary, lack of support and lack of resources. If the Department is now offering bursaries to educators and improving the support to educators then they will not have fewer reasons to leave the teaching profession.

25. Given the 2008 grade 12, maths and science results, what are the measures in place to improve your school's or district's situation?

Answers	Frequencies	Percentages
1. Workshops	7	58
2. Visits	5	42
Total	12	100

Figure 25:



To improve the results, 58 percent of the respondents agreed that workshops are conducted whereas 42 percent of the respondents said that visits are done by the senior office. As indicated above, it has also been highlighted that workshops were conducted where; a partnership between CASME and Sasol has resulted in the establishment of Teacher Development Training Project whose aim was to provide science and mathematics teachers weekend and school holiday training to

equip them with knowledge to teach the new curriculum. Dissatisfied leavers in a study by Futernick (2006) revealed that poor support by district officials was also the reason for them to leave teaching. Therefore to improve results, workshops and visits would be necessary and the quantity of workshops would be an equivalent quality of workshops.

Conclusion

The findings of the current study indicate that the Department of education is trying to attract new entrants to the teaching fraternity; however, it is experiencing some problems in its retention strategies as there are still educators who are resigning in this field for other jobs. Overall, schools in the Buffalo City area are showing problems in improving maths and science grade 12 results and the few learners who have managed to pass these subjects do not show any interest in furthering their career as educators. This study has also provided some indication that workshops were conducted by partnerships with non-governmental organizations to improve the skills and knowledge of maths and science educators and thereby improving the output to tertiary institutions.

Chapter 5

Conclusion and Recommendations

From the previous chapter it became clear that, 57% of maths and science educators who were asked whether they intended leaving teaching in the near future said 'yes' as opposed to the 43% who said they will not leave the teaching fraternity. To avoid this teacher exodus, the Department of Education (DoE) and other stakeholders need to do a better job of keeping best maths and science teachers in the classroom. To make that happen, the DoE needs to ensure that teachers have meaningful input in the decision-making process at their schools, strong, collaborative relationships with their colleagues, adequate support and resources. They also need effective, supportive principals and school district administrators /officials. The DoE also needs to assess teaching conditions regularly and then use the data when formulating policies and programs aimed at attracting and keeping teachers because if that is not done then more good maths and science educators will end up leaving teaching for other careers.

Additionally, if the DoE is going to attract talented people to teach and keep them in the classroom, there must be a focus on strengthening school leadership. It needs to determine the skills, experiences and qualities required for effective school leadership, and foster efforts to ensure that schools attract and retain the leaders needed to develop and sustain high-quality teaching and learning conditions. Increasing teacher retention requires recognition that in far too many places, schools remain unnecessarily frustrating places to work. The government and local policymakers must focus on making changes to the teaching and learning environment that ensures the students success and render schools more attractive to teaching professionals.

The main report provides numerous practical suggestions directed to all maths and science education stakeholders. Among other things, they could:

5.1 Improving the supply and quality of teachers.

The shortages of teachers is a matter of great concern because the results of this survey revealed that learners who were asked to choose careers they would like to pursue after grade 12, out of 50 respondents 0% chose education. This is in line with what has been revealed by the literature where it has been stated that the capacity of teacher education in South Africa is under pressure because teacher shortages are looming and the quality of a large number of practicing teachers is under suspicion. According to Simkin, Rule and Beinstein (2007), the new senior secondary curriculum will greatly increase the demand for maths teachers. This increase is specifically related to all Grade 12 learners having to do Maths or Maths Literacy. Simkin *et al* (2007) therefore suggest that at the very least maths and science teachers should be able to pass a Grade 12 maths paper with very high marks and quickly upgrade their skill to cope with the new curriculum. Heads of Department in schools should have several years experience of successful teaching, and teachers who cannot meet the required criteria should be assigned to tasks other than teaching maths and science in grade 10, 11 and 12. More maths and science teachers should be trained, and the quality of their training improved. This can be done by increasing the capacity at universities. To make up for the local shortfall, maths and science teachers should be recruited from abroad- India for example.

Raising salary levels may help attract new teachers, but a salary alone is not the only compensation teachers need. If the DoE is seeking to fill its teaching ranks, it needs to ensure that working conditions are fair for teachers and that, teachers have the training and resources they need. It must also ensure that the education continues to improve so that talented, motivated individuals are encouraged away from business and industry careers and towards invaluable and much needed teaching positions.

5.2 Start focusing in primary maths and science

The DoE should start focusing on Primary School maths and science, starting from the Foundation Phase and Intermediate Phase, rather than starting to focus on maths and science at the secondary school stage because that will be too late. Maths and science teaching in most primary schools is woefully inadequate. A poor foundation limits what can be achieved in secondary schools. Increased maths and science results are possible by interventions in secondary schools but moving beyond that will require attention to conditions in primary school. The literature showed that in many schools children starting secondary school had the maths skills of a seven-year-old. This is evident in the results of the survey where 86% of the schools agreed that they got less than 50% pass rate in grade 12 maths in 2008 and only14% got more than 50 percent. It further reveals that 71% of schools got less than 50 percent pass rate in grade 12 science in 2008 and only 29 percent got more than 50% pass rate.

Stimulation of greater demand by parents, learners, educators and principals for quality maths and science education is of greater importance. There should be an annual national maths and science aptitude test for grade nine learners, success in would make a learner eligible for financial support to attend a high-performing maths and science school. It should be implemented experimentally to streamline its effectiveness and optimize sector and other resources.

5.3 Making rural schools more attractive to teachers

Learners from rural schools should also be exposed to quality education and resources in respect of maths and science subjects. The problem with rural schools is that, teachers tend not to choose these schools because of various reasons mentioned in paragraph 2.3 above which therefore results in learners of these schools suffering. This is supported by the literature which states that many rural schools lack the financial and other resources to offer the variety of specialized classes often found in suburban schools. Literature further reveals that by nature of geographical location and community resources, rural schools face unique challenges not experienced by their suburban counterparts.

The DoE should make rural schools more attractive to qualified teachers by giving rural incentives to teachers and the necessary infrastructure and equipment.

5.4 Give more support to maths and science learners

Learners from low income group families are subjected to barriers to learning such as poverty, distance to and from schools, lack of resources such as classrooms libraries, laboratories and computer workstations with internet connection. The Department of Education and other stakeholders should consider increasing feeding scheme to accommodate all learners (including senior secondary school learners) because it becomes very difficult for learners to grasp if they know that there is no food during the day at school. Schools should also be provided with the infrastructure, teachers, equipment and consumables needed for the effective teaching of maths, science and language of instruction. Literature also proved that one the reasons why dissatisfied educators leave teaching is lack of resources which makes it very difficult for educators to effectively teach learners. Statistical analysis indicates that 75 percent of the challenges facing poor performing schools are lack of resources and 25 percent are underqualified teachers. It is also evident to the survey that there are 18 percent of learners who were without a science educator at the beginning of 2009, 78 percent agreed that they had a science educator while four percent had occasionally.

Learners who have the potential to do maths and science must be persuaded to take these subjects, and if they are not offered at schools close to where they live, they must be given the opportunity to attend schools where they are offered. High performing schools should not been taken for granted, they must also be supported and monitored because schools that have performed well historically are at a risk of deteriorating and need attention. These schools should also accept additional obligations such as enrolling additional high-potential learners, or assisting neighboring schools.

Provide bursaries to those learners who qualify so as to motivate other learners to work hard and achieve in the maths and science subjects.

Summary

The purpose of this study was to highlight the impact of qualified mathematics and science teachers in the Buffalo city area. The researcher established that the South African schooling system in general and the Eastern Cape in particular continue to produce far fewer passes in maths and science than the country's economy requires. Many university degrees and professional and technical careers require grounding in maths and or science, and the critical shortfall in the learners leaving the schooling system is a significant constraint on economic growth. However many teachers including those of maths and science who could produce high quality maths and science results have left the teaching profession because of various reasons such as old age, some are dying due to HIV/AIDS and other diseases, some are exploring other avenues of life yet few learners who are still at school are showing much interest in this field.

This study also focused on the strategies the Department of Education (DoE) is using to attract new entrants to this field and retain those who are already in this field. The sample comprised of 50 learners from different schooling backgrounds of the Buffalo City area, 14 educators and 12 Department of Education's officials. The findings of this study indicated that there is a lot that the DoE and other education stakeholders need to do to make this profession more attractive and to keep the best maths and science teachers in the classroom. This study also proposed some recommendations which are based on the responses gathered from all the respondents.

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Appendix 1

Consent Letter to Participants

NMMU Business School

Bird Street Campus

P O Box 77000. Port Elizabeth. 6031

Tel. +27 (0)41 5043736 Fax. +27 (0)41 5043891

Luella.VanWyk@nmmu.ac.za

Dear Sir/ Madam

Re: Consent by Department of Educations' officials dealing with Mathematics and Science subjects

It gives me pleasure to introduce myself to you. My name is Lungiswa Kopolo, I am a student at Nelson Mandela Metropolitan University in my final year of studying Masters in Business Administration (MBA). I am planning to do my research on the Impact of Shortages of Qualified Math and Science Educators in the Buffalo City Area. Doctor Ken Alston will be supervising this research. As such it would be greatly appreciated if you would consider being a participant in this study.

In order to gather data for this study, I need you to partake in a questionnaire designed to gather information about your personal understanding of the impact of qualified math and science educators in your district which falls under my area of study that is, Buffalo City area. Given the nature of sensitivity of this study, issues of confidentiality and anonymity will be upheld. I would like to

emphasize that participation in this study is voluntary and that you may withdraw your participation in the study at any time.

If you are interested in becoming part of this process please sign the attached consent form. I value your co-operation and thank you for your commitment. If you have any further questions before signing the consent form, I can be reached at the following address or telephone number:
kopolol@webmail.co.za or 082 220 5048

Thanking you in advance

Yours truly,
L. Kopolo

Appendix 2

Consent Form for Participants

I,……...……..., hereby give my informed consent to become a participant in this study. I fully understand and agree to the terms and conditions of consenting to be a participant in this study.

…….

Participating official

Contact details:

Address…….

……..

……...

Telephone numbers (Home)…….

(Work)……..

Signed this day of …… 200….. at ……..

Witness: ……

Appendix 3

Questionnaire A

Questionnaire for maths and science learners

Part 1: Biographic information

1. Gender

☐ Male

☐ Female

2. What is your home language?

☐ Afrikaans

☐ English

☐ Indian

☐ Xhosa

☐ Other (specify)

3. Age group

☐ Less than 16 years

☐ From 16-18 years

☐ From 18-21 years

☐ Over 21 years

4. What is your school background?

☐ Rural school

☐ Township

☐ Ex-model C school

☐ Former colored school

☐ Former Indian school

☐ Other (specify)

……
……
……

5. Which career would you like to pursue after grade 12?

☐ Education

☐ Management &Commerce

☐ Law

☐ Science & Agriculture

☐ Social Science & Humanities

☐ Other (SPECIFY)

……
…

Part 2: Math and Science related information

6. Did you have a math educator at your school from the beginning of 2009 to date?

☐ No

☐ Yes

☐ Sometimes

7. Did you have a science educator at your school from the beginning of 2009 to date?

☐ No

☐ Yes

☐ Sometimes

Statement	Strongly agree	Agree	Unsure	Disagree	Strongly disagree
8. Maths grade 12 NCS syllabus is easy					
9. Science grade 12 NCS syllabus is easy					
10. People can start doing maths at grade 12 level					
11. People can start doing grade 12 science syllabus at grade 12 level					

12. Which challenges are you encountering at your school in respect of maths and science subjects?

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13. What has your school done to improve the situation mentioned in (12) above?

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Appendix 4

Questionnaire B: Questionnaire for the Department of Educations' officials

1. BIOGRAPHIC INFROMATION

1. Gender

☐ Male

☐ Female

2. Age group

☐ from 25-35 years

☐ From 36-45 years

☐ From 46-55 years

☐ Over 55 years

3. What is your home language?

☐ Afrikaans

☐ English

☐ Indian

☐ Xhosa

☐ other (specify

……

……

2. ACADEMIC EXPERIENCE

Qualifications	**Name of qualification**	**Majors/subjects**
M	Senior certificate	
M+3		
M+4		
M+5		
Other		

3. WORK EXPERIENCE

5. What is your current job description?

☐ Senior Education Specialist

☐ DCES

☐ Other

6. In which level are you operating?

☐ Provincial

☐ District

7. How long have you been in this position?

☐ Less than a year

☐ From1-3 years

☐ From 3-6 years

☐ From6-9 years

☐ Ten years and more

8. Band?

☐ Foundation phase

☐ Intermediate phase

☐ GET band

☐ FET band

……

……

9. How many schools (districts, if you are holding a provincial office post) are under your supervision?

……

……

10. Do you have underperforming schools/districts under your supervision?

☐ Yes

☐ No

11. What are the challenges facing those poor performing schools/districts that are under your supervision?

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12. What strategies are you employing to improve the situation mentioned in (11) above?

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13. What strategies are you employing to encourage the best performing schools under your supervision?

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14. Are there any maths and or science educators who resigned from the schools/districts under your supervision in 2009?

☐ Yes

☐ No

15. Were there any maths/science educators who were appointed for the first time in the teacher fraternity at your schools/district in 2009?

☐ Yes

☐ No

16. What is the Department of Education doing to attract new maths and science educators to the teaching fraternity?

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17. What is the Department of Education doing to retain those educators who are already in the field of teaching?

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18. Given the 2008 grade 12 maths and science results (see appendix 6-8), what are the measures in place to improve your school's or district's situation?

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Appendix 5

Questionnaire C: Questionnaire for educators

PART 1: BIOGRAPHIC INFORMATION

1. Gender

☐ Male

☐ Female

2. Age group

☐ Less than 25 years

☐ From 25-35 years

☐ Over 45 years

PART 2: ACADEMIC EXPERIENCE

3.

Qualifications	**Name of qualification**	**Majors/subjects**
M	Senior certificate	
M+3		
M+4		
M+5		
Other		

PART 3: WORK EXPERINCE

4. How long have you been teaching maths and or science in the FET band?

☐ Less than ten years

☐ More than ten years

5. Do you find teaching interesting?

☐ Yes

☐ No

6. Do you consider leaving teaching in the near future?

☐ Yes

☐ No

☐

7. Do you have problems in teaching National Curriculum Statement approach? If yes, why?

☐ Yes

☐ No

……
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8. Are there any maths and or science colleagues from your school who have resigned in the past two years?

☐ Yes

☐ No

9. What is your 2009 school enrolment?

☐ Less than 300 learners

☐ From 300-600

☐ From 600-900

☐ More than 900

10. How many maths educators are there at your school?

☐ Less than 4

☐ From 4-6

☐ More than 6

☐

11. How many science educators are there at your school?

☐ Less than 4

☐ From 4-6

☐ More than 6

12. How were your schools' grade12 maths results in respect of 2008?

☐ Below 50 percent

☐ 50 percent and above

13. If below 50 percent what are the measures in place to improve your school's situation?

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14. How were your schools' grade12 science results in respect of 2008?

☐ Below 50 percent

☐ 50 percent and above

15. If below 50 percent what are the measures in place to improve your school's situation?

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Appendix 6

2008 Grade 12 Maths and Science end of the year's results (per districts)

District	Mathematics	Physical Science
Mt Fletcher	41.96	44.94
Mt Frere	29.49	32.36
Maluti	37.02	39.37
Lusikisiki	29.23	31.03
Mbizana	27.87	32.61
Sterkspruit	38.06	42.74
Queenstown	42.79	55.15
Lady Frere	33.04	38.61
Cradock	49.19	59.98
Mthatha	32.46	38.71
Qumbu	34.45	41.43
Libode	42.39	46.64
Ngcobo	25.11	29.93
Cofimvaba	29.11	25.98
Dutywa	31.34	22.95
Butterworth	24.71	28.79
Fort Beaufort	28.53	36.35
East London	42.58	46.46
King Williams Town	29.39	39.24
Graaff-Reinett	47.85	60.26
Grahamstown	53.09	60,67
Port Elizabeth	53.03	58.76
Uitenhage	54.04	57.99