

**The impact of teacher-related variables
on students' Junior Secondary Certificate (JSC) Mathematics results in
Namibia**

by

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submitted in accordance with the requirements for
the degree of

Doctor of Education

in the subject

Didactics

at the

University of South Africa

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August 2012

Declaration

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I declare that *The impact of teacher-related variables on students' Junior Secondary Certificate (JSC) Mathematics results in Namibia* is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.



Mr Simon Eno Akpo

3rd August 2012

Dedication

This work is dedicated to my wife and children: Patricia, Sally, Isabella, Abraham and Cynthia.

Acknowledgements

My special thanks and appreciation go to my supervisor, Professor L.C. Jita, who despite his other serious engagements devoted his time to guiding me through my project. I am highly indebted to him. I owe immense gratitude to my family (Mrs Patricia Akpo and Dr M U Akpo) for their active support, both financially and morally, all through my project.

I also acknowledge the editorial input of Ms Cynthia Murray, and I must pay tribute to Ms Maria Ausiku (Secretarial Services), Mr. N. Mutasa for financial assistance and to Mr. Clemence Chidua for his guidance in the analyses of the data.

I am particularly grateful to staff at the UNISA Library who provided me with materials for my literature review on the impact of teacher-related variables on students' academic achievement.

Furthermore, I would like to thank the following people in the Ministry of Education (MoE) for granting me permission to conduct the study in their respective educational regions and schools:

- The Permanent Secretary of the Ministry of Education, Mr. A. Ilukena
- The 13 Regional Education Directors: Messrs, Lupalezwi (Caprivi), J. Awaseb (Erongo), B. Boys(Hardap), A.J. Hoeseb (Karas), A. Dikua (Kavango), J. Undjombala (Khomas), C. Kamwi (Kunene), L. Kafidi (Oshikoto) and Mss, S. Steenkamp (Ohangwena), N. Goagoses (Omaheke), A. Nghipondoka (Omusati), D. Shinyemba (Oshana), F.Caley (Otjozondjupa).
- The principals and JSC Mathematics teachers of the sampled schools in the study.
- My thanks go to Dr Goldstein A.A for allowing me to adapt some items from NAEP.

Finally, I wish to express my profound gratitude to God for bottling up within me an unquantifiable store of energy to be able to conduct this research thus far. I praise his Name

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Abbreviations and acronyms

ACT	-	American College Testing
AIAN	-	American Indian/Alaska Native
BETD	-	Basic Education Teacher Diploma
CLAS	-	California Learning Assessment System
DABE	-	The Directorate of Adult Basic Education
DAP	-	The Directorate of Arts Programmes
DEPIM	-	Directorate of Educational Programme Implementation and Monitoring
DNEA	-	Directorate of National Examinations and Assessment
DNHC	-	The Directorate of National Heritage and Culture
DNLIS	-	The Directorate of National Library and Information Service
IGCSE	-	International General Certificate of Secondary Education
INSTANT	-	In-service Training of Namibian Teachers, Free University of Amsterdam
INSET	-	In-service Education and Training
ITBS	-	Iowa Test of Basic Skills
JSC	-	Junior Secondary Certificate
LSAY	-	Longitudinal Survey of American Youth
MASTEP	-	Mathematics and Science Teacher Extension Programme
MBESC	-	Ministry of Basic Education Sports and Culture
MCK	-	Mathematical Content Knowledge
NAEP	-	National Assessment of Educational Progress
NCHE	-	National Council on Higher Education
NELS	-	National Educational Longitudinal Study
NHRDP	-	Namibian Human Resource Development Programme
NIED	-	National Institute for Educational Development
NCTF	-	New York City Teaching Fellow
NQA	-	Namibian Qualification Authority
NTE	-	National Teacher Examination (US)

OLS/HLM	-	Ordinary Least Square / Hierarchical Linear Modelling
OTL	-	Opportunity to Learn
SAARMSTE	-	Southern African Association for Research in Mathematics, Science and Technology Education
SACMEQ	-	Southern African Consortium for Monitoring Education and Quality
SBPD	-	Standards-Based Professional Development
SBCA	-	Standard-Based Classroom Activity
TAI	-	Teacher Achievement Indices
TEAMS	-	Texas Educational Assessment of Minimum Skills
TFA	-	Teach for America
TECAT	-	Texas Examination of Current Administrators and Teachers

Definition of terms

Teacher Qualifications

Credentials, knowledge and experience that teachers bring with them when they enter the classroom, such as: Coursework, grades, subject-matter education, degrees, test scores, experience, certification(s), and evidence of participation in continued learning (e.g., internships, induction, supplemental training, and professional development).

Teacher Characteristics

Attitudes and attributes that teachers bring with them when they enter the classroom such as: Expectations for students, collegiality or a collaborative nature, race, and gender.

Teacher Practices

Classroom practices which teachers employ; that is, the ways in which teachers interact with students and the teaching strategies they use to accomplish specific teaching tasks, such as: Aligning instruction with assessment, communicating clear learning objectives and expectations for student performance, providing intellectual challenge, allowing students to explain what they are actually learning, using formative assessment to understand what and the degree to which students are actually learning, offering learning experiences, subscribing to cohesive sets of best teaching practices.

Teacher Effectiveness

Effectiveness refers to the teacher's ability to produce student learning. Usually, gains in student test scores that can be attributed to the teacher are assumed to provide evidence of effectiveness. For example, the state of Tennessee has a database that enables researchers to track student progress from grade to grade. Researchers there have used this data to show that individual teachers are remarkably varied in how much their students gain in any given year (Sanders & Horn, 1994). However, they do not say what kind of qualifications lead to effectiveness, nor what kind of teaching practices lead to effectiveness.

Pedagogical Content knowledge

Pedagogical content knowledge is defined as the distinctive body of knowledge required for teaching. It represents the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organised, represented and adapted to diverse interests and abilities of learners, and presented for instruction. Pedagogical content knowledge is the category most likely to distinguish the understanding of the content specialist from that of the pedagogue (Shulman 1987 p.4).

Certification

Certification refers to teachers holding credentials from an authoritative source, such as the government, a higher education institution or a private source, for the subject they were assigned to teach, and holding a certificate to teach at the grade level they were assigned to teach. Thus, improperly certified teachers do hold certification, but are not certified to teach the specific subject area or grade level to which they are assigned.

Qualified Teacher

A qualified teacher is one who teaches at the level (or lower) for which he/she completed a teacher training programme; for instance, a teacher who is teaching at the Junior Secondary phase, and who completed a teacher-training programme for junior or senior secondary education.

Under-qualified Teacher

An under-qualified teacher is one who has not completed any teacher-training programme. This teacher may have completed only a programme of academic studies.

Unqualified Teacher

An unqualified teacher is one who completed a teacher training programme which is below the level at which he/she is currently teaching; for instance, a teacher who is teaching at the senior secondary phase but completed a teacher-training programme for primary or junior secondary education.

Abstract

This study explored the link between teachers' inputs and process and students' academic achievement in Junior Secondary Certificate (JSC) Mathematics for the period 2006 to 2010. The outcome (teacher effectiveness) was obtained by means of value added measures (students' aggregate JSC Mathematics scores for 2006 to 2010 by school). One hundred and fifty JSC schools out of a total of 573 constituted the units of analysis for the study. The data regarding teachers were obtained by means of self-administered questionnaires, and JSC Mathematics results from 2006 to 2010 were obtained from the Directorate of National Examinations and Assessment (DNEA).

Multi-correlation and regression techniques at $\alpha = 0.001$; 0.05 and 0.10 were used to analyse the link between teachers' inputs and processes, and students' academic achievement in JSC Mathematics. The null hypotheses formulated for the study were tested at the 0.05 (5%) level of significance. In summary, it appears that the various aspects of teachers' inputs (teachers' educational qualifications, teaching experience, subject specialisation etc.), processes (standards-based professional development, standards-based classroom activities, and classroom management beliefs) are related to students' academic achievement in JSC Mathematics. In particular, a linear combination of the following variables had a significant and positive association with students' academic achievement in JSC Mathematics: teachers' major in Mathematics (teachers' inputs); teachers' usage of whole class discussion (standards-based classroom activities); perceived knowledge of algebra; teachers' professional development in interdisciplinary instruction; teachers' review of students' homework/assignments; and students talking to other students about how to solve mathematics problems. Teachers' pedagogical content knowledge (PCK) in general, and some classroom practices were not significantly related to students' academic achievements. This study, therefore, recommends that teachers' professional development should focus on the subject matter that the teachers will be teaching, as well as alignment of teachers' learning opportunities with real work experience using actual curriculum materials and assessment.

Keywords: Professional development, mathematics content knowledge, pedagogical content knowledge, teacher subject specialization, standard-based classroom practices, academic performance, junior school certificate, mathematics achievement, mathematics teacher, teachers' qualifications.

CHAPTER 1

BACKGROUND AND CONTEXT OF THE STUDY

1.1 Introduction

This study examined the relationship between students' performance in Junior Secondary Certificate (JSC) Mathematics in 573 secondary schools located in Namibia and the teacher-related variables that impact student achievement in those schools. The purpose was to identify statistically significant teacher variables that can be influenced by public policy to improve student achievement. Identification of teacher characteristics and practices that contribute most towards improving students' achievement has often eluded researchers, even though the most effective means of improving school quality may be through addressing weak teaching (Glewwe & Kremer, 2006). The objective of this study was to identify teacher characteristics and teaching practices that have the greatest influence on students' achievement in Mathematics.

There are various dimensions of teacher quality. Some might argue that the primary aspect of teacher quality is content knowledge, and some might argue that it is effective use of pedagogy. Others might argue that teacher quality should be assessed only by student outcomes, regardless of pedagogy. According to McCaffrey et al. (2003), teacher quality can be gauged by short-term outcomes such as students' performance in national tests at the end of the academic year. Long-term outcomes may be much more difficult to measure, but some might argue that the best teachers are those who somehow improve students' educational trajectories in important ways. In other words, teacher quality is multi-dimensional and complex in nature, and can be measured in multiple ways.

Existing literature probing teacher quality has distinguished two approaches. In the first, an educational production function links measurable teacher characteristics to student achievement, controlling for student characteristics. The various methodologies adopted in this approach include independent variable (IV) approaches (McCaffrey et al., 2003), panel data studies (Rivkin, Hanushek, & Kain, 2005; Clotfelter, Ladd & Vigdor, 2006), and randomized experimental studies (Lavy, 2002; Glewwe & Kremer, 2006). The consensus from this wide

array of studies is that many of the standard teacher characteristics, such as certification, training and experience, do not affect student achievement (Rivin, Hanushek, & Kain, 2005). As these characteristics often underpin teacher compensation policies, these findings are controversial and widely debated.

A second approach calculates teacher quality as a teacher-fixed effect in an equation of gains in student achievement where different groups of students (in a given year or other time period) are taught by the same teacher. The resulting total teacher effect enables researchers to define a good teacher as one who consistently produces high achievement growth for students. This approach of estimating total teacher effect does not require identification of specific teacher characteristics which generate student learning (Kingdom, 2007). A number of studies have used this approach (Rockoff, 2004; Rivkin, Hanushek & Kain, 2005) and they conclude that teacher quality matters substantially to student achievement. However, when these researchers regressed this teacher-fixed effect on teachers' observed characteristics, their findings were consistent with those from the more direct achievement production function approach, namely that observable characteristics such as certification and training explain little of the variation in teacher quality.

This study takes the direct approach, linking teacher characteristics to student outcomes in an achievement production function, but with specific innovations. The research will test the importance of classroom practices and teaching techniques rather than limiting attention only to teacher characteristics external to the classroom (for instance, level of education, teaching experience, etc.). My approach allows me to focus on more refined measures of what teachers know and can do, and it can also make a valuable contribution to what we know about the value of educational resources. In seeking to improve the Mathematics education of all students, it is important to understand the connection between the inputs (teacher qualifications and characteristics), processes (teachers practices and teaching quality), and outcomes (teacher effectiveness based on students' achievement in JSC Mathematics).

Available literature on teachers' inputs and processes (teacher practices) among Namibian junior secondary school teachers seems to suggest the following: Basic Education Teacher Diploma (BETD) graduates were not well prepared for the new JSC curriculum, particularly in

Mathematics (NCHE, 2007); the BETD teachers need to expand their repertoire of teaching strategies and their knowledge of the newly added content in the syllabus (NCHE,2007); there is a gap between the teachers' pedagogical content knowledge and their teaching practices (NCHE, 2007). These observed deficiencies can affect the quality of student outcomes in JSC Mathematics. It is hoped that this study will shed light on the influence of these factors on students' JSC Mathematics results.

1.2 Background to the Study

The Information and Communication Technology (ICT) Policy for Education in Namibia, aimed at bringing ICT knowledge to students in Namibia, has reflected concern about the Mathematics achievement of the nation's youth in the aftermath of the country's independence in 1990. While there is some evidence of gains in achievement over the past 15 years, large numbers of Namibian students show mastery of only rudimentary Mathematics skills, and only a small proportion achieve high levels of functional literacy (Marope, 2005).

Poor academic achievement in Mathematics is being witnessed at all levels in secondary schools in Namibia, particularly in external examinations such as the JSC examination (Grade 10) and the International General School Certificate (IGCSE) examination (Grade 12). For instance, the results of the November 1995 IGCSE examinations showed that only 8.1% of the 5288 candidates achieved a passing grade of C or better in Mathematics, with regional disparities for Grade C or better ranging from 17,8% in Windhoek to 2,5% in Katima Mulilo (MBESC, 1996). Furthermore, the results of the IGCSE examinations of the Khorixas Education Region for the years 1997 to 2000 showed a percentage passing grade of B or better in Mathematics as follows: 21,2% of 533 candidates in 1997; 23,8% of 508 candidates in 1998; 20,2% of 605 candidates in 1999, and 27,3% of 653 candidates in 2000 respectively.

Similarly, only 18% of the 1736 candidates achieved a passing grade of B or better in the JSC (Grade 10) Mathematics results for 2000 (MBESC Khorixas Region JSC results, 2000).

In 2001, only 46% of the candidates for the JSC examination (Grade10) attained the minimum level required for entry into Grade 11. Only 7% earned an average of a B grade or higher. The

proportion of “upgraded and incomplete” scripts (i.e. clearly failed scripts) was 40% for Grade 10 Mathematics and 27% for Grade 12 Mathematics (Marope, 2005).

In 2004, the country was divided into 13 educational regions, each headed by a Director of Education. The trend for students in each region attaining a grade D (which is the minimum passing grade) or better is presented in Table 1.1:

Table 1.1: Regional Performance in JSC Mathematics Results (Grade D or better)

	2005	2006	2007	2008	2009
Region/Grade D	Grade D(%)/better	Grade D(%)/better	Grade D(%)/better	Grade D(%)/better	Grade D(%)/better
Karas	41.3	33.7	22.1	31.7	27.9
Hardap	48.4	41.7	36.4	39.4	40.0
Khomas	51.2	49.0	44.2	46.0	40.6
Omaheke	32.6	32.1	22.6	27.7	30.2
Erongo	50.8	52.3	53.2	53.3	57.1
Otjozondjupa	36.6	34.9	33.3	32.6	44.0
Kunene	14.4	23.8	23.8	33.8	21.8
Omusati	31.9	32.9	31.8	39.7	39.4
Oshana	35.9	41.2	39.6	40.5	38.1
Ohangwena	37.9	37.5	41.2	45.8	42.6
Oshikoto	50.7	55.5	52.8	51.8	57.3
Kavango	21.6	25.3	23.7	24.5	23.4
Caprivi	15.7	15.2	20.8	24.9	26.0

Grade D = 40-49%; Grade C = 50-59%; Grade B = 60-69%; and Grade A = 70 = 100%

Source: Adapted from DNEA

From Table 1.1, it is evident that only two regions scored 50% and above between 2005 and 2009, namely the Erongo and Oshikoto Regions respectively (DNEA/Table 1.1).

In the past, there has been a widespread failure in Mathematics education to provide the majority of Namibian students with the knowledge and qualifications necessary to enter scientific and technological careers (Namibian Human Resource Development Programme (NHRDP), 2002, pp.20-21). If we, as Namibians, want to succeed in the global arena in a dynamic, competitive world, it is necessary for schools to prioritise the role of science and technology. In support of this, the Vision 2030 Document recommends that programme changes, initiatives and reforms must be implemented in Science and Mathematics education as soon as possible.

The former Minister of Education, Nangolo Mbumba, stated in 2006 that although there was notable progress regarding the enrolment at primary level through to institutions of higher learning, and significant growth in teacher qualification at both primary and secondary levels, the quality of education called for effective measures for quality improvement and efficiency management.

Mbumba pointed out that the state of the nation's education system revealed the following scenarios:

Although over 80% of the secondary school teachers are qualified, students' output has not risen commensurately. With regard to primary schools, despite a rise of 16% in primary teacher qualifications, the quality of learning in primary schools is on the decline. Furthermore, although there was increasing expenditure in education from 1995 to 2000, there has since been a decline in students' achievement. The transition rate to Grade 11 is about 60%, but the number of students leaving Grade 10 with 27 point or better has remained around 27%. Similarly, although the transition rate from Grade 10 to Grade 11 is about 60%, the majority of these students (about 68%) never reach the exit grade (Grade 12).

The Minister argued that the above statistics were a serious concern to his Ministry, the Government of Namibia, the citizens and the education and training sector as a whole.

Furthermore, the current Minister of Education, Dr. Abraham Iyambo, in his first address to Ministry of Education staff in May, 2010, stated that:

The performance of Grade 10 (JSC) and 12 (IGSCE) learners is highly tainted. We need to do research whether the high failure rate at the two levels are as a result of poor performance in lower grades. We need to find solutions to these. My deputy and I are sure there is enough data that can be analysed to provide us with indicators of where we are getting it wrong. We need your undivided attention to find the solution or solutions. We will not dwell on the possible reasons for these failures now. Collect the data, analyse and interpret so we provide the country with the hope of an educated youth for the future (MoE, 2010).

The statements by the former and current Ministers of Education and the poor performance of students in the national examinations constitute a clear signal that the current state of Mathematics education in Namibia is not as it should be. In support of the Minister of Education's views, the Namibian Human Resource Development Programme (NHRDP) report of 2002 recommended that there is a need for a systematic and extensive research agenda to inform decision-making and policy change. This should include, in particular, a thorough statistical analysis of the Mathematics examination results as well as an item analysis of all Mathematics question papers, in-depth research through case and tracer studies of representative samples of schools, and comparative curriculum studies with SADC neighbours, as well as co-operation and communication between researchers, policy makers and implementers.

The reports of the NHRDP (2002), Marope (2005), and the Advisory Council on Teacher Education (ACTE) (2007) pinpointed a number of problems that existed in Namibian schools, especially the formerly disadvantaged schools, which could possibly be at the root of why the performance of students in both JSC and IGSCE external examinations is not what it should be.

The three reports aptly identify one of the causes of the problem as being that BETD programmes not only lack subject content and appropriate teaching methodologies, but also have no clear guidelines on the content and the quality of the programme. Students in both primary and secondary schools are furthermore exposed to ineffective teaching as 60% of primary school teachers and 30% of secondary school teachers are unqualified, while among the qualified teachers, a large proportion lack essential competencies such as mastery of their teaching subjects, good English proficiency, reading skills, elicitation skills, curriculum interpretation, and skill in setting student tests. These weaknesses limit the effectiveness of the teachers.

1.3 Purpose of the Study

The present study was designed to investigate teacher characteristics and practices that affect students' Mathematics results as measured by the JSC Mathematics scores. More specifically, this study examined the relationship between teachers' classroom practices, professional development and characteristics external to classroom practices, and students' academic achievement as measured by the JSC Mathematics results. Furthermore, this study sought to determine the impact of these identified teacher characteristics on students' academic performance regarding JSC Mathematics results, and to develop a regression model for predicting student achievement in JSC Mathematics examinations.

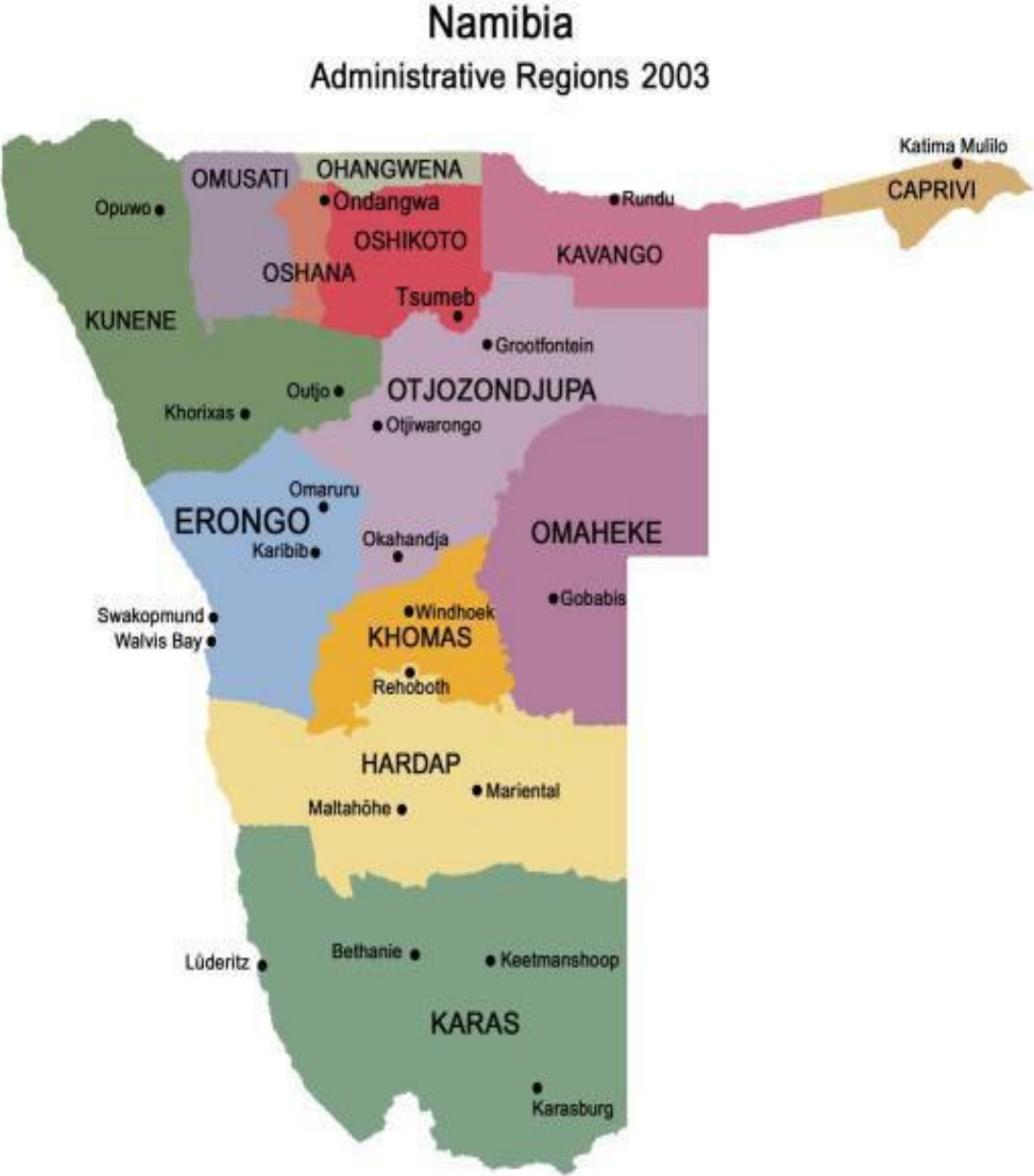
1.4 Namibia and its Education System

1.4.1 Introduction

This section will shed light on the geographical location of Namibia, its land mass, educational system, development of school syllabi, setting and administration of Junior and Senior Secondary Examinations and the management of both government and private schools.

Namibia is located on the south west coast of Africa, and has an area of 824,418 square kilometres. The country is bordered by the Atlantic Ocean to the west, the Republics of Angola and Zambia to the north and north-east respectively, and the Republics of Botswana and South Africa to the east and south respectively. Formerly under the mandate of South Africa, Namibia gained independence in March 1990. Namibia's population is estimated to be about 2 million (National Planning Commission (NPC), 2008). The country has 13 Regional Councils, with the

Khomas Region being the largest in terms of population size. Windhoek, in the Khomas Region, is the capital of the country.



Source: Adapted from the National Planning Commission

The Ministry of Education (MoE) was established by amalgamating the former 11 second-tier educational and cultural services into one unified national structure. The purpose was to unify

the previous racially and ethnically based education authorities into one ministry. After independence, Namibia was divided into seven (7) education regions headed by Directors of Education. However, in compliance with the policy of decentralising central government functions to all of the 13 administrative regions, education was equally decentralised to all 13 regions in 2003. Since Namibia gained independence in 1990, there has been an increased determination to restructure the education system to meet the country's development needs. Consequently, the Education Act of 2001 was promulgated in December 2001 with the primary objectives of providing for accessible, equitable, qualitative and democratic national education services, the establishment of a National Advisory Council on Education, a National Examination, Assessment and Certification Board, Regional Education Forums, School Boards, and an Education Development Fund, the establishment of schools and hostels, the establishment of a Teaching Service and a Teaching Service Committee, and provision for incidental matters (MoE, 2004).

Similarly, in order for education to be able to respond to the challenges of the 21st century, development of a knowledge-based society has become the driving force, as contained in the Vision 2030 National Document. The objectives being pursued towards the realization of Vision 2030 include the conducting of a comprehensive review of all curricula, the development and implementation of Human Resources Development plans, and the establishment of more Vocational Training Centres and Community Skills Development Centres (COSDEC). In addition, Vision 2030 is aimed at strengthening the teaching of Mathematics, Science and Technology at all levels, as well as integrating entrepreneurship-training into the education system, thus contributing towards achieving the Education for All objectives.

1.4.2 Namibian Education System

The education system of Namibia encompasses seven years of primary education (PE) catering for Grades 1-7, three years of junior secondary education (JSC) catering for Grades 8-10, and senior secondary education (SS) catering for Grades 11-12. Additionally, there are combined schools that cater for primary, junior secondary and/or senior secondary grades under one roof. However, very few of the combined schools offer all primary and secondary grades. Post-secondary education comprises 3-6 years of tertiary education. The Basic Education Teacher

Diploma (BETD) is a 3-year programme offered at the four National Colleges of Education, while a 4-year Bachelor of Education (B. Ed) degree programme is offered at the University of Namibia. The Polytechnic of Namibia offers 3-year diploma programmes and 4-year Bachelor of Technology (B. Tech) degrees.

There is a private-public partnership (PPP) for the delivery of education services; the government alone cannot afford a widely accessible, high-quality education and training system. In addition to the payment of salaries of teachers in government-owned schools, the government pays the salaries of teachers in private schools owned by missions and communities that are recognised by the government. However, the recruitment and administration of those private schools is in the hands of either the missions or the owners in the communities. Employment of teachers in Namibian secondary schools is not based on a teaching license, but rather, a teacher must hold a major/minor credit in a particular subject at BETD Diploma certificate level or at a higher degree level.

1.4.3 An overview of Teacher Professional Development and Administration of External Examinations

The National Institute for Educational Development (NIED) and the Directorate of National Examinations and Assessment of Namibia (DNEA), in conjunction with panels of subject experts on which the teachers are represented, are responsible for the development of syllabi, prescription of textbooks and provision of other resources (MoE, 2004).

The DNEA is responsible for the setting and administration of examinations both for JSC in Grade 10 and IGSC/ National Senior Certificate Examinations (NSCE) in Grade 12. Students are admitted to the senior secondary level conditional on their scoring a minimum of 23 points or better in their six best subjects in the JCE examination, including English Language. The grade symbols A, B, C, D, E, F, or G with their point scales are presented in Table 1.2. The MoE has decided to keep the minimum requirement at 23 points and the minimum requirement for English Language at grade F.

Table 1.2: Grading System of JSC Results

Symbol	Point	Percentage (%)
A	7	70 and better
B	6	60-69
C	5	50-59
D	4	40-49
E	3	35-39
F	2	30-34
G	1	20-29
U	Ungraded	Below 20

Source: Adapted from DNEA

The trend in JSC Mathematics results at both national and regional levels demonstrates a need for concern (see Table 1.3). The national percentages of students scoring a grade D or better in JSC Mathematics for the academic years 2000 to 2009 lie between 15.2% and 40.3%, and this poor performance of students in JSC Mathematics has been attributed to factors such as the professional isolation of Namibian teachers due to the isolation and size of Namibian Schools (Dittmar, Mendelssohn & Ward, 2002). Similarly, in 2005, the Southern Africa Consortium for Monitoring Educational quality (SACMEQ) Project 1 in Namibia observed that educational inputs such as teachers' characteristics (educational qualifications, teaching experience, professional development), school facilities and learners' socio-economic status were influencing students' academic achievement in the senior primary phase in Namibia. Also SACMEQ (2005) observed that learners in schools in regions where the conditions were judged to be more favourable achieved higher scores than those in regions where conditions were judged to be less favourable. In response to the findings of Dittmar et al. (2002) and SACMEQ (2005), my current study sought to determine the extent to which the observed teacher-related variables affect student academic achievement in JSC mathematics.

In Namibia, professional development for the Basic Education Teacher Diploma for In-service Teachers (BETD, INSET) level is managed by NIED, and for the past 15 years, NIED has been

upgrading the qualifications of BETD INSET. The University of Namibia (UNAM) is now running the BETD programme in addition to the formal Bachelor of Education degree (B. Ed) in science and arts subjects. The BETD INSET programme is designed for teachers who have the basic academic credentials of a Grade 12 education, but who have no formal teaching credentials. The BETD INSET is a four- year comprehensive in-service teacher-training programme that provides its participants with the basic pedagogical background needed to effectively serve as teachers in Namibia. In addition to the BETD programme, NIED provides standards-based professional training for secondary school teachers in Namibia.

The development of effective in-service teacher-training programmes and professional development within Namibia is challenging. A possible explanation is that this is due to the isolation and size of schools. Namibia is a large country, and has a small population of about 2 million people. Most of the people live in widely dispersed communities in rural areas, and the majority of schools are quite some distance from each other. Also, most Namibia schools are very small. Almost one-third (31%) of all schools have five or fewer teachers, and over half (54%) of all schools have ten or fewer teachers. Furthermore, only 5% of the schools have 30 or more teachers (Dittmar, Mendelsohn & Ward, 2002). The researcher observed that most teachers are professionally isolated, especially from people who teach the same subject to the same grades. Some examples of professional isolation were among the following findings of Dittmar et al. (2002):

There was only one Grade 1 teacher in 68% of schools that offered Grade 1, there was only one Grade 10 Mathematics teacher in 75% of schools that offered grade 10 Mathematics, and 83% of schools that offered Grade 7 Mathematics had only one Grade 7 Mathematics teacher. Of all the schools that offered Grade 8 Geography, 85% had only one Geography teacher for that grade. This implied that only 15% of schools had two or more teachers (p.3).

In addition to the findings of Dittmar et al. (2002), SACEMQ (2002) and the National Council on Higher Education (NCHE) (2007) observed that the BETD programme is very weak in terms of content knowledge and pedagogical content knowledge. In response to these observations, this study attempted to explore the disjuncture between teachers' mathematical content knowledge as

well as pedagogical content knowledge and other teacher-related variable on students' academic achievement in JSC Mathematics. In doing so, this study makes a new contribution to the general academic field and to the body of knowledge of working with teachers-related variables in relation to students' achievement under different socio-economic circumstances.

1.5 Statement of the Problem

Since 1960, questions concerning teacher quality and its impact on student achievement have increased among educational policymakers and researchers, and researchers have explored the relationship between teacher characteristics and behaviour, and students' achievement (Hill, Rowan & Ball, 2005). The measures of teacher characteristics have varied widely, as have results from these investigations.

The effect of teacher-related variables on students' academic achievement in general and Mathematics in particular, in various contexts is, of course, well known. There are several notable individual research studies on the subject: Monk (1994) and Rice (2003) maintain that teacher-related variables, and in particular subject-specific training, has a significant impact on students' achievement. Similarly, the results of the National Educational Longitudinal Study (NELS) conducted by Ehrenberg, Goldhaber & Brewer (1995) and Goldhaber & Brewer (1996) indicate that the academic degrees which Mathematics and Science teachers hold influence student test scores. Also, Darling-Hammond (2000) found that the major subject and subject-area certification of teachers played a role in state-level National Assessment of Education Progress (NAEP) Mathematics and Reading test scores.

This current study builds on the observations made by the above mentioned authors that students' academic achievement in Mathematics was influenced by a complex system of teacher-related variables (teacher qualifications, experience, mathematical content knowledge, a major in Mathematics in tertiary institutions, etc.) and that the impact of each of these teacher-related variables could not be fully understood in isolation but in relation to each other. Thus, the purpose of the current study was to determine the extent to which a linear combination of teacher inputs (such as educational qualifications, teaching experience, subject matter knowledge, gender), processes (use of standards-based classroom practices such as use of whole class

discussion, small-group discussion etc.), and professional development (standards-based professional development to enhance classroom instruction) could be correlated with students' achievement in JSC mathematics.

Researchers and policymakers have measured the influence of school characteristics, teacher characteristics, facilities, and student characteristics on students' academic achievement using production function. Production function includes a wide range of areas that encompass educational production studies. According to Greenwald, Hedges, & Laine (1996), production function is an important model which researchers and policymakers have used over the past decades to analyse the impact of educational resources on student academic achievement. Educational performance studies usually make an attempt to develop a model of the relationship between educational inputs and outcomes. According to Monk (1994), educational inputs include school characteristics, teacher-related variables, facilities and students' characteristics. Greenwald et al. (1996) define outcomes as achievement measured by standardised tests, future educational patterns, and adult learning. The standard production function model is always expressed as an equation, namely $Y = F(T,P,S)$ where Y represents the educational outcomes variable (dependent variable), T represents teachers' characteristics (independent variable), P represents school characteristics (independent variable), and S represents students' characteristics (independent variable). Since the purpose of the current study was to determine the impact of teacher-related variables on students' academic achievement, the researcher dropped P and S in the equation and adopted a Process-product model. A Process-product approach uses teachers' characteristics as the independent variable and students' academic achievement as the dependent variable.

In this approach, information about teacher preparation and experience was collected and used as a predictor of student achievement. Key measures here included a teacher's education level and certification status, the number of post-secondary subject matter courses and teaching methods courses taken by the teacher, and the teacher's years of experience in classrooms. The findings of Darling-Hammond (2000), Clotfelter, Ladd & Vigor (2006), Wenglinsky (2002) and other similar studies on the link between key measures such as teachers' educational level, teachers' certificate status or subject-matter and course content led to the establishment of a connection

between formal schooling and employment experience and the more proximate aspects of teachers' knowledge and performance that produce student outcomes.

On the link between instructional quality and practice and student academic achievement, Wang, Hartel & Walberg (1993/94) with the support of the Temple University Centre for Research in Human Development and Education and the Office of Educational Research and Improvement, US Department of Education, conducted an analysis of 50 years of research on the factors that influence student learning. They analysed the content of 179 handbook chapters, narrative reviews and 91 meta-analyses (research syntheses) and found that teachers' instructional quality and practices played a positive role in students' achievement. They maintain that "classroom climate and instructional learning had nearly as much impact on student learning as student aptitude" (Wang et al. 1993/1994). Furthermore, the authors observed that "effective classroom management increases student engagement, decreases disruptive behaviours, and makes good use of instructional time" (Wang et al. 1993/1994, p.76).

Also, Wiley & Yoon (1995) maintain that teachers' implementation of instruction requiring higher level skills contributed to students' scores in the California Learning Assessment System (CLAS). However, despite the findings on positive links between teachers' preparation programmes and teaching experience, some researchers have disputed the extent to which variables such as teacher preparation and experience in fact contribute to student achievement. For example, Rivkin, Hanushek & Kain (2002), and Hanushek, Kain, O' Brien, & Rivkin (2005) found that teacher experience matters only for the first few years of teaching. In 2002, the authors analysed data on approximately 3,000 schools representing a population of 600 000 students as part of a University of Texas, Dallas, school project. The authors used the hierarchical linear modelling and production function analysis methods to examine the impact of teacher-related variables such as experience and education on students' academic achievement using the Texas standardised state assessments, and found that teachers' experience was related to students' academic achievement. The researchers maintained that students of teachers in their first and second years of teaching tended to perform significantly lower than those of teachers with more experience in the classroom.

In addition, Hanushek et al. (2005) used teacher-related variables such as teachers' years of teaching, teachers' race and educational qualifications, and teachers' scores in certification examinations to determine the link between these variables and students' academic achievement in Mathematics using the Texas Assessment of Academic Skills (TAAS). The researchers found that experience matters only for the first year of teaching. Based on their findings, they postulated that "having a first year teacher on average is roughly equivalent to having a teacher a half standard deviation down in the quality distribution" (Hanushek, 2005,p18).

How long teachers' teaching experience continues to improve students' academic achievement is a point of debate among researchers. Murnane (1975) found that teacher effectiveness increased during the first three years, but levelled off after the fifth year. With regard to the effect of teachers' teaching experience beyond five years, Murnane & Phillips (1981) found that teachers' teaching experience had a significant positive effect on students' academic achievement at elementary school level during their first seven years of teaching. Ferguson (1991) found that at secondary school level, Texas students taught by teachers with more than nine years of experience had significantly higher test scores than students whose teachers had five to nine years of experience. These findings by Ferguson seem to suggest that the experience of teachers at high school level is very important for students' academic achievement in core school subjects.

In the light of the above findings and, in particular, Ferguson's findings at high school level, the current study sought to determine the extent to which the length of teachers' teaching experience can contribute to Namibian students' academic achievement in JSC Mathematics. In Namibia, the SACMEQ report of (2005) revealed that teachers' teaching experience was one of the few, if not the only, teacher-related variable that showed a significant influence on students academic achievement in grade six mathematics results. This teacher-related variable is thus further investigated in the current study in relation to other teacher-related variables affecting students' achievement at the JSC level.

Other studies have sought to measure teachers' knowledge more directly by looking at teachers' performance on certification examinations or other tests of subject matter competence. By using

findings from such measures, these studies implicitly assumed a relationship between teacher content knowledge as measured by such assessments and the kinds of teaching performances that produced improved student achievement. Studies using this approach typically found a positive effect of teacher knowledge, as measured by certification examinations or tests of subject matter competence, on student achievement.

Boyd, Lankford, Loeb, Rockoff & Wyckoff (2008) conducted a study on teachers' early-entry routes such as Teach for America (TFA) and the New York City Teaching Fellow (NCTF) in order to determine the effect of teacher qualifications on 4th and 5th grade students' performance in Mathematics. The researchers found that graduates of college preparation programmes were more effective than teachers lacking certification, and performed better than Teaching Fellows and TFA teachers.

Longitudinal studies conducted by Darling-Hammond (2009) and Boyd, Grossman, Lankford, Loeb & Wyckoff (2006) in Texas, New York and North Carolina indicated that students' achievement is most enhanced when teachers are fully certified, have completed a traditional teacher education programme, have strong academic backgrounds and have more than two years of experience. Similarly, teachers' scores on literacy or verbal ability tests correlate with both teachers' performance and students' outcomes.

Clotfelter, Ladd & Vigdor (2007) used data on state-wide end-of-course tests in North Carolina to examine the relationship between teacher credentials and student achievement at high school level. The researchers found that teachers' test scores were predictive of student achievement and that teachers' test score in Mathematics were particularly important for student achievement in algebra and geometry. Furthermore, the researchers maintain that teachers were found to be more effective if they had a standard license in the specific field taught, higher licensing examination scores, had graduated from a more competitive college and had completed National Board certification. Hanushek (1989) reviewed 187 separate studies in 38 published articles and books related to school resources and students' achievement, and found that teachers who performed well on verbal ability tests did better in their classrooms as measured through scores on tests. In support of Hanushek's findings, Greenwald, Hedges & Laine (1996) reviewed 29 of Hanushek's

studies, including other studies in journals and books that used production function techniques, and concluded that teachers' verbal ability had a significant impact on students' academic achievement.

Similarly, Ferguson (1991) analysed approximately 900 Texas districts schools with student populations of approximately 2.4 million and 150 000 teachers, and found that teachers' scores on Texas Examinations and their basic skills tests had a significant positive relationship with students' academic achievement. Also, Ferguson & Ladd's (1996) study of Alabama school districts found that there was a strong relationship between teacher scores on license tests and the National Teacher Examination, namely that teacher' re-certification examination scores and teachers' ability and recentness of education contributed to students' achievement in test scores.

Mullens, Murname, & Willett (1996) likewise found that teachers' Mathematics scores in their primary school exit examinations and high school completion examinations influenced students' gains in Mathematics tests developed by the Belize Ministry of Education to a greater extent than did teachers' completion of a pedagogy training programme. Rowan, Chiang & Miller (1997) found that teachers' subject-matter knowledge, expectation for students' outcomes, and placement in a collaborative school environment were associated with students' achievement in NELS Mathematics tests. Also, Strauss & Sawyer (1986) observed that the district average National Teacher Evaluation scores influenced students' rates of failure in state Reading and Mathematics competency examinations.

In contrast to the above findings, McColsky et.al (2005) found that teachers' National Board Certification did not predict students' gains in achievement tests. The goal of their study was to explore the influence of both National Board Certified Teachers (NBCT) and non- Board certified teachers on 5th grade academic achievement in North Carolina districts. The researchers could not establish any clear pattern of effects on student achievement based on whether the teacher was Board certified. Furthermore, at teacher level, using Teacher Achievement Indices (TAI), the researchers did not find any significant mean difference between 5th grade Board certified and non-Board certified teachers on the Mathematics or Reading TAIs.

While some of the studies above investigated the characteristics of teacher quality and distribution of teacher quality across schools and classrooms, previous studies tended to look at teacher characteristic variables (i.e. degree, certification, professional development, subject knowledge, etc.) separately. For example, these studies considered how many teachers had bachelor's degrees, or how many teachers had a major or minor in their subject area. Few studies attempted to combine teachers' characteristics in the process-product educational production function and teacher knowledge (content knowledge, pedagogical content knowledge (PCK) and curriculum knowledge) to estimate teachers' effects on students' achievements in Mathematics at secondary school level. In this study, I have added to the traditional approach of teacher quality by combining indicators of teacher' quality (e.g. degree, certification, subject knowledge, and classroom management) with teachers' effectiveness in the investigation of teacher-related variables on students' academic achievement and Mathematics results in Namibian junior secondary schools.

While numerous studies exist on the influence of specific teacher quality attributes on students' academic achievements, relatively few studies in the past twenty years have focused on exploring how teacher quality and teacher preparedness (professional development, curriculum knowledge, pedagogical knowledge and classroom management) affect students' academic achievement in secondary schools (Hill, Rowan & Ball, 2005). In an attempt to provide research evidence in this area, I explored in this study the relationship between teacher quality, teacher preparedness and students' academic achievement in Mathematics in the Junior Secondary School Certificate examinations.

The poor performance of students in Mathematics in secondary schools, as reflected by the JSC and IGCSE scores, is of particular concern as mathematics instruction during these years provides the foundation for success in algebra. Algebra is fundamental in all areas of mathematics, because it provides tools for representing and analysing quantitative relationships, for solving problems, and for stating and proving generalizations. Without proficiency in algebra, students will be unlikely to master other mathematical subjects. This leads, in turn, to poor preparation for entry to tertiary institutions, and closes off options for careers in mathematically related fields.

At the secondary school level, a number of studies (among others, studies reported by the Task Force of the Ministry of Basic Education, Sports and Culture (MBESC) (1996), Erwee (1997), Kasanda (1996) and the Namibian Human Resource Development (NHRDP) (2002)) have attributed the low percentage of passes in Mathematics not only to unsatisfactory syllabi, but also to inadequacies in teachers' qualifications, teaching experience, motivation, workload, professionalism and language proficiency, and to a general lack of teaching skills, as measured by inadequate knowledge of subject-matter and ineffective style of delivery of subject-matter. A further factor is inadequate funds for equipment and materials for fruitful practical work in Mathematics, especially in view of large class sizes.

In this regard, the Mathematics and Science Co-ordination Unit of the Directorate for Education Programme Implementation (2002) was asked to "conduct a thorough and incisive analysis of the factors contributing to poor performance of learners in Mathematics, and recommend what measures should be embarked upon to bring about the much needed improvement in this subject" (MBESC, 2002). This points to the fact that the causes of students' under-achievement are perhaps less obscure than their remedies. Also, the report of the Advisory Council on Teacher Education and Training (2007) on merging the four Colleges of Education in Namibia indicated that the BETD programmes lacked quality due to insufficiencies in management, qualifications and commitment of lecturers, student capacity resources and the design and content of the programme. The report concluded that this had resulted in poor quality teachers being produced by the colleges. Under these limiting factors, we cannot expect these BETD graduates to be effective in the teaching of Mathematics at JSC level.

While it may be true that high achievement in Mathematics is a function of a number of inter-related variables, the impact of the teacher variables, and in particular, teachers' qualifications, teaching experience, certification, motivation and grasp of the subject-matter content, can hardly be over-emphasized (Salau, 1995).

It is salutary to note that not only have these causes been identified, but educators have been actively engaged in seeking a clearer understanding of the issues involved, and in some cases,

have instituted viable remedies such as the Mathematics and Science Teacher Extension Programme (MASTEP)(1999), which was established to enhance teachers' content knowledge (CK) and pedagogical content knowledge (PCK), and yet the problem of the poor performance of learners in Mathematics in Namibian secondary schools seems to persist, as observed by the Directorate of National Examinations and Assessment (DNEA) (2000-2009) and the Namibia Human Capital and Knowledge Development for Economic Growth with Equity (2005). The trend in JSC Mathematics results at both national and regional levels demonstrates a need for concern (see Table 1.3).

Table 1.3: National Performance in JSC Results: 2000-2009

NATIONAL	Percentage (%) a grade D and better	Percentage Below D grade
2000	15.2	84.8
2001	21.6	78.4
2002	27.2	72.8
2003	26.7	73.3
2004	32.1	67.9
2005	36.8	63.2
2006	37.2	62.8
2007	36.8	63.2
2008	40.3	59.7
2009	39.7	60.3

Source: Adapted From DNEA

From Table1.3, it is evident that the trend in national performance between 2000 and 2009 is not linear.

The percentages of students who fell below the national requirements in Mathematics for 2000 - 2009, potentially preventing them from proceeding in studying sciences in the senior secondary phase, were: 84.8% ,78.4%, 72.8%,73.3%,67.9%, 63.2%; 62.8%; 63.2%; 59.2%; and 60.3%.

The Vision 2030 National Document has established a deadline of 2030 for the attainment of 100% enrolment in school. Failure to fulfil this mandate will result in school districts facing severe consequences, including replacement of some MoE officials at both Regional and Local Authority levels (Marope, 2005). Some Regional Education Councils (see Table 1.1) are successfully increasing the numbers of students who meet the national requirement of scoring a D symbol (40-49%) or C symbol (50-59%) etc. in the JSC examination, and are potential candidates for admission into senior secondary phase and university, yet the successful results of such regions are coinciding with an increase in the dropout rates in other regions of students who score below a grade D symbol and are thus prevented from pursuing science-based courses in the senior secondary phase.

Given the magnitude of this poor performance in Namibian secondary schools, it is imperative for specifically identified causal factors, and in particular the effects of teacher-related variables on students' achievement, to be examined empirically in the Namibian context. This, then, is the motivating factor for this study.

In an effort to determine which teacher-related variables affect school success, as measured by students' achievement in the JSC Mathematics examination, the following question is posed: To what extent did the following teacher characteristics (qualifications, field of specialisation, and years of experience, classroom practices, and professional development) affect students' academic performance with regard to JSC Mathematics results for 2006 to 2010.

An important limitation of this study is that it cannot account for many extraneous variables that may affect students' gains. For example extraneous variables include the amount of time a student studies and /or the inputs of a previous teacher. In order to address the inputs of previous teachers, this study examines the JSC results for 2006 to 2010. Teachers who taught the Mathematics course in Grade 10 for five consecutive years at the same school will constitute the target group for this study. This approach may help to address the question of the input of previous teachers.

The relationship between teacher-related variables and students' achievement in Mathematics in JSC Grade 10 Mathematics 2006 – 2010 can be modelled into an educational production function presented in Chapter 4.

1.6 Research Objectives

The overall objective of this study was to determine the extent to which teacher inputs (qualifications and characteristics) such as education level, field of specialisation, years of experience, and professional development received in support of classroom practices, and process (classroom practices, classroom management) affect students' results in the JSC Mathematics examinations for 2006 to 2010. More specifically, the study objectives were:

1. To explore the extent or type of teachers' inputs (educational qualification, field of specialisation, teaching experience, and teachers' mathematical content knowledge) on students' results in the JSC Mathematics examinations for 2006 to 2010.
2. To explore the link between teachers' reported classroom practices, participation in professional development and teachers' beliefs in standards-based classroom management on students' results in the JSC Mathematics examinations for 2006 to 2010.
3. To explore how various aspects of teacher quality inputs, classroom practices and management, and professional development) influence one another and how these myriad influences impact students' results in the JSC Mathematics examinations for 2006 to 2010.

1.7 Research Questions

In this study, the researcher examined variables that may be correlated to JSC Mathematics scores for 2006 – 2010. Questions addressed in this study include the following:

1. To what extent does type of teacher input (paper qualification, teaching experience, subject specialisation, perceived mathematical content knowledge) affect students' results in the JSC Mathematics examinations for 2006 to 2010?
2. How are teacher-reported classroom practices (standard-based classroom practices), teachers' perceived pedagogical knowledge and teachers' beliefs in standard-based

classroom management and teachers' participation in professional development associated with students' results in the JSC Mathematics examinations at JSC level for 2006 to 2010?

3. What combination of the six variables (teacher experience, teacher level of education, teacher professional development, teacher classroom practices, teacher subject specialization and teachers' mathematical content knowledge) predict achievement for students as measured by students' JSC Mathematics scores?

1.8 Hypotheses

To address the research questions, the following null hypotheses will be tested at the 0.05 level:

1. There is no significant correlation between teachers' experience and the achievement of students as measured by JSC Mathematics scores.
2. There is no statistically significant correlation between teachers' level of education and the achievement of students as measured by JSC Mathematics scores.
3. There is no statistically significant correlation between teachers' classroom practices and the achievement of students as measured by the JSC Mathematics scores.
4. There is no statistically significant correlation level between teachers' subject specialisation and the achievement of students as measured by the JSC Mathematics scores.
5. There is no statistically significant relationship between a linear combination of the five predictor variables of teachers' experience, teachers' level of education, teachers' professional development, teacher s' classroom practices and teachers' subject specialization and the achievement for students as measured by the JSC Mathematics scores.

1.9 Significance of the Study

The teachers' related variables have been identified as factors that are linked to students 'academic achievement in mathematics at secondary school level(see Rice 2003, Darling-Hammond 2000; and Wenglisky 2002).This study adds to the field of research on the relationship between teachers' attributes and students' Mathematics achievement. This study of

the impact of teacher quality, including professional development, pedagogical content knowledge, and knowledge of curriculum, on students' achievement in Mathematics is unique for several reasons. First of all, this study is timely in light of recent concern about teacher quality and its influence on students' academic achievement in Namibian secondary schools. Many of these concerns draw attention to such issues as the professional training teachers receive and the qualifications of teachers who teach a specific subject (Mathematics in particular), since teacher certification, pedagogical content knowledge and subject knowledge have been identified as important elements of teacher effectiveness and student achievement (MoE, 2005). By analysing the natural data set, this study provides a national picture of the current status of teachers' professional development, pedagogical content knowledge and qualifications in their main teaching assignment field as well as in each subject field they teach. The results of this study can also help keep track of trends in teacher preparation. For example, researchers and policymakers can compare the findings of this study with previous studies and subsequent studies regarding teachers' professional development, pedagogical content knowledge, content knowledge and qualifications, and policymakers can use the findings of this study to monitor or regulate future teacher preparation programmes.

Secondly, the study departs from the more traditional teacher quality research that focused on describing each indicator of teacher quality separately. By combining indicators of teachers' qualifications, their majors in the subjects taught, professional development, pedagogical skills, curriculum knowledge etc. and their influence on students' Mathematics achievement, this study is not only able to contribute to the existing knowledge of teacher quality, but it also provides a new dimension to the understanding of teacher quality problems and more importantly, to the understanding of the qualities of effective teachers.

Stronge (2002) proposes the qualities of effective teachers as being teacher preparation, classroom management and the way a teacher plans, teaches and monitors student progress. These indicators of the effect of teacher quality on students' academic achievement are challenges that many policymakers and educators are currently confronted with. To date, few studies have empirically probed the effects of teachers' attributes such as qualifications, content

knowledge, pedagogical content knowledge, curriculum knowledge, classroom management, etc. on students' achievement in secondary school Mathematics.

Thirdly, this study will help policymakers and researchers to understand the connection between the content knowledge and pedagogical content knowledge of Mathematics and how professional development can influence growth in both of these types of knowledge. In addition, this study will shed light on the influence of professional development, pedagogical content knowledge and content knowledge of Mathematics on students' Mathematics results in the Junior Secondary School examination.

The consequences of poor academic achievement must be avoided as the effects are debilitating and harm not only the student but the surrounding society and economy (Darling-Hammond, 1991). Standardized tests such as the Namibian JSC examination were developed to assess student academic achievement levels in terms of specific subject areas and educational goals. Achievement can continue to be increased by using student performance data to inform instruction through identifying student strengths and weakness, and through developing educational goals and remediation activities (Birkmire, 1993; Darling-Hammond, 1991). However, this study does not investigate students' strengths and weaknesses, but rather teachers' characteristics (or strengths and weaknesses) that are associated with particular student outcomes.

A teacher's ability to use assessment data for the purpose of evaluating his/her teaching is primary to effective, productive instruction (Stiggins, 1994). Only through effective, informed instruction and curriculum development can student achievement continue to improve in Namibian secondary schools. Finally, the overarching goal of teaching teachers how to use data to inform instruction is primary, since the literature suggests that teachers are challenged with assessing students effectively (Connell, 1990; Stiggins, 1994; Thomas, 1998).

1.10 Assumptions

1. The respondents possess the knowledge, ability and desire to answer the questions accurately.
2. The teachers' responses to issues about their academic qualifications, subject specialisations, years of teaching experience, and teaching experience at JSC level will be honest.
2. The subjects are all secondary school Mathematics teachers of Grade 8 to Grade 10.

1.11 Structure of the Dissertation

The dissertation is organized into five chapters, each chapter reflecting one essential component of the inquiry.

Chapter 1 is an introduction to the problem under investigation. The context and aims of the study are described. This chapter also provides specifications for the research questions and hypotheses, the significance of the study, and the theoretical and conceptual framework which includes classroom level factors, school-level factors and teachers' level of subject matter knowledge. Furthermore, the limitations and assumptions of the study are discussed, a brief definition of the research is provided, and the structure of the dissertation is delineated.

Chapter 2 presents a review of the literature relating to the impact of teacher characteristics on students' academic achievement in Mathematics.

Chapter 3 explains the methods employed to select the sample, outlines the design adopted for the research, and discusses the tools used to collect the quantitative and qualitative data. This chapter also provides a rationale for the selection of the statistical methods employed to analyse the data.

Chapter 4 presents the findings of the study. The first section of the chapter presents results regarding the demographic characteristics of the schools and teachers, while the second section

of the chapter presents the findings regarding the research questions and hypotheses. Descriptive and inferential statistics were used to analyse the research questions and hypotheses.

Chapter 5 discusses the results of the study in terms of the theoretical models, and considers the appropriateness of the theoretical models and specific aspects of the research findings. Also, this chapter provides a summary of the findings and a conclusion as a synthesis of the entire study. The chapter concludes by exploring wider implications for secondary school Mathematics education and suggesting avenues for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Chapter 1 presented an introduction to the proposed study, including background information concerning the poor performance of students in the JSC Mathematics examination. It also discussed the purpose of the study as well as the research questions, hypotheses and significance of study, and definitions of key terms were provided.

2.1.1 Theoretical Framework

Chapter 2 covers the theoretical framework of the relevant literature. The purpose of this study was to determine the effects of teacher-related variables, based on inputs, processes and outcomes, on students' academic achievement in the JSC Mathematics examination in Namibian secondary schools. The literature review was organised into two segments. In the first segment, the researcher examined the literature on models of educational performance with special focus on In-put-Process-Output Models (IPO) by Goe, Bell & Little (2008), Oaks (1986), and Shavelson, McDonnell & Oaks (1987). These models served as a framework, a guide, and a checklist for the selection of teacher-related variable to be used in this study. In the second segment, the researcher reviewed the literature about teacher-related variables that have been evidenced through empirical studies that correlate with student academic achievement in Mathematics at secondary school level. The review took into consideration the findings of the National Council of Higher Education (2007), the Namibia Human Resource Development Programme (2002), and Dittmar et al. 2002) regarding the weakness of the BETD teacher training programme and professional isolation of JSC Mathematics teachers as discussed in chapter one.

2.1.2 Modelling Educational achievement

Hartel, Walberg & Weinstein (1983) maintain that there are numerous models of educational performance. The authors conducted a meta-analysis of studies (Oaks, 1986; Kaplan & Elliot 1997; Kaplan & Kreisman, 2000) that modelled the link between school resources and student

academic achievement at secondary school level, and found that the models had a common structure. The authors argue that though the models differed in their specifications, their structure consisted of three categories, namely, pre-existing conditions (cognitive/affective attributes and resources), processes (opportunity to learn, quality of teaching), and outcome measures (students' achievement etc.). Furthermore, Hartel et al. (1983) maintain that these models present students academic achievement (outcome) as a function of school resources (teachers, students, and/or school environment etc.).

The models of educational performance of interest to my current study are those that modelled students' academic achievement as a function of teacher-related variables. The model that I adopted to select the teacher-related variables was informed by Shavelson, McDonnell & Oaks, (1987) and Goe, Ball & Little (2008). The Input-Process-Output (Outcome) models of Oaks (1986) and Goe, Ball & Little (2008) or Rand Model (Shavelson, McDonnell & Oaks, 1987) have similar structural components as discussed by Hartel et al. in 1983. Furthermore, my current study adopted this model as a conceptual framework because of its scope of coverage of teacher-related variables. Additionally, this model has been used extensively to guide education researchers in the selection and analysis of teacher-related variables that correlate with students academic achievement (see Rockoff, 2003; Wenglisky 2002; Howie 2002).

2.1.3 Input-Process-Output Model/ Rand Model by Shavelson, McDonnell and Oaks (1987)

This section presents a brief discussion of the IPO or Rand model by Shavelson, McDonnell & Oaks. The Rand Model consist of three components, namely, inputs (fiscal and other resources, teacher variables, student background), processes (curriculum quality, teaching quality), and outputs (students' academic achievement, attitudes/ aspiration, participation, dropouts) (Shavelson, McDonnell & Oaks, 1987). From the literature study, it is evident that the choice of variables in the IPO model is linked to the objectives of the study. Kaplan & Elliot (1997) adopted the Rand model for their framework to propose a model-based approach for validating educational indicators that explicitly took into account the organisational features of schooling and found that it was not necessary for every variable in the IPO model to be included in their

model. The authors contend that the research questions/ hypotheses and the goals of the study should guide which variables to include in a statistical model.

Furthermore, Kaplan & Kreisman (2000) adopted the Oaks et al. Model to validate the variables of mathematics education using the International Mathematics and Science Study (TIMSS) data. Kaplan et al. Rather than grouping their variables into the three distinct categories of Input-Process-Output as outlined by the Rand model, they contend that the model of Oaks et al. was intrinsically multilevel, a subset of the inputs and processes that occurred at higher levels of the educational system. Consequently, they grouped their variables into three organisational stages: teacher, school and student. Kaplan et al. argue that although the Rand Model grouped school resources, teachers' variables and students' background variables as one category of input variables, these variables occur at different hierarchical levels of the school organisation. The variables in models proposed by Kaplan et al. were classified into three categories as: teacher variables (classroom practices, educational qualification, teachers' teaching experience), school level variables (professional development, school climate, school facilities, school discipline) and student level variables (mathematics achievement, parents' educational background and students' attitude towards mathematics (Kaplan & Kreisman, 2000).

The findings of Kaplan et al. (2000) seem to suggest that the IPO model of Oaks et al. (1987) is rather a conceptual framework than a prescript model. This implies that the model does not prescribe what variables a researcher should include in the IPO model for testing educational outcomes, but rather proffers guidance as to which components researchers should select as their variables.

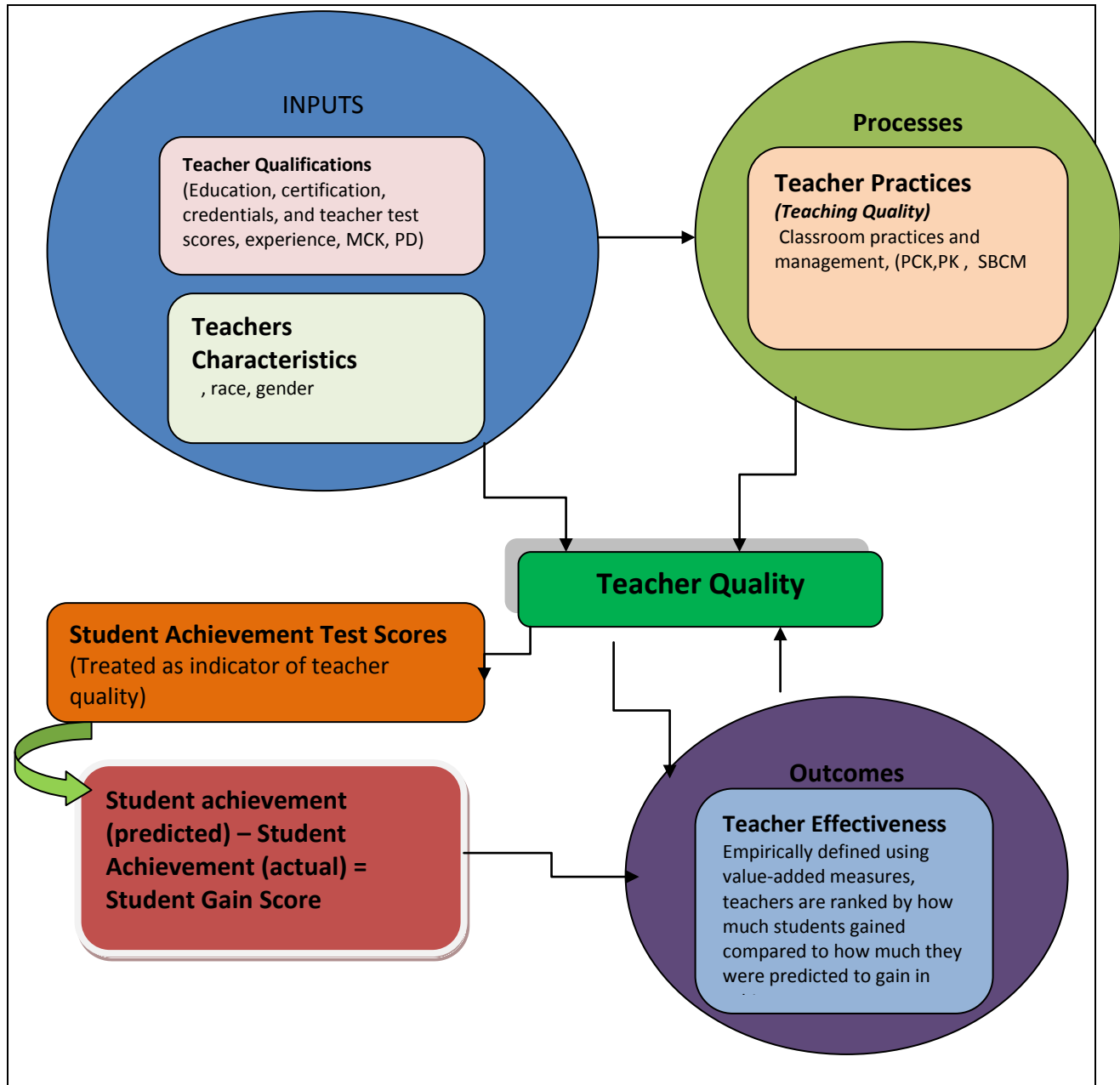
2.1.4 Conceptual Framework for the Study

In order to understand the multiple influences of teacher-related variables on students' academic achievement in JSC Mathematics, I adopted the Input-Process- Output (outcome) model as a conceptual framework to guide my variable selection. The IPO model adopted in this study guided my choice of the contextual factors within different levels of teacher-related variables that correlated with students' academic achievement in JSC Mathematics. Instead of selecting all the variables in the IPO model, in my analysis, I selected only those teacher-related variables

that were found in the reports of NCHE (2007), NHRDP (2002) and Dittmar et al. (2002) that seem to have influenced students' academic achievement in JSC examination outcomes in Namibia as discussed in Chapter One. The variables identified by these authors include, among others, the following: teachers' mathematical content knowledge, (MCK) pedagogical content knowledge (PCK), subject specialisation, teaching experience, professional development and classroom management skills. A graphical representation of the model is presented in Figure 2.1.

Figure 2. 1 provides a graphical representation of four distinct but related ways of looking at how teacher-related variables impact on students' academic achievement in Mathematics in secondary schools.

Figure 2.1: Graphic representation of a framework for literature reviews



Note: Adapted from Goe, Ball, & Little (2008).

The conceptual framework for this study must provide a clear, coherent and comprehensive account of the key teacher-related variables that influence the nature of secondary school Mathematics courses and predict student learning outcomes in Mathematics in secondary schools. The previous sections presented the context in which the study was conducted. This section presents the concepts and theories that guide the study. Specifically, the three purposes

of the conceptual framework are to assist in the selection and development of appropriate methods of investigation, facilitate links with the relevant literature, and provide a structure for the analysis, reporting and discussion of the findings of the investigation.

The framework for this literature review consists of three categories, with four distinct but related ways of looking at teacher quality and effectiveness. The three categories are presented below as follows: Inputs (teacher qualification, teacher characteristics), processes (teacher classroom practices & management), and outcomes (student academic achievement).

These three categories further encompass the following sub-categories: teacher's educational qualifications; teacher's years of experience; teacher's subject specialization; teacher's mastery of subject matter; teacher's degree levels; teacher's training programmes; teacher's professional development; and teacher's classroom practices.

In this section, a description of the definitions of teacher-related variables is presented, followed by how teachers' inputs, processes and outcomes are related. Furthermore, this chapter discusses the conceptual framework that guided the literature review. Finally, the chapter reviews the empirical evidence on the impact of teacher-related variables on students' academic achievement. The empirical review is presented in two categories: literature on teacher variables affecting students' academic achievement in other parts of the world, followed by literature on teacher variables affecting students' academic achievement in Namibia and other African countries.

The chapter concludes with a summary of the main findings on the effects of teacher-related variables on students' academic achievement in Mathematics.

2.2 Definition of Teacher Variables

Although there are many different dimensions of teacher quality, this section focuses on four main aspects that have been examined by researchers in recent years. These four aspects include the following: qualifications, characteristics, teachers' practices and teachers' effectiveness based on student academic achievement in secondary schools.

Qualifications

A discussion of teacher qualifications includes such issues as what subject the teacher majored in, whether the teacher has a Bachelor's degree or a Master's degree, whether the teacher has passed the required licensure tests, and so forth (Kennedy, 2004). Kennedy further defines qualifications as those qualities that teachers have even before they are employed as teachers and that are often assumed to contribute to the quality of their teaching. These qualities, which she calls 'teachers' personal resources', include the following: knowledge, skills and expertise, beliefs, attitudes and values, credentials and personal traits. Goe (2007) defines qualifications as resources which teachers bring with them to the classroom and which are considered important in establishing who should be allowed to teach. These resources include teachers' coursework, grades, subject-matter education, degrees, test scores, experience, certification and credentials, as well as evidence of participation in continued learning such as internships, induction, and professional development.

Teacher Characteristics

These include attitudes and attributes that teachers bring with them when they enter the classroom, assigned characteristics such as race, ethnicity, and gender, and characteristics that are potentially changeable, such as the ability to communicate in a second or third language (Goe & Stickler, 2008). In addition, Kennedy (2004) discusses teacher characteristics such as orientation, which refers to how teachers understand and think about their work. It includes their beliefs and values, their goals and their interpretation of classroom events as they unfold. This aspect of teacher quality is the least visible of the four, but is frequently assumed to be an important contributor to both classroom practice and effectiveness (Kennedy, 2004).

Teacher Practices

Goe (2007) defines teacher practices as including practices both in and out of the classroom, planning, instructional delivery, classroom management, and interactions with students. Similarly, Kennedy (2008, pp.59-63) defines teacher practices and performance as encompassing "teachers' day-to-day work", so that performance of teachers includes practices that occur outside the classroom (for example, interacting with colleagues and parents, planning a curriculum that engages students etc.), practices within the classroom (for instance, being

efficient, providing clear goals and standards, keeping students on task), and learning activities provided for students (for instance, providing students with rote memorisation tasks, tasks that require complex problem solving and reasoning, or tasks that draw on superficial understanding of the content versus tasks that require deeper knowledge).

Teacher Effectiveness

Teacher effectiveness refers to teachers' contributions to students' learning as measured by standardised achievement tests. Usually, gains in student test scores that can be attributed to teachers are assumed to provide evidence of effectiveness. Kennedy (2008, pp. 59-63) describes "effectiveness" as including how good teachers are at raising students' scores on achievement tests. She maintains that effectiveness is not a unitary concept and can mean many things, including fostering student learning (for instance, raising scores on standard achievement tests or state competency tests), motivating students (for instance, increasing the level of effort they invest in school work or in broader academic results), and personal responsibility and social concern (for instance, promoting civil discussions within and outside the classroom or increasing student participation in community development and interest in public policy).

The sections below will review empirical evidence of the impact of teacher- related variables on students' academic achievement in Mathematics.

2.3 Teacher Qualifications

This section will discuss the link between students' academic gains in Mathematics and teachers' attributes such as: coursework and degrees, subject matter knowledge, pedagogical knowledge, teaching experience, certification, and academic proficiency.

2.3.1 Teacher's Degree Level

Research suggests that the prestige of the institution which teachers attend has a positive effect on student academic achievement, particularly at the secondary level. This may be a reflection of the cognitive ability of the teacher. Similarly, evidence suggests that those teachers who have earned advanced degrees have a positive impact on secondary school Mathematics and Science examination results when the degrees earned were in these subjects (Goe, 2008).

However, the research on the value of a teacher's advanced degree has produced mixed results; some studies show that while additional teacher education has a positive correlation with student achievement in some cases, others found that it negatively affects achievement (Greenwald, Hedges, & Laine 1996; Hanushek, 1986). Goldhaber & Brewer (1997) found that a teacher's advanced degree is not generally associated with increased student learning in Grade 8 to Grade 10, but for Mathematics and Science teachers, having an advanced degree does appear to influence students' achievement. The same was not found to be true for teachers of English or History (Goldhaber & Brewer, 1997).

Goldhaber & Brewer (1997) suggest that the findings of other studies regarding the impact on student achievement of teachers' advanced degrees are inconclusive because they considered only the level of the degree and not the subject of the degree. They argue that the subject of the degree may affect student achievement in ways different from the effects of degree level. However, results from all the studies seem to imply that there is no positive correlation between the subject of the degree and student achievement.

2.3.2 Subject matter knowledge and pedagogical knowledge

Research suggests that teachers' course work in both the subject area and pedagogy contributes to positive educational outcomes. Also, pedagogical coursework seems to contribute to teacher effectiveness at all grade levels, particularly when combined with content knowledge (Goe, 2008).

Subject matter knowledge and pedagogical knowledge have been measured according to various indicators: subject major, number of courses taken at undergraduate level and National Teachers Examination (NTE) scores. A brief discussion of each section is presented below.

2.3.2.1 Subject Matter Knowledge/Course Work

Because content knowledge is not clearly defined or measurable in all content areas, studies often rely on an individual's undergraduate coursework as an indicator of content preparation. Coursework, however, varies across institutions, as does an individual's mastery of content. Whereas Goldhaber & Brewer (1997) found that students who had teachers with advanced subject-related degrees in Mathematics and Science performed better than students of teachers without subject training, Monk & King-Rice (1994) found that even in subjects where subject-specific training may make a difference (e.g. Mathematics), its impact depends on the type of classes taught (primary or secondary). The number of college Mathematics courses taken by a teacher at university or college had an impact on high school students' Mathematics achievement, but additional teacher coursework beyond that only mattered if the teacher was teaching an advanced course. Goldhaber & Brewer (1997; 2000) using data from the National Education Longitudinal Study (NELS) (1988, p.88), examined the impact of subject major or degree on student achievement in the 10th and 12th grades and found that those students who were taught Mathematics by teachers with an undergraduate or graduate Mathematics major made greater achievement gains than those who were taught Mathematics by teachers with a non-Mathematics major or degree (see also Rowan, Chiang & Miller, 1997).

The relationship between student achievement and the number of subject matter courses teachers have taken was established by empirical studies in secondary school Mathematics (Monk & King, 1994) and secondary school Science (Druva & Anderson, 1983) but not in elementary Mathematics (Eberts & Stone, 1984). The studies that examined the impacts of both subject matter courses and pedagogy courses, however, showed that pedagogy course work had a larger impact on teaching performance (Ferguson & Womack, 1993) and student achievement in high school Mathematics and Science (Monk, 1994) than did subject matter coursework.

2.3.2.2 Pedagogical Content Knowledge

Knowledge of mathematics and knowledge of mathematical representations are related to content knowledge, while knowledge of students and knowledge of teaching are related to pedagogical content knowledge (PCK). Shulman (1995) defines content knowledge (CK) as the

knowledge about the subject, for example, mathematics and its structures. According to Shulman (1995, p.130), PCK includes:

The ways of representing and formulating the subject that make it comprehensible to others... an understanding of what makes the learning of specific topics easy or difficult; the conceptions and preconceptions that students of different ages and background bring with them to learning of those most frequently taught topics and lessons.

Shulman (1986) maintains that mathematical CK and PCK are integrated parts of effective Mathematics instruction. In order to construct mathematical concepts in students' minds, PK as well as mathematical CK is needed. The manner in which teachers relate their subject matter (what they know about what they teach) to their PK (what they know about teaching), and how subject matter knowledge is a part of the process of pedagogical reasoning, are seen as integrants of PCK (Cochran, DeRuiter & King, 1993).

Research demonstrates that the following pedagogical principles affect students' academic achievement:

Building on students' prior knowledge: The research literature makes a case for teachers needing a strong understanding of students' CK and skills in order to plan and deliver effectively (National Research Council, 1999).

Linking goals, assessment and instruction: Research evidence reveals that good teachers base their instruction on specific and ambitious learning goals, frequently use assessments to monitor students' progress towards those goals, and continually adjust their instruction based on what they learn from the assessments (Danielson, 2007).

Teaching content and critical thinking: Content knowledge and critical thinking skills are central to academic success, and research literature suggests that effective teachers focus on both (Resnick, 1999).

Developing Language skills: Competency in oral and written language is central to students' academic success. Therefore, a key aspect of any teacher's job is to develop students' language skills, regardless of students' ages or the specific subject matter being taught (Tharp, et.al. 2000).

Creating a culture of learning: Effective teachers create a classroom culture that promotes learning. Here students and teachers are engaged in meaningful work together (e.g., students are applying ideas and concepts to tasks relevant to instruction). Of critical importance is the community that is established among students (Brown & Campione, 1994; Danielson, 2007).

2.3.3 Teacher experience

Several studies have found a positive effect of experience on teacher effectiveness; the learning by doing effect, specifically, is most obvious in the early years of teaching (Rice, 2003). If teacher learning accumulates with longer years of teaching practice, experienced teachers should be more effective than novice teachers in improving student achievement. Many empirical studies have indeed shown a significant and positive relationship between teachers' number of years of experience and student achievement (see reviews by Greenwald, Hedges & Laine, 1996; Rice 2003). However, the relationship is not linear. Teachers' effectiveness in improving student achievement appeared to increase most in the first three years of teaching, but no major improvement in their effectiveness was observed after three years of teaching experience (Boyd, Grossman, Lankford, Loeb, & Kain, 2005). Murnane (1995) suggests that the typical learning curve of students peaks in a teacher's first few years (estimated at year two for Reading and year three for Mathematics). It is plausible that a positive finding regarding experience actually results from the tendency of more senior teachers to select high-level classes with higher achieving students (Hanushek, 1986). Thus we might reasonably infer that the magnitude of the experience effect, should it exist, is not terribly large.

2.3.4 Teacher Certification

Teacher certification is relevant in the United State of America (USA) because one cannot teach if you are not certified by the state where you are teaching. However, this teacher certificate

license is not relevant to Namibia or Southern Africa. Teachers' licensing and certification standards policy nonetheless support the notion that subject knowledge is important.

Research has demonstrated positive effects of certified teachers on secondary school Mathematics results when the certification is in Mathematics. Also, studies have shown little clear impact of emergency or alternative-route certification on student's performance in Mathematics as compared to teachers who acquired standard certification (Rice, 2003). Studies have found that students taught by teachers holding subject-specific certification achieve better.

Based on a paired-comparison design of 36 secondary teachers and 826 students, Hawk, Coble & Swanson (1985) found that students taught by teachers certified in mathematics scored higher in both general mathematics and algebra than did students taught by teachers certified in other subjects. Similarly, Boyd, Grossman, Lankford, Loeb & Wyckoff (2006) and Darling-Hammond (2009) found that student achievement is most enhanced when teachers are fully certified, and have completed a teacher education programme. Goldhaber & Brewer (1997, 2000) analysed a nationally representative group of secondary school Mathematics teachers in the NELS study (1988, p.88) data set and found that students had higher achievement gains when their teachers were certified than those whose teachers had no certification or certification in other subjects. Darling-Hammond (2000) conducted a state-level analysis using the National Assessment of Education Progress (NAEP) data set and found that the percentage of teachers with full certification and the percentage of teachers with a subject major predicted higher state-level student achievement in both Mathematics and Reading.

Contrary to the findings of these studies, Rowan, Correnti & Miller (2002) found that subject-specific certification had no significant impact on elementary school students' achievement growth in Mathematics or Reading, based on an analysis of survey data from the congressionally mandated study of Educational Growth and Opportunity, 1991 – 1994. These empirical studies seem to suggest that teacher certification plays a role in secondary school but not in elementary school (see Rice, 2003, for the same conclusion).

2.3.5 Teacher's Academic Proficiency

Researchers have also considered the relationship between student outcomes and teachers' general academic proficiency. Measures such as performance on tests of verbal ability, teacher licensure, or college entrance examinations, and the selectivity of the undergraduate institutions attended by teachers, are used as reflections of intelligence and motivation. The research predicting student achievement that includes measures of teacher academic proficiency is not plentiful, but it consistently shows a positive relationship between the two (e.g. Strauss & Vogt, 2001). However, the studies were conducted at the school or school district level as opposed to teacher or student level, thus casting some doubt on their results (Goldhaber, 2003).

Measurement issues and issues of causality leave unanswered the question of whether higher-scoring teachers lead to higher-scoring students, or whether affluent districts, which tend to have higher achieving students, hire teachers with higher scores.

A few studies conducted at the individual student level found that teachers who attended more selective undergraduate colleges are more effective (Ehrenberg & Brewer, 1994; Summers & Wolf, 1975).

Greenwald, Hedges & Laine (1996) found a total of only nine studies that analysed the effect of teachers' academic proficiency on student achievement, but positive relationships were found in the overwhelming majority of these studies.

2.4 Teacher Characteristics

This section focuses on characteristics such as attitudes, race and gender, and ability to communicate in a second or third language.

2.4.1 Attitudes

In general, definitions of attitudes include the idea that attitudes manifest themselves in responses to objects, tasks or situations. The word 'attitude' is defined within the framework of social psychology as subjective or mental preparation for action. It includes outward and visible

postures and human beliefs. Similarly, 'attitudes' means the individual's prevailing tendency to respond favourably or unfavourably to an objective (Morris & Maitso, 2005).

Similarly, Leder (1992) observes that attitudes are learnt, and predispose one towards action which may be either favourable or unfavourable with respect to a given object. These definitions imply that attitudes comprise an emotional reaction to an object, behaviour towards an object and belief about the object (Rajecki, 1982). Formation of attitudes towards an academic subject is thought to develop through the automatisation of repeated emotional reaction to the subject and the transference of an existing attitude to a new but related task (McLeod, 1992). Furthermore, formation of academic attitudes has been identified as a complex process involving socialisation, relationships with teachers, teacher attitudes and aspects of the subject matter itself (Taylor, 1992).

In exploring the attitudes of teachers towards Mathematics, it is crucial to consider not only their attitudes towards the subject itself, but also their attitudes towards the teaching of Mathematics. Although the research evidence on the influence of teacher's attitudes toward student gains is mixed, it has been established that positive teacher attitudes contribute to the formation of positive attitudes on the part of students (Sullivan, 1989; Relich, Way & Martin, 1994). Similarly, some studies have shown that instructional strategies used in classrooms to teach a subject are influenced by teacher attitudes and beliefs (Carpenter & Lubinski, 1990; Williams, 1988).

2.4.2 Teacher Race and Gender

Research on the influence of teacher gender on student academic gains is inconclusive. Ehrenberg, Goldherber & Brewer (1995) found that there is little evidence of an association between teachers' race, gender and ethnicity and student academic achievement. Nonetheless, these authors found that students were evaluated differently based on teacher gender. They observed that in Mathematics and Science, white female teachers evaluated female students more favourably than did white male teachers.

In contrast to the little evidence of the link between gender and student academic achievement found by Ehrenberg, Goldherber & Brewer (1995), Ismail & Awang (2009) found that in Malaysia, students with female teachers achieved significantly higher scores in Mathematics than those with male teachers.

2.5 Process (Teachers' Practices)

This section will focus on teaching quality with reference to teachers' classroom management, teaching strategies, interaction with students and professional development. The focus is to determine the extent to which teachers classroom practices and professional development are aligned with recommended practices known to be effective in students' learning outcomes.

2.5.1 Classroom practices

The term 'classroom practices' refers to instructional methods or techniques that teachers use to accomplish their classroom learning/teaching objectives. These instructional methods or techniques specify ways of presenting instructional materials or conducting instructional activities. Teachers' teaching practices shape the classroom learning environment. The prime aim of teaching is to promote students' learning/achievement. Findings from research studies have shown that teaching practices are a critical factor in promoting students' achievement in Mathematics (Peterson, 1998; Stigler & Hiebert, 1999; Wenglinsky, 2002).

Wenglinsky (2002) observes that teaching practices are important elements of students' learning and environment. He argues that regardless of the level of preparation students bring into the classroom (e.g. students' socio-economic status), teachers' teaching practices can either greatly facilitate student learning or serve as an obstacle to learning/teaching. Wenglinsky furthermore identifies three constructs that relate positively to students' achievement, namely, teachers' usage of standards-based classroom instruction such as hand-on learning practices, higher order problem-solving approaches, and authentic assessment (such as portfolios as opposed to traditional tests).

Wenglinsky maintains that classroom practices are the most important variable affecting students' outcomes, since this is where teachers and students interact. Most researchers have also

stressed that teaching practices play an important role in students' cognitive development. Entwistle & Entwistle (2003) maintain that students' learning outcomes and classroom environment are closely linked, while Bransford, Brown & Cocking (1999) observe that there are ways students are taught a subject such as Mathematics that make it possible for the majority of students to develop a deep understanding of important subject matter.

Similarly, Grouws & Cebulla's (2000) study on improving students' achievement in Mathematics in high schools in the USA found that certain teaching practices such as whole class teaching, whole class discussions and cooperative group work are worth careful consideration as teachers strive to improve their mathematics teaching practices. According to Bransford, Brown & Cocking (1999), cognitive research has uncovered important principles for structuring teaching and learning that enable students to be successful. Empirical evidence on the design and evaluation of learning environments among cognitive and developmental psychologists and educators is yielding new knowledge about the nature of learning and teaching as it takes place in a variety of settings. Also, emerging technologies are leading to the development of many new opportunities to guide and enhance learning that could not be imagined even a few years ago.

The impact of new knowledge about teaching and learning on classroom instructional practices is a shift from a teacher-centred to a learner-centred approach to teaching. Mathematics teachers are expected to challenge, motivate and fill in gaps in students' educational backgrounds by disseminating information in a way that encourages students to think mathematically. For example, Zemelman, Daniels, & Hyde (1998) maintain that the goal of teaching Mathematics is to help students to develop mathematical power that enables them to feel that mathematics is personally useful and meaningful, and to feel confident that they are able to understand and use mathematics. The Namibian JSC Mathematics curriculum is in agreement with this goal of Mathematics teaching. It stipulates a learner-centred teaching approach that emphasizes understanding and application of mathematical concepts as opposed to rote memorization and application of formula. The curriculum also suggests that there should be more hands-on-activities for students (MoE, 2004).

The teaching and learning of mathematics are complex tasks. The effects on students' achievement of changing a single teaching practice may be difficult to determine because of competing effects of other teaching activities that surround it, and the context in which the teaching takes place. Nonetheless, research studies conducted by Hafiner (1993) and Grouws & Cebulla (2000) found that teaching practices that generate a high degree of opportunity to learn are related to high student achievement in Mathematics. Opportunity to learn (OTL) refers to equitable conditions or circumstances within a classroom that promote learning for all students. It includes the provision of adequate instructional experience that enables students to achieve high standards (Grouws & Cebulla, 2000). According to Grouws & Cebulla (2000), teaching practices that appear to be related to students' increased opportunity to learn include the following: opportunity to learn; small-group learning; whole-class discussion; use of homework; use of group work etc.

2.5.2 Relationship between Classroom Practice and Student Performance in Mathematics

This section examines the relationship between certain classroom practices and student performance in Mathematics. These strategies include the following: opportunity to learn, whole class teaching, use of homework, and use of group work.

2.5.2.1 Opportunity to Learn

The extent of students' opportunity to learn Mathematics content bears directly and decisively on student Mathematics achievement. The term 'opportunity to learn' (OTL) refers to what is studied or embodied in the tasks that students perform. In Mathematics, OTL includes the scope of the Mathematics presented, how the Mathematics is taught and the match between students' entry skills and new materials (Grouws & Cebulla, 2000).

The strong relationship between OTL and student performance in Mathematics has been documented in many research studies. The concept was studied in the First International Mathematics Study (Husen, 1967), where teachers were asked to rate the extent of student exposure to particular mathematics concepts and skills. Strong correlations were found between student OTL scores and mean student achievement scores in Mathematics, with high OTL scores being associated with high achievement. The link between student Mathematics achievement and

OTL was also found in subsequent international studies such as the Second International Mathematics Study (SIMSS) (McKnight et al., 1987), and the Third International Mathematics and Science Study (TIMSS) (Schmidt, McKnight & Raizen, 1997).

Furthermore, there is also a positive relationship between total time allocated to Mathematics and general Mathematics achievement. Suarez et.al. (1991), in their review of research on instructional time, found strong support for the link between allocated instructional time and student performance. Similarly, Keeves (1976; 1994) found a significant relationship across Australian states between achievement in Mathematics and total curriculum time spent on Mathematics.

Despite these research findings on the link between total curriculum time spent on Mathematics and students' gains, many students still spend only a minimal amount of time in Mathematics class. For example, Grouws & Smith (2000), in an analysis of data from the 1996 National Assessment of Education Progress (NAEP) Mathematics study, found that 20% of 8th grade students had thirty minutes or less of Mathematics instruction each day.

Also, textbooks are related to student OTL, because many textbooks do not contain much content that is new to students. Gouws & Cebulla (2000) observe that lack of attention to new material and heavy emphasis on review in many textbooks are of particular concern at the elementary school and middle school levels. In support, Flanders (1987) examined several textbook series and found that fewer than 50% of the pages in textbooks for grades two through eight contained any material new to students. In addition, Kulm, Morris & Grier (1999), in their review of twelve middle-grade Mathematics textbook series, found that most traditional textbooks series failed to address many of the content recommendations made in standard documents.

From the above findings, it is evident that the relationship between OTL and student achievement has important implication for teachers. In particular, it seems prudent to allocate sufficient time for Mathematics instruction at every grade level. The institution of short class

periods in Mathematics, for whatever practical or philosophical reason, in most schools in Namibia should be seriously questioned.

Textbooks that devote major attention to review and that address little new content each year should be avoided, or their use should be heavily supplemented in appropriate ways. Teachers should use textbook as just one instructional tool among many, rather than feel duty-bound to go through the textbook on a one-section-per-day basis.

2.5.2.2 Whole-Class Discussion

Research suggests that whole-class discussion can be effective when it is used for sharing and explaining a variety of solutions by which individual students have solved problems. It allows students to see the many ways of examining a situation and the variety of appropriate and acceptable solutions (Gouws & Cebulla, 2000). Similarly, Wood (1999) argues that whole-class discussion works best when discussion expectations are clearly understood. Students should be expected to evaluate each other's ideas and reasoning in ways that are not critical of the sharer. This helps to create an environment in which students feel comfortable sharing ideas and discussing each other's methods and reasoning. Furthermore, students should be expected to be active listeners who participate in the discussion and feel a sense of responsibility for each other's understanding.

Based on the findings above, it is important that whole-class discussion follow student work in problem-solving activities. The discussion should be a summary of individual work in which key ideas are brought to the surface. This can be accomplished through students presenting and discussing their individual solution methods or through other methods of achieving closure that are led by the teacher or the students, or both.

Furthermore, whole-class discussion can be an effective diagnostic tool for determining the depth of student understanding and for identifying misconceptions. Teachers can identify areas of difficulty for particular students, as well as ascertaining areas of a student's success or progress.

Finally, whole-class discussion can be an effective and useful instructional practice. Some of the instructional opportunities offered in whole-class discussion do not occur in small group or individual settings. Thus whole-class discussion has an important place in the classroom together with other instructional practices (Ball 1993; Wood, 1999).

2.5.2.3 Small-Group Learning

Using small groups of students to work on activities, problems and assignments can increase student Mathematics achievements. Considerable research evidence within Mathematics education indicates that using small groups of various types for different classroom tasks has positive effects on student learning.

Davidson (1985) reviewed seventy-nine studies in Mathematics and compared student achievement in small-group settings with traditional whole-class instruction and found that in more than 40% of these studies, students in the classes using small-group approaches significantly outscored control students on measures of student performance. In only two of the 79 studies did the control group students perform better than the small-groups. Similarly, Slavin (1990) reviewed 99 studies of co-operative group-learning and found that co-operative methods were effective in improving student achievement. He further observed that the small-group approach had positive effects on cross-ethnic relations and student attitudes toward school.

In addition, qualitative studies have shown that other important and often unmeasured outcomes beyond improved general achievement can result from small-group work. Yackel, Cobb & Wood (1991) conducted one such study of a second-grade classroom in which small-group problem solving, followed by whole-class discussion, was the primary instructional strategy for the entire school year, and they found that this approach created many learning opportunities that do not typically occur in traditional classrooms, including opportunities for collaborative dialogue and solution of conflicting points of view.

Gouws & Cebulla (2000) recommend that when using small-groups for Mathematics instruction in the classroom, teachers should choose tasks that deal with important mathematical concepts and ideas. They should select tasks that are appropriate for group work, so that after initially working individually on tasks, students could then follow up with group work where they could share and build on their individual ideas and work. In addition, teachers should give clear instructions to the groups and set clear expectations for each, emphasising both goals and individual accountability. They should choose tasks that students find interesting, and ensure that there is closure to the group where key ideas and methods are brought to the surface, either by the teacher or the students, or both.

From the above literature, it is evident that the findings support the use of small groups as part of Mathematics instruction. This approach can result in increased student learning as measured by traditional achievement measures, as well as in other important outcomes.

In conclusion, teachers should not think of small groups as something that must either always be used or never be used. Rather, small-group instruction should be thought of as an instructional practice that is appropriate for certain learning objectives, and as a practice that works well with other organisational arrangements, including whole-class instruction.

2.5.2.4 Group Work Teaching Method

In this teaching technique, teachers allow students to work together in groups, providing opportunities for them to share their solution methods. Working in groups with peers, according to Dossey et al. (2002), provides students with a less threatening environment to work in because they do not feel the pressure to perform in front of their peers. Group work helps to develop students' problem-solving strategies because "the fact that a group contains more knowledge than an individual means that problem solving strategies can be more powerful" (Reynolds & Muijis, 1999, p.282). As students work in groups to solve problems and present their work to their peers, they will have an opportunity to learn from each other. The collaborative group problem-solving activities enhance the students' higher-order thinking skills. Problem-solving in the group allows the students to become more deeply involved in their learning process. It can

also enhance logical reasoning, helping the students to decide what rule a situation requires or, if necessary, to develop their own rules in a situation where an existing rule cannot be directly applied (Branford, Brown & Cocking, 1999).

2.5.2.5 Use of homework

Homework is an instructional tool that refers to tasks assigned by teachers to students to be completed outside the regularly scheduled class. Its purpose includes providing additional practice, increasing the amount of time students are actively engaged in learning, extending time on task, developing skills, increasing understanding and developing application (Grouws, 2001). It is useful to teachers for monitoring students' learning and identifying their learning difficulties as it gives teachers feedback about students' learning. Marking or review of homework also gives feedback to the student, which is a very important aspect of teaching (Bodin & Capponi, 1996).

Cooper (1994) reported that homework accounted for 20% of the time students spent on academic tasks in the United States. However, he noted that little attention has been paid to the issue of homework in teacher education. Likewise, Eren & Henderson (2006) indicate that most of the literature on homework is theoretical, since very little research has been completed on the role of homework in students' achievement.

In contrast, Aksoy & Link (2000) found a positive and significant effect of homework on 10th grade Mathematics achievement. Similarly, a review of 134 studies by Marzano et al. (2001) reported a positive relationship between use of homework and students' achievement.

The above empirical evidence seems to suggest that homework is positively related to students' achievement. Nonetheless, the effect of homework in an environment like Namibia (where most of the parents are illiterate and cannot help in their children's homework) needs to be empirically studied so as to shed more light on the effect of homework on students' achievement.

2.6 Professional Development

Introduction

There is a growing recognition of the impact of teachers' teaching quality on student learning. In this section, I will discuss the connection between teachers' professional development and student achievement, and the aspect of professional development that makes a difference for students.

Professional development is considered an essential strategy to enhance teacher quality and ultimately affect student achievement (Mullens, et.al., 1996; Wenglinsky, 2002). Supporting this notion, some researchers have found that professional development positively affects teachers' practices (Cohen & Hill, 1998; Jacobson & Lehrer, 2000; Schoen, et.al., 2003).

Other studies have defined teacher quality in terms of teacher qualifications such as certification and field of study (Darling-Hammond, 2000), teacher characteristics such as verbal ability (Ferguson 1997), subject matter knowledge, knowledge of teaching and learning, and ability to use a wide range of teaching strategies (Haycock, 1998; Mullens, et.al., 1996).

While teachers with full certification and a major in the field have been found to affect student achievement positively, the level of teacher education (e.g. holding a master's degree) does not appear to have such an impact (Darling Hammond, 2000). More importantly, improvement of student achievement is sustained over time when it is a consequence of qualified teaching (Jacobson & Lehrer, 2000).

2.6.1 Recommended Principles of Professional Development

The section will describe the recommendations and suggestions of several experts on principles of effective professional development. The experts include Loucks-Horsley, Stiles & Hewson (1998), Glenn (2000), and Kahle (1999).

Glenn (2000) suggests that professional development should ideally be a collaborative educational process aimed at the continuous improvement of teachers. Such a process should be able to deepen a teacher's knowledge of the subject (content knowledge) and sharpen a teacher's teaching skills in the classroom. It should also help teachers keep up with developments in their fields and education in general, and generate and contribute new knowledge to the profession. Furthermore, it should increase teachers' abilities to monitor students' work so that they can provide constructive feedback to students and appropriately redirect their own teaching.

Similarly, Kahle (1999) outlines the features of professional development that should be encouraged and supported, arguing that professional development should be sustained and content-based, and address new teaching methods. It should provide for follow up experiences so that teachers have opportunities to test, discuss and analyse new teaching strategies, and should include leadership opportunities and model strategies that teachers can use with their students. Moreover, professional development should provide time for teachers to reflect on and practice what has been learned, as well as including on-going assessment that provides information to revise and redesign the professional development experiences. Incentives which are tied to career goals such as differential staffing and teacher career ladders should be provided. It is also important that the process of professional development should be accountable, and include research to assess the changes in teaching practices and in student learning.

In support of above mentioned two authors, Loucks-Horsley, Stiles & Hewson (1998) present seven principles for effective professional development, stating that these principles are driven by a clear, well-defined image of effective classroom learning and teaching. Professional development based on these principles provides teachers with opportunities to develop knowledge and skills and broaden their teaching approaches, so that they can create better learning opportunities for students. Teachers are also trained to use instructional strategies to promote learning for adults which mirror the methods to be used with students. This type of professional development also builds or strengthens the learning communities of Science and Mathematics, prepares and supports teachers to serve in leadership roles if inclined to do so (as teachers master the skills of their profession, they need to be encouraged to step beyond their

classrooms and play a role in the development of the whole school and beyond), provides links to other parts of the education system, and enables teachers to continuously assess themselves and make improvements.

From the literature above, it is evident that the views of the authors are similar, and seem to suggest that professional development in education should be a continuous process requiring commitment and investment, and should be firmly embedded in the teaching occupation. The process must be strongly collaborative in nature, providing ample opportunity for exchange of knowledge and collective reflection on the outcomes of professional development activities.

2.6.2 Framework of Garret, Desimone, Porter, Yoon & Birman (2002)

In order to illustrate the effect of effective professional development on teacher practice and consequently, on student gains, a study was undertaken jointly by researchers from the Universities of Wisconsin and Vanderbilt together with the American Institute of Research. The research was funded by the USA based Eisenhower Professional Development Programme for teachers (Garet et.al. 2002).

Based on a sample of 207 teachers, the features of the teachers' professional development and its effects on changing their teaching practices were examined. The authors found that three core features of professional development activities had significant positive effects on teachers' knowledge, and consequently changed their classroom practices (Garet et.al. 2002). This framework, adopted from Garret et al. (2002), is divided into two categories, namely, core and structural features. The characteristics of each of these categories are presented below:

Core features

Core features include content focus (the degree to which the activity focuses on improving and deepening teachers' content knowledge), opportunities for active learning (the opportunities teachers have to become actively engaged in a meaningful analysis of teaching and learning), and coherence (the level of activity which encourages continued professional communication among teachers and the extent to which the content is in alignment with state standards and assignments).

Through these core features, the following structural features significantly affect teachers' learning and practices.

Structural features

Structural features include form (where activities are presented as 'reform' activities such as a study group or a network, or as a traditional workshop or conference), duration (the number of hours participants spend and/or the span of time over which the activity takes place), and participation (either groups from the same school, department or grade level participate collectively, or teachers from different schools participate individually). Each of these features is presented in Figure 2.2, and then discussed.

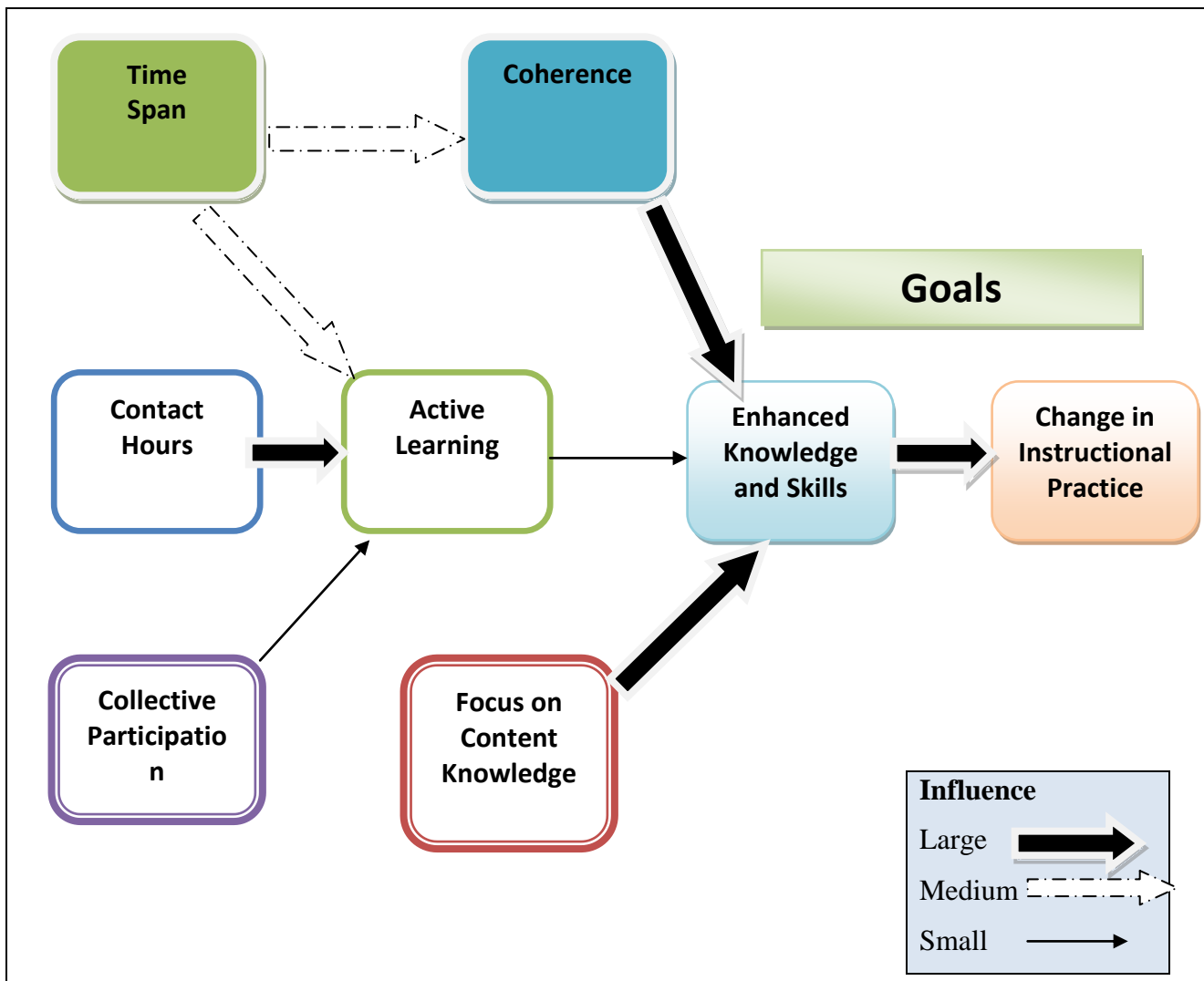


Figure 2.2: Aspects of teacher professional development and their relationship to better instruction

2.6.2.1 Content

According to Garet et al. (2001), teachers' professional development can improve student achievement when it focuses on teachers' knowledge of the subject matter and how students understand and learn it. Research has shown that professional development of teachers can influence teachers' classroom practices significantly and lead to improved student achievement when it focuses on factors such as how students learn particular subject matter, instructional practices that are specifically related to subject matter and how students understand it, and strengthening teachers' knowledge of specific subject-matter. This implies that close alignment of professional development with actual classroom conditions is crucial.

Kennedy (1998) reviewed the effect of in-service programmes for Mathematics teachers on student achievement, and found that programmes that focused on subject-matter content and how students learn it had the largest positive effect on student learning. Likewise, Garet et al. (2001) noted that content-focused activities had a substantial positive effect on enhanced knowledge and skills, as reported by the teachers in their study.

Other studies that focused on academic content and curriculum include those of Whitehurst (2002) and Cohen & Hill (1998). According to Whitehurst (2002), out of the seven teacher characteristics that could increase achievement, participation in professional development that focused on academic content and curriculum was second only to a teacher's cognitive ability. Cohen & Hill (1998) confirmed that the average Mathematics achievement was higher in schools where teachers had participated in professional development focusing on teaching specific Mathematics content, compared to the achievement in schools where teachers were not exposed to specific Mathematics content.

2.6.2.2 Active Learning

In activity learning strategies, teachers are engaged in meaningful analysis of teaching and learning. They give and receive productive feedback to one another through such activities as reviewing students' work together and joint curriculum planning at school level. Research has shown that when teachers have the opportunity to become actively engaged in their own learning

through observation, close study of student work in collaboration with colleagues, and joint curriculum planning, they are more likely to improve their practice (Loucks-Horsley, 1998). Similarly, in their study of the characteristics of professional development and how they influence teacher practice, Garet et al. (2001) found that opportunities for active learning had a small positive effect on teachers' knowledge and skills.

2.6.2.3 Coherence

Professional development coherence is reflected in the incorporation of experiences that are consistent with teachers' goals, alignment with standards and assessments, and encouragement of professional communication among teachers (Garet et al., 2001).

Research has shown that teachers are more likely to change their teaching practices when professional development is directly linked to the programmes they are teaching and the standards and assessments that they use. Garet et al. (2001) found that the coherence of professional development activities has an important positive influence on change in teaching practice. Also, Parsad et al. (2001) found that when teachers' report a connection between professional development and other school efforts, they are more likely to say that professional development has improved their teaching practice. In support of the findings of Parsad et al., Ainley & McKenzie's (2000) study of exemplary organisations in both the educational and private sector found that professional development was most effective when coordinated with organizational goals. Similarly, a study by Snipes, Doolittle & Herbihiy (2002) looked at four urban school systems that were raising academic performance and reducing the achievement gap, and found that district wide professional development for teachers and staff in implementing a coherent curriculum was one of the key characteristics in all four systems.

2.6.2.4 Form/Type of Activity

Many researchers have documented the ineffectiveness of traditional professional development activities. Teachers are usually exposed to traditional professional activities in two ways: Either teachers attend in-service training days, sponsored by their education districts, in which they are offered a menu of training options designed to transmit specific sets of ideas, techniques or materials (Little, 1993), or they attend courses taught by university-based teachers with an

academic rather than an applied focus (Stein, Smith, & Silver, 1999). Research has shown that neither of these approaches leads to substantive and sustained changes in teacher practice (Porter et al., 2000).

2.6.2.5 Duration

Teachers are more likely to change their teaching practices when they experience professional development over a longer period of time. According to a US Department of Education (1999), teachers who were exposed to Eisenhower professional development programmes over a longer period of time reported that there was an improvement in their teaching practice. One explanation of this may lie in how duration interacts with the core feature of an activity. Garet et al. (2001) established that activities of a longer duration have more subject-area content forms, more opportunities for active learning, and more coherence with teachers' other experiences. Similarly, Kennedy (1998) found that duration alone is not enough to ensure success. She established that variations in content have a stronger effect than longer duration of the programme.

2.6.2.6 Participation

Collective participation, which involves professional development designed for groups of teachers from the same school, department or grade level, tends to create more active learning (e.g. observing and being observed while teaching; planning for classroom use of what was learned in professional development; reviewing students work; giving presentations; leading discussions; and producing written work), and this has some effect on teacher knowledge and skills (Rosnick, 2005).

Similarly, McLaughlin & Talber (1993) found that teachers who belong to strong professional communities were better able to adapt to the challenges of teaching today's students.

Furthermore, Newmann (1996) found that in the more successful schools, professional development targeted groups within the schools rather than individual teachers. He concluded that in the more successful schools, professional development planners use a combination of local and external expertise.

In summary, it is evident that aspects of professional development such as being grounded in the curriculum that students study, being connected to several elements of instruction, and being extended in time contribute to positive and significant impact on student achievement (Cohen & Hill, 1998).

Similarly, others aspects of professional development that have a positive impact on student academic achievement include the following: being focused on how to teach a content area/subject matter effectively (Schoen et al., 2003); being based on the relation between content/benchmarks and student thinking (Jacobson & Leher, 2000); and promoting hands on teacher learning (Wenglinsky, 2002).

2.7 Framework for Designing Professional Development

Several models of professional development are presented in the literature. One of the most advanced is that outlined by Loucks-Horsley, Hewson, Love & Stiles (1998) for designing professional development programmes for teachers of Science and Mathematics. This framework, presented in Figure 2.3, emphasises the continuous and circular design permeating the implementation of professional development programmes. This design is infused with the continuous reflection based on the outcomes of the programme to re-evaluate and further improve it.

The strategies in Figure 2.3 can be grouped into five categories: immersion, examining practices, curriculum development, curriculum implementation, and collaborative work.

An immersion strategy involves having teachers actually do Mathematics, and gain the experience of doing Mathematics with a mathematician, while examining practices include case discussion of classroom scenarios or examination of real classroom instruction. In curriculum development, teachers are helped to create new instructional materials to better meet the needs of students, and curriculum implementation involves having teachers using and refining the use of instructional materials in the classroom. Collaborative work includes study groups, peer coaching, mentoring and classroom observation and feedback.

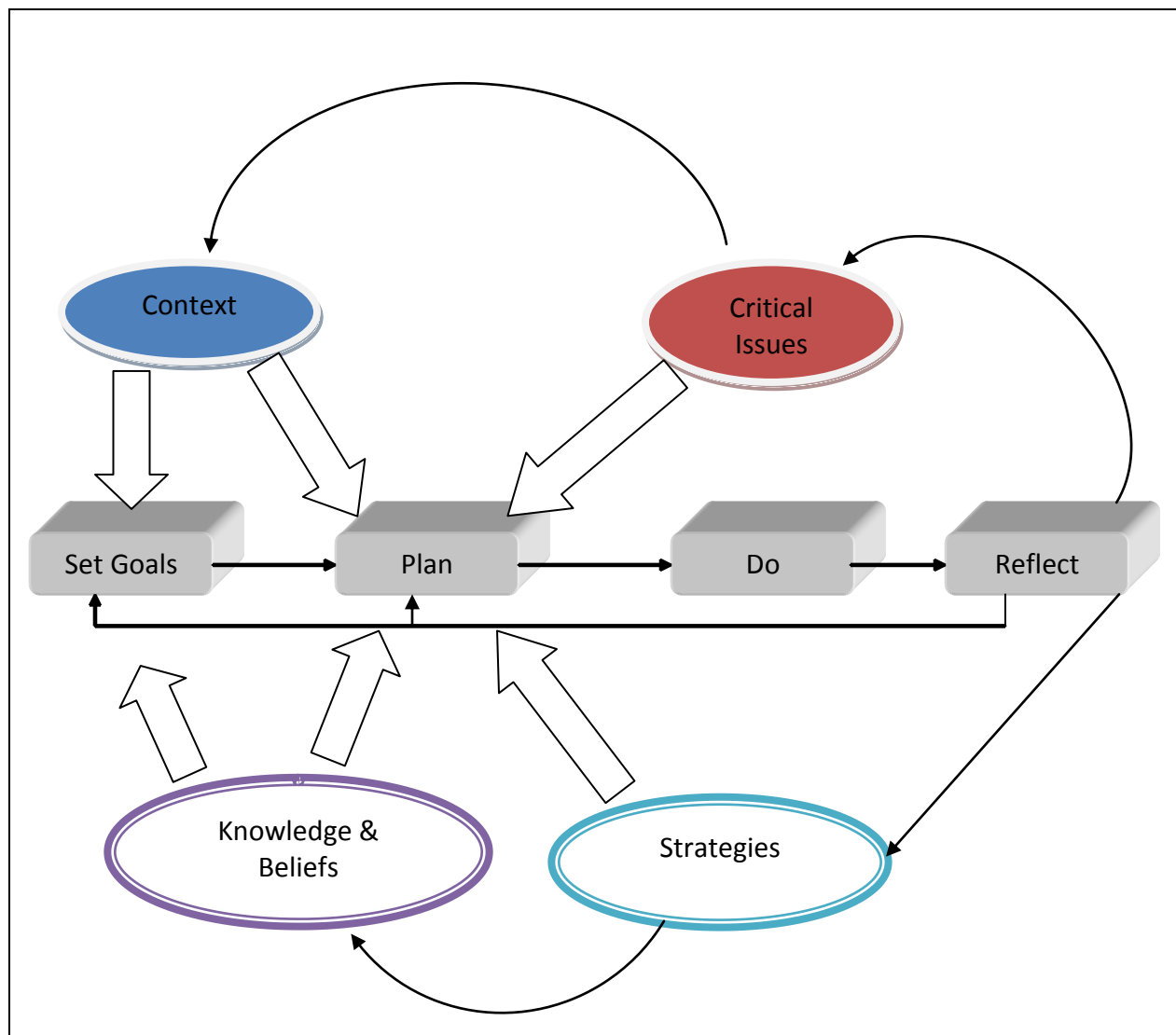


Figure 2.3: Professional development design process for Mathematics and science education reform (Loucks-Horsley et al., 1998).

The above strategies seem to fit theoretically with Ball & Cohen's (1999) 'practice-based' theory of professional development. According to this theory, professional development for teachers should emphasise long-term active engagement, connections between teachers' work and their own students' learning, and opportunities to practice and apply what students learn in a real-world context. The emphasis is on a continuous cycle of exploring new issues and problems, engaging in collaborative discussions, constructing new understanding, and improving professional practice.

2.8 Teacher Effectiveness

Introduction

This section will focus on teacher effectiveness as determined by gains in student achievements in learning as measured by standardized achievement tests.

It is worth noting that there has been a substantial shift during the past 30 years in how teacher effectiveness is defined and measured. At the 1978 Conference of the International Association for Educational Assessment, Schulman (1978) described eight ways of measuring teacher effectiveness. These include, firstly, characteristics deduced from a theory; starting from existing educational, psychological or sociological theories, one deduces a number of characteristics of the effective teacher. The second measure of teacher effectiveness is characteristics determined by the pupils, where the evaluation of pupils is used as the criterion for effectiveness. Thirdly, there are characteristics defined by specialists, such as inspectors and directors, who determine the characteristics of effective teachers from their own experiences with teachers and from their own theories. Characteristics derived from the functional analysis of the teacher constitute a further measure of teacher effectiveness. This means that from the results of observation, surveys and theories, a functional analysis of the teacher is made, on which conclusions about the characteristics of the effective teacher are based. Yet another measure includes characteristics derived from a role analysis of the teacher, based on a set of norms and expectations about teachers. Characteristics derived from descriptive research on the teacher population may also be an indicator of teacher effectiveness, determined on the basis of characteristics discovered in the existing population of teachers.

In addition, there is empirical research on teacher characteristics, as measured by observation scales and questionnaires exploring specific criteria such as the evaluation of teaching, the judgment of inspectors, and the opinion of pupils and, in some exceptional cases, the achievement results of the pupils. Finally, there is predictive research of teacher characteristics which attempts to determine to what degree specific characteristics of trainees can predict a criterion of effectiveness, such as the obtaining of a diploma, the marks awarded, or the judgment of inspectors.

Before reviewing the studies on teacher effectiveness, it is necessary to identify the methods used to measure effectiveness. According to Laine (2009), the most common methods for measuring teachers' effectiveness include a review of teacher lesson plans, classroom observations, portfolios assessments, student achievement data, student work sample reviews and value-added measures (VAM).

Of the methods listed above, value-added measures are the most prominent type of method used to assess teacher effectiveness, and these measures will be discussed in detail in this section.

Value-added measures are defined as the contribution of various factors toward growth in student achievement (Goldhaber & Anthony, 2004). There are many advantages in using value-added measures to identify and support effective teachers. According to Goe (2008), these include the fact that value-added measures are relatively objective, since they consider only teachers' contribution to student learning. Furthermore, they provide a useful way to look for evidence as to which teacher qualifications and characteristics matter for student learning. Value-added data are also relatively inexpensive compared with other means of assessing teachers, and value-added measures focus on student learning, rather than on teaching practices that may or may not be linked to positive outcomes for students. In addition, value-added measures identify highly successful classrooms and teachers, creating opportunities to learn from those teachers (p.3-4).

In contrast, the disadvantages of these value-added measures, according to Goe, & Croft (2009), include the fact that data systems for value-added measures are costly to build from scratch. Also, there is no information about what effective teachers do in the classrooms, ways to help them improve, and/or information about some teachers' skills (e.g. special education, art, music and early elementary training).

2.9 Research Studies on Value-Added Methods (VAM)

Value-added modelling purports to estimate the effect of educational inputs on student outcomes, in particular, student achievement as measured by standardised tests. In this review, we focus on VAM applications to estimate the effects of teacher rather than of schools because these applications have attracted the most recent attention (McCaffrey, Lockwood, Koretz, & Hamilton, 2003). Value-added modelling teacher-effect estimates purport to measure a teacher's contribution to student achievement and learning. Teacher effects of this sort are what analysts refer to as causal effects. In lay terms, the teacher causes the effects.

McCaffrey et al. (2003) maintain that measures of teacher effects are of interest as a means of answering two broad questions:

1. Do teachers have differential effects on student outcomes?
2. How effective is an individual teacher at producing growth in student achievement, and which teachers are most or least effective?

The first question requires an estimate of the variability among teacher effects. If the data and statistical models can accurately describe the contribution of teachers to student achievement, the models can provide estimates of the variability among teacher effects and determine the proportion of variability in achievement or growth that is attributed to teachers. The second question requires estimating individual teacher effects. As noted above, these estimates might be used to reward or sanction individual teachers on the basis of the teacher's performance relative to the distribution of teachers, possibly through ranking. A summary of the findings on the use of VAM for measuring teacher effects on students' achievement is presented below.

Aaronson, Barrow & Sanders (2003) conducted a study using Chicago Public High School data that linked students and teachers. These researchers used a value-added model and focused on eighth and ninth grade standardized test scores for Mathematics, and found that having a teacher who was rated two standard deviations higher than other teachers in quality (as determined by value-added scores) could add 25% to 45% of an average school year's growth to a student's Mathematics scores.

Furthermore, the authors correlated teachers' value-added scores with teacher characteristics for which they had data, such as age, experience, degree level, certification and undergraduate major. They found that very little of the variance in teacher quality could be accounted for by these observable characteristics (except having an undergraduate qualification in Mathematics or Science). This finding may suggest that variation in paper qualifications may matter little (with the exception perhaps of the undergraduate major, at least when Mathematics is the subject being taught).

In support of the importance of value-added models, Rivkin, Hanushek & Kain (2005) used matched panel data from Texas to determine the impact of teachers (and schools) on student academic achievement. The researchers tested observable components such as teacher education and experience, and unobservable components of teachers (residuals), to determine their relationship to student achievement gains on the Texas Assessment of Academic Skills in Reading and Mathematics for students in grades 3-7. They found that observable teacher characteristics have small but significant effects on students' achievement gains, but noted that most teacher effectiveness was due to unobservable differences in teacher instructional quality. The researchers also found that teacher effectiveness increased during the first year but levelled off after the third year.

Noell (2006) conducted a two phase study to investigate scores on the efficacy of teacher preparation, using value-added scores for Louisiana students. In the first phase of the study, value-added scores were calculated for students in grades 4 - 9 in 66 out of 68 Louisiana public school districts, and were linked with teachers. The databases were constructed to allow separation of subject tests so that teacher effectiveness could be examined based on scores in specific subjects (English Language, Art, Mathematics, Science and Social Studies). Noell found that the single largest predictor of student achievement was the student's prior test score in the content area, followed by prior achievement in other subject areas. For the second phase of the study, teachers' preparation programmes were identified and ranked according to estimates of effectiveness. Despite the fact that the author found a relationship between teacher preparation programmes and teacher effectiveness, large overlapping confidence intervals were observed, suggesting that the relationships could not be reliably determined with the data

2.10 Literature Review in the Namibian Context

2.10.1 Introduction

This section will discuss the relevant studies in teacher-related variables that may influence students' academic achievement in Mathematics in Namibian secondary schools.

Based on performance in international school assessments, Namibia performs worse than its regional neighbours. Table 2.1 places Namibia's learning achievement in perspective compared with other countries in the region as assessed by the Southern African Consortium for Monitoring Education Quality (SACMEQ) for grade six pupils. The table shows that Namibia is ranked twelfth in Reading and fourteenth (last) in Mathematics, and consistently performs worse than either South Africa or Botswana which border Namibia in the south and east respectively.

Table 2.1. Average Reading and Mathematics Scores amongst Southern and Eastern African Countries

No.	Country	Reading	Rank	Mathematics	Rank
1	Seychelles	582	1	554	3
2	Kenya	546	2	563	2
3	Tanzania	546	3	522	5
4	Mauritius	536	4	584	1
5	Swaziland	530	5	516	6
6	Botswana	521	6	513	7
7	Mozambique	517	7	530	4
8	South Africa	492	8	486	9
9	Uganda	482	9	506	8
10	Zanzibar	478	10	478	10
11	Lesotho	451	11	447	11
12	Namibia	449	12	431	14
13	Zambia	440	13	435	12
14	Malawi	429	14	433	13
	All countries	500		500	

Source: SACMEQ, 2005

The relatively poor school performance may be partly attributed to under-qualified teachers, lack of proficiency in English on the part of both learners and teachers, complicated terminology in the syllabi, and lack of commitment by many of the teachers (MoE, 2002).

The findings on factors perceived to contribute to poor student performance at JSC level in schools, particularly in Mathematics, are as follows:

Only four surveys or research studies have been conducted to identify the teacher-related and school-related factors that may influence students' academic achievement in both JSC in Grade 10 and IGCSE in Grade 12. The surveys/reports include the following: Report of the Task Force: Ministry of Basic Education, Sports and Culture (1996); Erwee (1997); NIED, 1998; the Namibian Human Resource Development (NHRDP) report (2002). All these reports attribute the low percentage of passes in Mathematics to inadequacies regarding the following: syllabi, teachers' qualifications, teaching experience, motivation, workload, professionalism, research, teaching skills as measured by knowledge of subject-matter, style of delivery of subject-matter, and funds for equipment and materials for fruitful practical work, especially in view of large class sizes.

A detailed discussion of the factors that have been identified as contributing to the poor performance of students in Mathematics is presented below.

2.10.2 The Curriculum-Syllabi, Teaching and Assessment

A study conducted by NHRDP (2002) indicated that the weaknesses in implementing effective curricula for Mathematics in Namibian secondary schools are due to the following factors:

1. Teachers in the JSC phase concentrate on finishing the syllabi content for examination purposes rather than for skills development. As a result of this weak implementation of Mathematics curricula, students are inadequately prepared for entry to the senior phase in grades 11 and 12.
2. The curriculum for JSC students lacks motivation for achievement in Mathematics, as six subjects are needed for certification for JSC.
3. Assessment in Mathematics at JSC in grades 10 and 12 is examination-driven and restrictive in terms of skills development.

4. Some teachers have poor subject knowledge of the basics in Mathematics due to lack of specific entry requirements for training at tertiary level.

The above mentioned factors seem to suggest inadequacy in teacher training programmes and professional development which are discussed below.

2.10.3 Teacher Training in Namibia

Research has shown that the quality of training in both course content and pedagogical skills provided in tertiary institutions is crucial for teachers' effectiveness in secondary schools. When teachers are exposed to low quality academic and professional training in tertiary institutions, their effectiveness is weak. Teacher training programmes in Namibia, especially the BETD, has been criticised as being very weak in terms of content knowledge and pedagogical content knowledge. For example, the NHRDP Report of (2002) and the National Council on Higher Education (NCHE) (2007) identified a number of weaknesses in the BETD programmes. These included teachers' lack of competence due to inadequate training at the lower level, inadequacy of school-relevant subject content in terms of equipping teachers' with competency in content and pedagogical knowledge, and the inefficiency of teaching methods advocated for Mathematics.

With regard to the BETD Mathematics programme specifically, the NHRDP Report (2002) identified further weaknesses, arguing that training in this programme lacks application and contextualisation, creates little feel for numbers, does not allow Mathematics to be visualised, emphasises procedural thinking (rote procedures), and is not sensitive to class size and mixed abilities. Furthermore, the programme lacks emphasis on individual attention and remedial teaching, is inadequate for teaching problem-solving (learners are not taught to apply skills to unfamiliar situations), fails to address language barriers for Mathematics being taught through the mother tongue, and also fails to promote a level of English necessary for understanding Mathematics.

The above reports have identified the factors purported to influence students' academic achievement by using only data from surveys on aspects such as teachers' level of education and

experience, number of educational materials in school, teacher/student ratio and type of school (e.g. public or private). However, none of these studies have explored the impact of these identified teacher-related variables on students' academic achievement in the JSC Mathematics examination.

To better understand some policy-relevant variables that could help explain Mathematics achievement in Namibian Schools, it would be important to conduct a correlation study to investigate school and teacher-related variables which impact Mathematics achievement in Grade 10 in Namibian secondary schools. Along this line, the current study sought to determine the impact of the teacher-related variables on student academic achievements in the JSC Mathematics examination.

2.11 Overview of Teacher-related Variables and Student Achievement in Countries in Africa

Some studies have identified significant variations in student access to qualified teachers in countries in Africa. The UNESCO Institute for statistics (2006) examined the gap in teacher quality among isolated/rural areas, small towns, and large cities in 13 southern and eastern African countries, including South Africa, Botswana, Kenya and Uganda. In most of these countries, a higher percentage of students in isolated/rural areas were taught by teachers with less than 3 years of experience than were students in small towns or large cities. In addition, in Namibia, Tanzania, and Uganda, teachers in isolated/rural schools scored lower in a sixth grade Mathematics test than teachers in large city schools (UNESCO Institute for Statistics 2006). The findings of the UNESCO Institute for Statistics and the Namibia Human Capital and Knowledge Development for Economic Growth with Equity study of 2005 revealed that among qualified Namibian teachers, "a large proportion lacks essential competencies in areas such as mastery of their teaching subjects, English proficiency, reading skills, curriculum interpretation and setting student tests". These weaknesses limit teachers' effectiveness in implementing the official curriculum in Namibian primary and secondary schools.

Acknowledgement of the role of teacher-related variables in improving student achievement has also received widespread support. The findings of Alausa(1997) and Stols (2003) were used to

justify the statement that teacher-related variables such as teachers' qualifications, teaching experience, attitudes and mathematical knowledge influence a student's chance for success. Alause (1997), in discussing Chacko's (1981) findings in a study conducted in Ibadan Metropolis, Nigeria, states that the attitudes and teaching experience of the teachers contributed most highly to variance in achievement gains by students. Findings from the above study cannot be conclusive, however, because the data was obtained from schools in the Ibadan metropolis only, and the rural schools were not considered. Furthermore, the study did not examine the influence of specific teacher-related variables on students' academic achievement in Mathematics. There is a need to develop more studies to investigate the impact of these teacher-related variables on students' academic achievement in Mathematics in secondary schools.

Furthermore, the findings of Stols' (2003) survey entitled "The correlation between teachers and their learners' mathematical knowledge in rural schools in South Africa" seem to suggest that to improve students' mathematical examination results in rural schools, we must improve the teachers' school content knowledge. Furthermore, Howie (2001) states that the language issue contributes to poor subject knowledge on the part of both teachers and learners in South Africa, and if there is to be a commitment to improving the levels of students' performance in the core subjects (Mathematics and Science) in the future, then solving the language issue will be a critical part of the solution. In addition, Taylor & Vinjevold (1999) and Arnott & Kubeka (1997), as cited in Howie (2002), note several factors which have been perceived as influencing the poor performance of learners in matriculation examinations. These include inadequate subject knowledge on the part of teachers, and an inadequate communication ability on the part of both pupils and teachers in the language of instruction, as well as difficulties experienced by teachers in managing activities in classrooms, and pressure to complete examination-driven syllabi. In addition, students' performance is affected by the fact that teachers have to deal with heavy teaching loads and overcrowded classrooms, as well as with a lack of professional leadership, a lack of support due to a shortage of professional staff in Ministries of Education, and poor communication between policy-makers and practitioners.

These findings, however, cannot be conclusive because the researchers' studies were based on classroom observations and discussions with teachers and other stakeholders, and were collected from rural schools of low socio-economic status.

To create a clear interpretation of the impact of teacher-related variables on students' academic achievement in Mathematics for policymakers and researchers, it is important to include data from urban, semi-urban and rural schools, and utilise inferential statistics to determine the impact of perceived teachers factors on students' academic achievement in Mathematics. The present study was designed to fill this gap.

2.12 Summary

The purpose of this study was to determine the impact of teacher-related variables on students' academic achievements in JSC Mathematics. This summary of the reviewed literature is presented from the perspective of studies done in other parts of the world, as well as in Namibia and Africa. A brief synopsis of the empirical evidence is presented below:

Firstly, it is evident that teacher's experience plays a role in the first few years of teaching, ranging from two to five years (see Boyd, Grossman, Lankford, Loeb & Wyckoff, 2006; Kane, Rockoff & Staiger, 2006; Rivkin, et al., 2005).

In addition to experience, qualifications also play a role in student performance, and an advanced, subject-specific degree has been identified as contributing positively to students' academic achievement in Mathematics at secondary school level (Clotfelter, Ladd & Vigdor, 2006; Hanushek & Darling-Hammond, 2005; Rice, 2003; Wenglinsky, 2002).

Teacher certification (licensure) likewise plays a significant role in student achievement in Mathematics (Boyd, Grossman, Lankford, Loeb & Wyckoff, 2006; Darling-Hammond, 2000; Goldhaber & Brewer, 1997, 2000), as does teacher coursework, which has an impact on student learning at all grade levels, with subject-specific coursework playing the greatest role at the secondary education level (Darling-Hammond, 2000; Monk, 1994; Wellingsky, 2002).

Furthermore, the extent to which teachers' professional development is linked to subject content or the way students learn is positively related to higher student achievement in Mathematics (Garet et al., 2002; Kennedy, 1998; Wenglinsky, 2002), as are instructional practices such as whole-class teaching, collaborative group work and use of homework (Grouws & Cebulla, 2001; Cohen & Hill, 1998; Kennedy, 2004; Wenglinsky, 2002).

In the light of the above literature review on the relationship between teacher-related variables and students' academic achievement in Mathematics at secondary school level, the researcher constructed a framework for the teacher-related variables examined in this study.

Table 2.2 Constructs, Indicator Variables, and Corresponding Metric

Constructs	Indicator variable	Questionnaire item	Metric
Academic qualifications	qualification	Highest education level attained	1 to less than BETD to 5 master degree
Teaching experience	experience	Number of years of teaching	Continuous variable starting at 1
Subject specialisation	Teacher major	Teacher major	
Professional Development	Standards-based PD	Exposure to PD activities	1=yes to 2=no
Classroom practices	Mode of teaching	usage of instructions	1=never to 4 every day
Mathematics content knowledge	Perceived MCK	Knowledge of JSC topics	1=no knowledge to 4 very knowledgeable
Pedagogical content knowledge	Beliefs	Perceived PCK	1= not at all to 4 a high extent
Class room management	Teachers' beliefs		1= not at all to 4 a high extent
JSC achievement			

2.13 Conclusion

The literature reviewed provided me with the beacons that directed my search for teacher-related variables influencing underachievement in Mathematics among JSC students in Namibian schools. The next chapter discusses the methods used in collecting data and the methodology of the study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the methodology used to investigate the impact of teacher-related variables on student's academic achievements in JSC Mathematics for the period 2006 to 2010.

Furthermore, the chapter discusses different perspectives on research methods and justifies the choice of particular methods for this study. The study examined the relationship that teacher-related variables such as qualifications, subject specialisation, mathematical content knowledge, teaching experience, professional development, classroom instructional methods, and classroom management have with students' academic in JSC Mathematics for 2006 to 2010.

The study explored the following research questions:

1. To what extent does type of teacher input (paper qualification, teaching experience, subject specialisation, and perceived mathematical content knowledge) appear to have affected students' results in the JSC Mathematics examinations for 2006 to 2010?
2. How are teacher-reported classroom practices (standard-based classroom practices), teachers' perceived pedagogical knowledge, teachers' beliefs in standard-based classroom management and teachers' participation in professional development associated with students' results in the JSC Mathematics examinations at JSC level for 2006 to 2010?
3. What combination of the six variables (teacher experience, teacher level of education, teacher professional development, teacher classroom practices, teacher subject specialization and teachers' mathematical content knowledge) predict achievement for students as measured by students' JSC Mathematics scores?

In this chapter, the researcher presents a description of the research process that was adopted in this study. The research design and approach, the sample size and sampling procedures, the research instruments, the data collection methods, the data coding and the data analysis methods and procedures are discussed.

3.2 Research Design

The research design is the detailed plan of how the research study will be executed (De Vos, et al., 1998, p.77). It denotes the procedural details of the study by which data is collected. It aims to develop the set of methods and procedures which helps to test research hypotheses with a high degree of confidence (Gray & Diehl, 1992).

Cooper & Schindler (2001) argue that although there are different views on what a research design is, there are certain essentials that are common amongst the definitions. These include the fact that the design should always be based on the research question, and should be an activity-time based plan. Furthermore, the design should guide the selection of sources and types of information, and provide a framework for specifying the relationship among the study variables. It should also outline the procedures for every research activity, and provide answers to questions such as what technique will be used to gather data, and what kind of sampling will be used.

The fundamental objectives of a research design are to develop a set of methods and procedures that will answer the research question or test the research hypotheses with a high degree of confidence. In other words, the researcher attempts to design a study so that it will yield the strongest possible evidence to support or refute a knowledge claim (Borg & Gall, 1989). In order to achieve this, different types of research designs are developed. The most commonly used are: descriptive, causal-comparative (or ex post facto), correlational, and explanatory (or experimental).

3.3 The Design for This Study

Since the purpose of this study was to determine the extent to which teacher inputs (qualifications and characteristics) such as education level, field of specialisation, years of experience, professional development received in support of classroom practices, and processes (classroom practices, classroom management) affected students' results in the JSC Mathematics examinations for 2006 to 2010, the researcher adopted a research design encompassing ex post facto, correlational and descriptive approaches. A brief discussion on each of the designs used in the current study is presented below:

One of the research designs used in this study was the ex post facto design. Gall, Borg & Gall (1996) maintain that the main reason for using an ex post facto design is that many cause-and effect relationships are not open to experimental manipulation. Furthermore, the authors contend that ex post facto designs allow the researcher to study cause-and effect relationships either where experimental manipulation is impossible, or where the aim is to examine many relationships in a single research study. An ex post facto design was thus used in this study because the teachers-related factors (independent variable) in the study could not be manipulated since their presumed effect on the academic achievement of students in JSC Mathematics had already occurred.

The data collected was analysed in a three phase methodological approach including descriptive statistics, correlational analysis and regression analysis.

A descriptive study, as the name suggests, is undertaken in order to describe a phenomenon of interest, especially when a certain amount of knowledge is available on the topic. It involves collecting data in order to test hypotheses or to answer questions about the opinions of people on a particular issue. Also, descriptive studies are often undertaken in order to describe and explore the characteristics of a certain group in organisations. The goal of a descriptive study is to describe relevant aspects of the phenomenon of interest (Sekaran, 1992). It is also called survey design, and it often focuses on 'how' and 'who' questions.

Correlational research design involves collecting data to determine whether and to what extent (degree) a relationship exists between two or more variables. The degree of relationship is expressed as a correlation coefficient. The purpose of correlational research is often only to detect the existence of a relationship between variables (co-variance) which suggests a possible base for causality (Bless & Higson-Smith, 1995). Thus, as is the case in this study, correlational research design is useful as a first step to explanatory research design.

Regression analysis (multiple regressions) is the recommended procedure when the researcher is interested in predicting a dependent variable from a set of predictors (Stevens, 1996). Stevens

contends that the output of the regression analysis sheds light on how the variables that significantly affect students' academic gains in correlational analysis could predict students' achievement. Since one of the objectives of this study was to identify the set of teacher-related variables that predicted the students' academic achievement in JSC Mathematics, the researcher adopted the regression analysis approach to accomplish this objective.

3.4 Research Strategy (Type)

3.4.1 Introduction

The main aim of this study was to determine the impact of teacher characteristics on JSC Mathematics results for students in Namibian schools, and to analyse whether the teacher input and output fitted into any of the standardized models for teacher quality. The researcher found survey to be the most appropriate strategy for this study. Denga & Ali (1989) and Goe (2008) observed that surveys provide a cost-efficient, generally unobtrusive way to gather a large array of data at once. Goe (2008) recommends that one instrument can be used to collect data on teachers' instructional practices as well as on administrative support, professional development opportunities, and relationships with students, school climate, working conditions, demographic or background information, and perceptions or opinions that may have a bearing on the effectiveness of a teacher. Based on the geographical dispersion of the population in the 13 education regions in Namibia, the researcher adopted the survey method as a means of obtaining teachers inputs (qualifications, subject major, teaching experience, professional development), and processes (classroom practices). The offices of the 13 Regional Directors of Education facilitated the distribution of the questionnaires which were self administered and collected by trained enumerators, most of whom were pre-service teachers at the University of Namibia and/or students of the Polytechnic of Namibia.

3.4.2 Research Approach

A research study can be approached in two different ways, a qualitative or a quantitative way. The distinction between the two research methods lies in how the data are treated, and how they

are dealt with analytically. Qualitative research involves collection of narrative data to gain insight into phenomena of interest while quantitative research involves the collection of numerical data to gain insights into how one variable influences other variables (Leedy & Ormod 2010).

The purpose of the study was to determine the relationship between teachers' characteristics such as qualifications, years of teaching experience, subject matter and content knowledge, academic proficiency, professional development and classroom practices etc., and students' achievement in JSC Mathematics thus quantitative research approach was adopted so as to allow for statistical measurement of the impact and influence of some of the factors influencing JSC Mathematics results for students. In this approach, the researcher identified and described teachers' processes-practices, (teaching quality) such as classroom management, perceptions regarding knowledge of JSC Mathematics, curriculum, pedagogical content knowledge, professional development training and teaching methods and their links to students' performance in JSC Mathematics. Similarly, data on teachers' inputs such as paper qualifications, experience, areas of specialisation, etc., were collected and used to determine their effects on students' achievement in JSC Mathematics.

In quantitative research, a researcher relies on numerical data (Charles & Mertler, 2004). The researcher who uses logical positivism or quantitative research employs experimental methods and quantitative measures to test hypotheses (Hoepfl, 1997). Also, the researcher emphasises the measurement and analysis of causal relationships between the variables (Denzin & Lincoln, 1998). To shed light on the meaning of quantitative research for its use in explaining social problems, Bogdan & Biklen (1998, p.4) observe that:

Charts and graphs illustrate the results of the research, and commentators employ words such as 'variables', 'populations' and 'results' as their daily vocabulary...even if we do not always know what all of these terms mean...[but] we know that this is part of the process of doing research.

3.4.3 Research Population

The selection of a population is the most crucial stage in research. The term ‘population’ has been defined by various authors. In a statistical sense, the term population means the aggregate of persons or objects under study (Babbie, 2001). In methodological language, the population is defined as the place from where the relevant data is collected.

A population may be of virtually any size, and may cover almost any geographical area. The population that a researcher ideally would like to generalize to is referred to as the target population. The population that the researcher realistically can select from is referred to as the available or accessible population.

The selected population for this study was all JSC Mathematics teachers in Namibia. There are 573 secondary schools offering JSC in the 13 educational regions of Namibia. The target population of the Grade 10 Mathematics Teachers Baseline Survey is defined as all women and men teaching Grade 10 in all 13 regions of Namibia. This target population is covered through state and private junior secondary, secondary and combined schools in Namibia. For the purpose of this study, a JSC school is defined as any school housing grades 8, 9 and 10.

While junior secondary school students may write JSC examinations in nine subjects, this study will examine the Grade 10 Mathematics examination results only.

3.5 Sample Size and Sampling Procedures

A sample is a finite part of a statistical population whose properties are studied to gain information about the whole. “Sampling is the process of selecting a sufficient number of elements from the population so that by studying the sample, and understanding the properties or the characteristics of the sample subjects, we will be able to generalize the properties or characteristics to the population elements” (Sekaran, 1992, p.226). Basically, a sample is considered to be a subset of the population. There are many sampling techniques available to a researcher. Sampling techniques allow a researcher to collect the data from a subset or subgroup

rather than the whole population and therefore reduce the amount of data to fit the purpose of the study.

A good sample should possess the properties of the population from which it has been drawn. A sample is representative when it is an accurate, proportional representation of the population under study. For reliable conclusions to be drawn from the research, samples for research must be representative of the target group. There are various ways of achieving this to varying degrees, random samples often being regarded as the most reliable and statistically correct, but usually also as the most costly, compared to quota samples that select respondents to match certain criteria, for example socio-demographic. Quota sampling is more cost-effective while still being reliable.

3.5.1 Sample Size

The sample size is simply the number of people or units available to be studied. In this study, a stratified random sample of 150 JSC schools was drawn, adopting the procedure of proportional allocation.

Sample Size

The sample size for this survey was aimed at achieving reliable estimates at national level. The sample size (n) was calculated based on the following formula:

$$n = \frac{z^2 * p * q}{E^2}$$

where $z = 1.96$, taken as 2

$p = 0.5$, (since the order of the prevalence is unknown)

$q = 1-p$

$E = 7\%$ absolute margin of error

Under the above-mentioned conditions, the sample (n) comprised 204 individuals (schools), assuming one Grade 10 Mathematics teachers per school, and the design was a simple random sample (SRS). In testing the condition $n_o > 0.05N$, it was found that 0.05 (N = 573) equals 29 individuals, which is far less than the $n_o = 204$. Therefore, adjustment was done through a

deflator, using the correction factor, and a sample size of 150 individuals was obtained using the formula below:

$$n = \frac{n_o}{1 + \frac{n_o}{N}}$$

The final sample for this survey consisted of 150 schools/teachers in 13 regions.

Table 3.1: Distribution of the Sample Schools by Region

Region	Sample	Sampled	Total Number	Sampling
Caprivi	1	13	49	0.265
Erongo	1	7	26	0.269
Hardap	1	4	16	0.250
Karas	1	3	13	0.231
Kavango	1	15	55	0.273
Khomas	1	11	42	0.262
Kunene	1	3	12	0.250
Ohangwena	1	26	98	0.265
Omaheke	1	3	11	0.273
Omusati	1	29	111	0.261
Oshana	1	15	59	0.254
Oshikoto	1	17	63	0.270
Otjozondjupa	1	4	18	0.222
Total	13	150	573	0.262

3.5.2 Sampling Method

The selection of a research sample has important consequences for the validity of research findings (Vaus, 2001). The major purpose of conducting the research is to be able to make some claim about the larger population. Therefore, it is essential to choose a sample that enables the researcher to generalize findings to that larger population. Selection is usually performed in different ways. Random selection is a basic requirement to get better, comparatively accurate

information (Babbie, 2001). Most data are collected through sample surveys, and sampling is based on the theory of probability and inductive reasoning. Probability is the chance or likelihood of something happening. Through sampling, conclusions are derived about the characteristics of a larger entity by studying only a part thereof, which saves time, manpower and money (Hagood & Price, 1957).

Sampling essentially refers to choosing a portion of the target population for the study. The primary advantages of sampling are feasibility and convenience. If the target population is small, the entire population may be accessed. Otherwise, sampling methods should be applied.

The population of the present study is the 573 JSC secondary schools in the 13 regions of the country. Due to limited resources, the study is limited to 150 JSC Schools. A multi-stage sampling procedure was used due to limitations of time and resources within which this study had to be completed. Multi-stage sampling makes use of different sampling procedures at each stage. Stratification was used in the first stage, and random sampling in the second stage. The first stage units in multi-stage sampling are known as Primary Sampling Units (PSUs), while the second stage units are called Secondary Sampling Units (SSUs). The final stage units are known as the ultimate sampling units (USUs).

In the first stage of this study, a stratified random sampling procedure was adopted, based on the 13 educational regions of the country. The first stage units (regions) were selected using the probability equal to one. That implies that all regions would be selected. At the second stage of sampling, the selection of 150 JSC schools was made for the purpose of data collection to save time and resources. The schools were selected from a current list of schools stratified by region, using systematic sampling with a random start. The self-administered questionnaires to be completed by JSC Mathematics teachers were distributed to the targeted 150 JSC schools with the assistance of trained enumerators and the offices of the 13 Education Regional Directors. In the final stage, the units (JSC Mathematics teachers) for the 150 schools were selected from a current list of schools stratified by region, using systematic sampling with a random start. All eligible teachers completed the self-administered questionnaire.

3.6 Research Instrument

3.6.1 Introduction

The research instrument used for this study was a self-administered, structured questionnaire. According to Msokwa (2001), a questionnaire is a scientific instrument that is used to collect data, especially for primary information. The questionnaire consists of a form with a list of questions and spaces in which the respondents or enumerators fill in responses on the subject matter of the investigation.

On procedures for the construction of questionnaires, Mitchell (2005) points out that for a researcher to design a questionnaire, he or she should find out as much information as possible from previous researchers on the same topic or related topic. The questionnaire development, structure and composition are discussed below.

3.6.2 Questionnaire Construction

The self-administered questionnaire for this study was adopted from the United State of America National Assessment of Educational Progress (NAEP) studies on the effects of teachers' characteristics on students' achievement in Mathematics at high school level, and was also based on professional development programme reports from the Ministry of Education in Namibia.

In December 2010, the researcher contacted NAEP for permission to adopt items in the studies of Wenglinsky (2002), and Akiba et. al (2008) to conduct a study on the impact of teacher-related variables in students' achievement in JSC schools in Namibia. On 20th December, 2010, Dr. Arnold A. Goldstein, Director for the Design, Analysis, and Reporting Assessment Division of NAEP, and Professor Dorn Sherman, former editor of Education, Policy Analysis Archive (EPAA), granted me permission to adopt items from the questionnaires of both Wenglinsky (2002) and Akiba et al.(2008). In addition, based on the advice of Professor Sherman and Dr.Goldstein that I could adopt any items from questionnaires in EPAA studies because they are in the public domain, I adopted some items from questionnaires used in the EPAA studies of Easton-Brooks & Davis (2009) and Ingvarson et.al (2005).

Three major categories were included in the questionnaire to establish the effects of teacher-related variables on students' academic achievement in JSC Mathematics for 2006 to 2010. The scales (constructs) in the questionnaire were: teachers' biographical information (inputs data), teachers' teaching practices, teachers' professional development, and teachers' pedagogical knowledge and pedagogical content knowledge.

Items dealing with teachers' biographical profile included teachers' gender, years of teaching experience, academic qualification, subject specialisation etc.. These items were selected because they were reported to have a relationship with students' academic achievement in Mathematics in previous studies (see Darling-Hammond, 2000; Hanushek et al., 2005; Goldhaber & Brewer, 1995; Monk, 1994; Wenglinsky 2000, 2002 etc.). The items were adopted from a study conducted by Wenglinsky (2002) entitled: "How School Matters: The link between teacher classroom practices and student academic performance", and a study by Easton-Brooks and Davis (2009) entitled: "Teacher qualification and the Achievement Gap in Early Primary Grades". Wenglinsky (2002) and Davies et al. (2009) concluded that teachers' majors and certification were significant predictors of students' academic achievement at high school and primary level.

Items on teaching practices and management were inspired by the works of Akiba et al. (2008) entitled: "Standards-based Mathematics Reforms and Mathematics Achievement of American/Alaska Native Eight Graders". The findings of Akiba et al. (2008) were mixed in terms of teachers' reported standards-based instructions and students' reported standards-based classroom activities. The researchers found that teachers' reported standards-based instruction was not significantly associated with students' performance with regard to American-Indian/Alaska Native (AIAN) students. However, the researchers found that students' reported standards-based classroom activities were significantly associated with the achievement of AIAN students.

Items on teachers' professional development and its impact on teaching practices and students' academic achievement were drawn and adapted from a study conducted by Ingvarson et al. (2005) entitled: "Factors Affecting the Impact of Professional Development Programmes on

Teachers' Knowledge, Practice, Student Outcomes and Efficacy", and a study by Wenglinsky (2002) entitled: "How School Matters: The link between teacher classroom practices and student academic performance", published in EPAA.

In his findings, Wenglinsky concluded that teacher's professional development in higher-order thinking skills, hands-on learning, and professional development in diversity correlated positively with students' academic achievement. Similarly, Ingvarson et al. (2009) found that teachers' professional development in content focus and active learning correlated positively with students' academic achievement in Mathematics.

The fourth section of the questionnaire in this study addressed content knowledge for teaching Mathematics. A key feature of this measure was that it represented the knowledge teachers used in classrooms rather than general mathematical knowledge. Items on teachers' content knowledge were drawn from and the National Assessment of Educational Progress (NAEP).

3.7 Data Collection Methods

3.7.1 Introduction

Secondary information was obtained from publishers of various materials such as textbooks, journals and previous studies on the subject. Furthermore, data for students' academic results in Mathematics for the JSC Mathematics (2006 - 2010) were obtained from the Directorate of National Examinations and Assessment (DNEA) in Windhoek, Namibia. Information not obtainable from publications that were relevant to the study purpose was gathered through the use of questionnaires directed at the target group of this study.

The primary information was gathered by means of an empirical study. Respondents were requested to complete a questionnaire comprising both open-ended and closed questions. The questions were formulated according to a model established during the literature study.

3.7.2 Data collection procedures

Permission was obtained from the Permanent Secretary of the Ministry Education (MoE) and the 13 Regional Directors of Education (RDE) in order to gain access to the target schools that were selected by means of a systematic sampling method.

In the process of data collection, a brief introduction to the questionnaire was provided and informed consent was obtained from participants who had been selected in the JSC schools in the 13 educational regions of the country. The procedures for the data collection and conducting of the study are briefly discussed below:

Step 1: Upon receiving approval from the both the Permanent Secretary of the Ministry of Education and the 13 Regional Directors of Education, the researcher recruited as enumerators 26 In-Service Education and Training (INSET) teachers and pre-service teachers who were pursuing their studies through distance mode at the University of Namibia.

Step 2: The researcher conducted two days' training on the administration and collection of data from the targeted schools, using the questionnaire as a guide. At the training session, each enumerator received a packet that included the questionnaire, consent form, approval letters from the Ministry of Education and the acknowledgement letters for confirmation by principals of the target schools that the enumerators had permission to visit their schools.

Step 3: The collection of data was done between April and June, 2011. Enumerators were deployed to the 13 Education Regions based on their familiarity with the regions and JSC schools.

Prior to the deployment of the enumerators, the researcher had distributed the questionnaires in advance to the target schools through the 13 Education Regional offices.

Step 4: After the collection of the questionnaires from the enumerators, the researcher coded the schools for data analysis. The researcher hired vehicles and, in addition, paid a daily allowance

to enumerators. Most of the school principals returned the completed questionnaires either by post or through the Regional Education offices.

3.8 Pilot Test and Coding

3.8.1 Pilot Testing

Pre-testing of the questionnaires is a pre-requisite of data collection. It provides not only correctness and interpretation of the questionnaire, but also provides the possibility of discovering new aspects of the problem being studied (Young, 1962).

Prior to collecting the data from the sample, the researcher pilot-tested the questionnaire using teachers from secondary schools that were not in the sample. The purpose of this pilot test was to determine the clarity of items on the questionnaire and to establish the reliability of the instruments. The pilot study was conducted in secondary schools in rural and urban areas of the 13 education regions. This pilot study was limited to 10 secondary schools.

After completing the questionnaire, respondents in the pilot test observed that some items appeared to be repetitive (or were interpreted as having the same meaning as another statement). Furthermore, it was suggested that items regarding teacher's mathematical knowledge should include only items in the new JSC mathematics curriculum.

Based on the above points, the researcher included only eight items in the section on mathematical content knowledge instead of ten items. Two of these items concerned the Senior Phase of secondary school. Dr. Miranda of the Ministry of Education then reviewed the final version of the questionnaire and agreed that the questionnaire was valid and should be administered to the JSC Mathematics teachers.

3.8.2 Coding

Computer analysis typically requires that people's answers to questions or the researcher's own observations be converted into numbers. This conversion process is called coding. It involves

four main steps: allocating codes for answers to each question (or variable); allocating computer columns to each question; producing a code book; and checking codes (Bryman & Duncan, 2001).

In this study, the studied variables were first edited to minimize error, and then a code book listing of all variables and value labels was prepared. Each variable label had its own name consisting of a specified maximum number of characters. For example, the variable 'Sex' has two possible values, male or female. The values of male and female were coded as 1 and 2, respectively. All the coded values were entered to prepare the tally sheet.

3.9 Validity and Reliability of the Instruments

Validity and reliability are the fundamental components used in assessing the quality of instruments (Cramines & Sellar, 1979, as cited in Mayer, 1999). This section discusses the meaning and definitions of reliability and validity in quantitative research, the approach that is used in this study.

3.9.1 Validity

The validity of an instrument is the degree to which the measured value reflects the characteristics it is intended to measure. Validity indicates that the study has investigated the intended subject, and nothing but the subject (Thuren, 1991, p.130). It is also concerned with how accurately the observable measures actually represent the concept in question or whether, in fact, they represent something else. Bless & Higson-Smith (1995, p.135) suggest questions to test validity as being 'What does the instrument measure?' and 'What do the results mean?'

Wainer & Braun (1998) depict the validity in quantitative research as 'construct validity'. The construct is the initial concept, question or hypothesis that determines which data is to be collected and how it is to be collected.

There are basically four forms of validity: content validity, construct validity, criterion validity and face validity. Content validity refers to the degree to which the content of a test or questionnaire covers the extent and depth of the topic it is intended to cover.

3.9.1.1 Validity of Study Questionnaire

The content validity in the current study refers to the extent to which the items in the questionnaire and the scores from these questionnaires are representative of all possible teacher-related variables that influenced the JSC students' achievement in Mathematics. The items in the questionnaires were adopted from studies of Wenglinsky (2002), Akiba et al. (2008) and Ingvarson et al. (2009), as published in EPAA, that established a link between teachers' relative variables and students' academic achievement in Mathematics. For the current study, adoption of some items from these questionnaires helped establish the relevance of the items in the study questionnaire's ability to measure the impact of the teacher-related variables on students' achievement in JSC Mathematics.

Construct validity refers to the consistency between the questions on a questionnaire and accepted theoretical constructs related to the subject being studied. It is based on a logical relationship between variables (Babbie, 2001). Babbie furthermore maintains that construct validity will address the concern as to whether the results produced by a researcher's measuring instrument are able to correlate with other related constructs in the expected way. To address construct validity, the results of the current study will be compared or correlated with the results from studies measuring related constructs dealing with the impact of teacher-related variables on students' achievement in Mathematics.

Criterion-related validity refers to the degree to which the content of the questionnaire covers the extent and depth of the topics it is intended to cover (Bless & Higson-Smith, 1995). Bless & Higson-Smith further contend that one way to test whether an instrument measures what it is expected to measure is to compare it to another measure which is known to be valid. For this purpose, this researcher adopted the instruments from EPAA studies that focused on the impact of teacher-related variables on students' achievement in Mathematics. The measures and

procedures of the instruments used in those studies have proven to have criterion-related validity (see Wenglinsky, 2002; Akiba et al., 2008).

3.9.1.2 Validity of JSC Examination

The content validity of the JSC Mathematics question papers for 2006 to 2010 was established by judgment of the subject by experts such as officers and specialists from the Colleges of Education and the University of Namibia as well as staff of both the DNEA and NIED. The questions are usually drawn from a pool of JSC examination questions set by Mathematics teachers and examiners. The experts' judgement seeks to establish whether the means of measurement are accurate and whether they are actually measuring what they are intended to measure. They establish that the questions are in line with the JSC syllabus content and are appropriate for the time allocations before the Mathematics question papers are adopted for the purpose of the JSC Mathematics examinations. JSC examination questions are always set up six months before the examinations are written in October of each year.

3.9.2 Reliability

Reliability is the extent to which the observable (or empirical) measures that represent a theoretical concept are accurate and stable when used for the concept in several studies (Bless & Higson-Smith, 1995, p.129). Reliability is concerned with the consistency of measures thus: "An instrument is reliable to the extent that independent administration of it ... yields consistently similar results' (De Vos, et al., 1998, p.85).

According to Joppe (2000, p.2), reliability in quantitative research can be defined as 'the extent to which the results are consistent over time and an accurate representation of the total population under study ... and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable'.

Kirk & Miller (1986, p.42) recognise three types of reliability referred to in quantitative research, relating to the degree to which a measurement, given repeatedly, remains the same, the stability of a measurement over time, and the similarity of measurements within a given time period.

3.9.2.1 Reliability of Questionnaire Items

In this section, the researcher discusses how reliability tests were carried out on the four scales (constructs).

The reliability of the questionnaire was tested using Cronbach's Alpha coefficient. This was deemed to be appropriate because it requires only a single administration and provides a unique quantitative estimate of reliability for the given administration. It measures how well a set of items (variables) measures a single one-dimensional latent construct (Lapsley, 2006). It is considered to be a conservative (lower bound) estimate of reliability, meaning that the true relationship is likely to be not lower than this estimate (Lapsley, 2006). The value of the coefficient of reliability falls between 0 and 1. An instrument with no reliability will score 0 and an instrument with very high reliability will score close to 1.

The four scales that were tested to determine their reliability are presented in Table 3.2.

Table 3.2. Overall Correlation / Consistency between Variables in the Teachers' Questionnaire (Reliability of the Scales)

Construct	Cronbach's Alpha(α)	Number of items
Teachers' biographical data	0.654	19
Teachers' mathematical content knowledge (MCK)	0.883	8
Standards-based professional development (SBPD)	0.812	11
Standards-based classroom activities (SBCA)	0.725	15
Teachers' pedagogical content knowledge (PCK)	0.612	8
Teachers' classroom management beliefs	0.725	11
All	0.757	72

Computation of Cronbach's coefficient alpha:

$$\alpha = \frac{n}{n-1} \left[\frac{1 - \sum S_i^2}{S_x^2} \right]$$

where:

- α = is the estimate of reliability
- N = is the number of items in the instrument
- S_i^2 = is the variance of the individual scores
- S_x^2 = is the variance of the individual(s) total scores on all the items

Cronbach's coefficient alphas of 0.88, 0.61, 0.76, and 0.73 were obtained by using scores of 4,3,2,1 for the responses on items for teachers' mathematical content knowledge, pedagogical content knowledge, classroom management beliefs, and classroom instruction (see questionnaire). These coefficients are above average and seem to suggest that the items in the questionnaire hang together or measure the same construct.

3.10 Data Analysis Method and Procedures

This study was conducted as a survey that used both descriptive statistics and inferential statistics to analyse the data. The study utilised a quantitative approach to collect and analyse the data, and an ex post facto correlation research design (Gall, Borg & Gall, 2006). Multiple regressions are the recommended procedure when the researcher is interested in predicting a dependent variable from a set of predictors (Stevens, 1996). Multiple regression analysis was conducted to assess predictions of students' performance.

The eight measured variables in this study are labelled as: teachers' academic qualifications, teachers' teaching experience, teachers' subject specialisation (a mathematics major was coded as "1" and a non-mathematics major was coded as "0"), teachers' mathematical content knowledge, teachers' exposure to standards-based professional development, teachers' use of standards-based classroom activities, teachers' pedagogical content knowledge, and teachers' classroom management beliefs.

The data collected was analysed in a three phase methodological approach including descriptive statistics, correlational analysis and regression analysis.

3.10.1 Phase 1: Descriptive Statistics

Descriptive statistics, including frequency counts, percentage of respondents choosing the different response category of the respective measuring instruments, means (M) and standard deviations (SD) of frequencies were used to describe teachers' biographic characteristics, the extent to which teachers use standards-based classroom activities, and teachers attitudes toward standards-based classroom management techniques.

Response Frequencies

A statistical summary was made of the independent variables. These variables comprise the percentage of male and female Mathematics teachers, sample size, teachers' experience, teaching qualifications etc. Response frequencies for individual items were included to give a broad picture of the patterns yielded by the participating samples. Also, frequency distributions were used to determine the most frequent factors relating to teachers' professional development and classroom teaching practices, and these statistics were used in the correlation analysis in Phase 2.

3.10.2 Phase 2: Correlation Analysis

In Phase 2, a correlation analysis of students' academic achievement with teachers' background characteristics, professional development and classroom teaching practices was performed using Statistical Pack for Social Science (SPSS) computer software.

A correlation analysis was carried out in order to identify the extent of the relationship between the dependent variable (students' achievement) and the independent variables (teachers' background characteristics, professional development and classroom teaching practices).

3.10.3 Phase 3: Regression Analysis

A regression analysis was carried out between students' achievement and the correlated variables identified in Phase 2 to ascertain the nature of the relationship between variables. The output of the regression analysis shed light on how the variables that significantly affect students' academic gains in Phase 2 could predict students' achievement.

3.10.4 Coding of Independent Variables and Dependent Variable

- **Independent variables**

The teachers' qualifications, teachers' teaching experience, teachers' usage of standards-based classroom practices and teachers' exposure to standards-based professional development were quantified using the Likert scale as depicted in Appendix 1. Also, the coding for subject specialization was quantified as "1" for teachers who majored in pure Mathematics or Mathematics education, and "0" for teachers who did not major in Mathematics.

- **Dependent Variable**

The dependent variable was the students' JSC Mathematics results for 2006 to 2010. Each school was used as a unit of analysis.

Academic achievement was determined for each school by getting the cumulative percentage for all the students in that particular school that obtained a grade "D" or better. The JSC grading points system is as follows: A (70%-100%), B (60%-69%), C (50%-59%), D (40%-49%), E (30%-39%), F (20%-29%), G (10%-19%), and U (0%-9%). The final academic achievement was computed by aggregating the scores for 2006 to 2010.

Average pass rate per school

Students' academic achievement (performance) is represented by the average pass rate for each school over the years 2006 to 2010. The average pass rate was captured as

$$\bar{X}_s = \frac{\sum_{t=2006}^{2010} P_t}{n} \quad \text{or} \quad \bar{X}_s = \frac{(P_{2006} + P_{2007} + P_{2008} + P_{2009} + P_{2010})}{5}$$

where:

\bar{x}_s = The average performance (pass rate for a grade D or better) for each school (JSC mathematics teacher).

\bar{x}_s = The dependent variable, which the researcher used to find the correlations with other teacher constructs (independent) variables.

For example, Performance (students average pass rate for 2006 to 2010) =

$F(\text{Teachers' qualifications})$.

The researcher used average pass rate as the proxy of students' academic achievement. To find the correlations then the researcher correlated: \bar{X}_s With F (teachers' qualifications per school).

Representing this equation in Tabular form:

Table 3.3. Hypothetical Sample Data on Teachers' Qualifications and Average Pass Rate per School

Name of school Starting from 1 to 150	F(Teachers' qualifications)	Y(P)=Average pass rate per school(Grade D Or better)
JSC School no.1	2	30
JSC school no. 2	4	40
.	.	.
.	.	.
JSC No. 150	6	50

Academic qualifications were coded as "1"= 1-Year training certificate to "6" = 5-Year (or more) Master's degree.

Table 3.3 was used as a guide to find the strength of the correlation between the teachers' academic qualifications and the students' academic achievement in Mathematics. Similarly, other teacher constructs were correlated with students' academic achievement using the format of Table 3.3.

3.11 Ethical Considerations

It is the responsibility of the researcher to ensure that the research project is conducted in an ethically appropriate manner. Ethics "is a set of moral principles ... which offers rules and

behavioural expectation about the most correct conduct towards experimental subjects and respondents” (De Voss et al., 1998 p.24) and every other role player in the research project.

The ethical issues related to this research project were addressed as follows:

3.11.1 Informed consent

De Vos (1998, p.p.25 -26) postulates that informed consent relates to the communication of all possible information about the research as accurately as possible to participants. The participants in this research were Grade 10 (JSC) Mathematics teachers with the capacity to give informed consent directly. Consequently, the researcher provided information about the purpose of the study to the participants. This was done by attaching a covering letter to the questionnaire that stated the purpose of the study. Issues related to the research such as aims, procedures of investigation, and possible advantages or disadvantages, were shared with the participants.

3.11.2 Anonymity

Generally, anonymity does not constitute a serious constraint in research, as social scientists usually are more interested in group data, and in averages rather than in individual results. Thus, either the names of participants can be omitted altogether or respondents can be identified by number instead of by name. Since anonymity is regarded as essential by many respondents, they must be convinced that it will be respected. To avoid possible harm to participants, anonymity in this study was ensured by not collecting participants’ names.

3.11.3 Confidentiality

In general, social scientists should accept responsibility for protecting their participants. In many studies, anonymity cannot be maintained, especially when data is collected using interviews and /or questionnaires. The interviewer has direct contact and is able to recognise each one of the respondents. In this case, respondents must be assured that the information given will be treated with confidentiality. In order to address confidentiality, the respondents were assured that data would only be used for the stated purpose of the study at the University of South Africa, and no other person would have access to the raw data.

3.11.4 Voluntary Participation

Participation was strictly voluntary, with respondents having the freedom to withdraw at any time. This was explained to them before the research commenced.

3.11.5 Respect

All research participants were treated with respect (Grasso & Epstein, 1992, p.119). No teacher was forced to take part in the study. Participants had the right to refuse to participate in the study, and this right was respected.

3.11.6 Publication of Findings

Ethics demand that researchers be honest in reporting their findings (Babbie, 2001). Similarly, De Vos, et al.(1998:32) recommend that the research report should be compiled as accurately, objectively and clearly as possible, in order for the reading public to understand and gain benefit from the research findings. In order to address the views of these authors, the findings that are reported in this study focus on the data derived from the teachers that were correlated with the JSC Mathematics results of 2006 to 2010.

3.11.7 Limitations of the Research

The limitations of this study could be attributed to the following:

Firstly, the data are cross-sectional. The information about aspects of teacher quality was collected at the same time as student test scores (JSC).

Limitations of this study include the number of subject areas, grade level examinations and the availability of current data related to teacher-related variables. The examination of only the JSC students (Grade 10) subgroup also limited the scope of the study.

National Mathematics examinations are administered to students in Grade 10 and Grade 12. Only the results of students' performance in Grade 10 (JSC) were included in the study.

This research was limited to 150 secondary schools in Namibia out of a total of 573. The scope of the study was limited to JSC Mathematics teachers only in those 150 schools.

3.12 Conclusion

This chapter provided an overview of the research design, regions and study subjects, instrumentation, data collection methods, and data analysis procedures. The purpose of the study was to determine the impact of qualifications, characteristics, classroom practices and teachers' professional development on students' academic achievements in JSC Mathematics for 2006 to 2010, as measured by the Grade 10 JSC Mathematics examinations. Analysis of covariance, multiple regression, and logistic regression were employed as the statistical tools.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents the results of the data analyses. Data was collected from Mathematics teachers concerning their demographic information, qualifications, subject majors, professional development and Mathematics teaching practices by means of a self-report questionnaire. Students' achievement grades were collected from the Directorate of National Examinations and Assessment (DNEA). Both descriptive and correlation statistics were used to analyse the data. First, the chapter presents the descriptive statistics of data collected from the teachers, followed by the correlation analysis and regression analysis of the variables with students' achievement. Using these data analyses techniques, the research hypotheses were tested.

4.2 Descriptive Statistics for Teachers' Demographic Characteristics

4.2.1 Teachers' Gender, Academic and Professional Qualifications, and Subject Specialisation

Table 4.1 provides detailed statistics for teachers' demographic characteristics by gender, academic qualifications, professional qualifications and subject specialization.

Table 4.1. Gender, Academic and Professional Qualifications and Subject Specialization

		Number	Percentage
			%
Gender	Male	87	60.4
	Female	57	39.6
	Total	144	100
Academic Qualifications			
	1-2 year training certificate	4	2.5
	3 year training diploma	92	57.5
	4 year Bachelor's /Honours Degree	53	33.1
	5 year or Master's Degree	3	1.9
	Others	8	5.0
	Total	160	100
Professional Qualifications			
	No teacher training	7	4.6
	1-2 teacher year training certificate	43	28.5
	3 year teacher training certificate	46	30.5
	4-5 year teacher training certificate	32	21.2
	Other	23	15.2
	Total	151	100
Subject specialization			
	Mathematics	153	93.3
	Biology	7	4.3
	Physics	3	1.8
	Other	1	0.6
	Total	164	100

4.2.2 Teachers' Teaching Experience And Duration of Professional Training

Table 4.2 illustrates the statistics for JSC teachers' teaching experience, the length of time they had been teaching JSC Mathematics in their current school, and the amount of time they were exposed to professional development between 2008 and 2010.

Table 4.2 General Teaching Experience, Length and Professional Development

		Number	Percentage %
General Teaching experience			
Less than 2 years		19	11.9
2-5 years		52	32.5
6-9 year		36	22.5
10 years and above		53	33.1
Total		160	100
Length of time teaching Mathematics in current school			
Year			
2006	Grade 10	31	22.8
2007	Grade 10	11	8.1
2008	Grade 10	21	15.4
2009	Grade 10	16	11.8
2010	Grade 10	57	41.9
Total		136	100
Duration of teachers' professional development(2008-2010)			
Less than 5 hours		55	41.0
6-15 hours		32	23.9
16-20 hours		18	13.4
21-40 hours		13	9.7
41-59 hours		6	4.5
60 hours		10	7.5
Total		134	100

Table 4.2 reveals that one-third (33.5%) of the teachers had taught JSC Mathematics for more than 10 years, while 32.2% and 22.4% of the teachers had taught JSC Mathematics for 2-5 years and 6-9 years respectively. Furthermore, 57 (41.9%) of the teachers in the study had taught JSC Mathematics in the same school for 5 years. Table 4.2 also reveals that while most teachers had received some professional development training between 2008 and 2010, this professional development tended not to be of long duration. Forty-one percent of the teachers indicated the total number of hours they had attended professional training between 2008 and 2010 as being less than 5 hours.

4.3 Professional Development Experience of JSC Mathematics Teachers in Standards- Based Professional Development (SBPD)

Table 4.3 presents statistics on the professional development experience of JSC Mathematics teachers in Standards- Based Professional Development.

Table 4.3. Professional Development Experience of JSC Teachers in Standards-Based Activities (n=162)

Statement on participation in standard-based PD	M	SD
Problem solving in Mathematics (1 = yes, 2 = no)	1.21	0.86
Use of manipulatives (e.g. counting blocks, algebra tiles or geometric shapes) in Mathematics instructions (1= yes, 2 = no)	1.25	0.453
Understanding students' thinking about Mathematics in professional development workshops or seminars (1 = yes, 2 = no)	1.39	0.489
Classroom management (1 = yes, 2 = no)	1.30	0.461
Cooperative learning (1 = yes, 2 = no)	1.38	0.488
Cultural diversity (1 = yes, 2 = no)	1.66	0.474
Higher-order thinking skills (1 = yes, 2 = no)	1.51	0.502
Limited English proficiency (1 = yes, 2 = no)	1.61	0.489
Interdisciplinary instruction (1 = yes, 2 = no)	1.60	0.492
Performance-based assessment (1 = yes, 2 = no)	1.39	0.904
Special-needs students (1 = yes, 2 = no)	1.62	0.487

The statistics in Table 4.3 show that most JSC students had teachers who had received some standards-based professional development (SBPD) in the previous three years on the most

common topics, such as problem solving, classroom management, performance-based assessment, co-operative learning or understanding student thinking. The mean (M) and standard deviations (SD) were computed for each of the 10 standards-based professional development criteria reported by the teachers. The responses for each were coded as 1= yes if teachers attended the professional development and 2 = no if the teachers did not attend the professional development. The mean focus is the average emphasis placed on the 10 standards-based professional development criteria for teachers. Taking 1.5 as the mean average, only five of the standards-based professional development criteria scored less than 1.5, implying a weak ‘yes’ for teachers’ reported involvement in standards-based professional development training.

4.4 Standard-Based Classroom Practices

4.4.1 Standard-Based Classroom Instruction of JSC Mathematics Teachers

For the teacher survey, two measures were developed (see Tables 4.4 and 4.5) which included the teachers’ reports on their use of standards-based instruction in classrooms. The study asked Mathematic teachers to indicate the frequency with which their students did each of the following: participated in whole class discussion, addressed geometry assessment using multiple-choice questions, completed assessments using portfolios, completed assessments using individuals projects etc..

The teachers’ responses for each were coded as 1 = never or hardly ever, 2 = 1-2 times a month, 3 = 1-2 times a week, and 4 = once or twice a week. The mean and standard deviations (SD) were computed for each of the 10 standards-based instruction techniques reported by the teachers.

Table 4.4. Frequency of Usage of Standards-based Classroom Activities by Teachers (n=164)

Statement on usage of standards-based classroom activities	M	SD
Introduce content through formal teacher presentation	3.64	0.682
Pose open-ended questions	3.53	0.661
Use whole class discussions	3.18	0.792
Require students to explain their reasoning when giving an answer	3.83	0.65
Ask students to explain concepts to one another	3.16	0.782
Ask students to consider alternative methods for solutions	3.66	0.782
Ask students to use multiple representations (e.g. numeric, graphic, geometric, etc.)	2.84	0.902
Allow students to work at their own pace	3.05	0.989
Help students see connections between Mathematics and other disciplines	3.62	0.786
Assign Mathematics homework	3.80	0.500
Read and comment on the reflections students have written (e.g. in journals)	2.46	1.180
Complete assessments using multiple-choice questions	1.64	0.900
Complete assessments using portfolios	3.07	0.933
Complete assessments using individual projects	1.96	0.453

The statistics in Table 4.4 show that the teachers introduced content knowledge through formal teacher presentation, asked students to explain concepts to one another, posed open-ended questions, used whole class discussions, allowed students to work at their own pace, assigned Mathematics homework and asked students to see connections between Mathematics and other disciplines, and assessed students using portfolios 1-2 times per week during Mathematics lessons in class. Also, teachers reported that they assessed students by using multiple-choice questions, or assessed students by using individual projects 1-2 times per month during Mathematics lessons in class.

4.4.2 Standards-Based Classroom Activities by Students.

The survey asked Mathematics teachers to indicate the frequency with which students did each of the following activities: discussed issues with other students, used textbooks to solve real-life problems, designed their own activities and listened and took notes etc.. Their responses were coded as 1 = never to 4 = almost every day. The mean and standard deviations for each of the 14 items were computed.

Table 4.5. Frequency of Usage of Activities by Students (n = 160)

Statement	M	SD
Listening and taking notes during presentation by teacher	3.49	0.861
Working in groups	3.04	0.721
Reading from a Mathematics textbook in class	3.41	0.861
Talking with other students during class about how they solve Mathematics problems	3.83	0.54
Engaging in mathematical activities using concrete materials	3.31	0.752
Reviewing homework/worksheet assignments	3.46	0.783
Following specific instructions in an activity or investigation	3.11	0.873
Designing their own activity or investigation	1.99	0.940
Using mathematical concepts to interpret and solve applied problems	3.23	0.784
Answering textbook or worksheet questions	3.51	0.782
Recording, representing, and/or analysing data	2.59	0.941
Talking to the class about their Mathematics work	3.46	0.876
Making formal presentations to the rest of the class	2.81	0.564
Working on extended mathematics investigation or projects	2.31	0.743
Using calculators or computers for learning or practicing skills	3.64	0.832
Taking Mathematics tests	2.56	0.731
Discussing solutions to Mathematics problems with other students	3.27	0.790
Solving and discussing Mathematics problems that reflect real-life situations	3.09	0.935

The statistics in Table 4.5 show that teachers reported that they asked students to work in groups, engaged students by using concrete materials, reviewed students' homework or asked students to solve and discuss mathematics problems that reflected real-life situations 1-2 times a week. Also, students were asked to design their own activities or work on extended Mathematics projects 1-2 times per month.

4.5 Teachers' Mathematical Content Knowledge (MCK)

The survey asked Mathematics teachers to indicate the extent to which they understood and could explain mathematical concepts in the new JSC Mathematics syllabi to students. The teachers indicated the extent of their knowledge of numbers, money and finance, mensuration, geometry, algebra, graphs and functions, statistics and probability and trigonometry. Their responses were coded as 1 = little or no knowledge, 2 = somewhat knowledgeable, 3 = knowledgeable and 4 = very knowledgeable.

Table 4.6. Mathematics Content Knowledge (n=164)

Statement	M	SD
Numbers: I can solve problems involving direct and indirect proportions (e.g. draw straight line graphs of relationships that are in direct or indirect proportion)	3.62	0.580
Money and finance: I can interpret municipal bills hire purchase and personal income tax (e.g. calculate the compound interest earned on an amount over a period of 2 or 3 years)	3.67	0.521
Mensuration: I can use and teach the concepts of volume and surface area of a cylinder and a cuboid in problems and structured questions (e.g. calculate the unknown dimensions of cuboids and cylinders, if the volume or surface area and sufficient other information are given).	3.77	0.499
Geometry: I can construct and describe enlargements, scale drawings and nets; apply the properties of similar triangles, regular and irregular polygons, angles in circles.	3.64	0.552
Algebra: I can carry out the four basic operations with algebraic fractions; solve linear equations which contain brackets and fractions; solve quadratic equations by factorization.	3.73	0.474
Graphs and Functions: I can draw and interpret $y = mx + c$, find the equation of a straight line graph; draw parabola and hyperbola from tables and interpret graphs. (e.g. construct tables of values of functions of the form	3.60	0.593
Statistics and probability: I can draw and interpret histograms with equal intervals, find the modal class of a frequency distribution, calculate the probability of a simple event occurring.	3.55	0.648
Trigonometry: I can use the sine (sin), cosine (cos) and tangent (tan) ratios to solve problems in right-angled triangles; interpret angles of elevation and depression (e.g. solve problems in two dimensions using angles of elevation and depression)	3.72	0.502

The statistics in Table 4.6 show that teachers were knowledgeable in JSC Mathematics topics in the curriculum. The findings seem to suggest that the teachers understood and could explain

topics such as algebra, geometry, trigonometry and statistics and probability etc. to JSC students in class.

4.6 Teacher’s Mathematical Pedagogical Knowledge (MPK)

The survey asked teachers to indicate the extent to which they used standards-based mathematical pedagogical knowledge and pedagogical content knowledge in their classrooms. Their responses were coded as 1 = not at all to 4 = to a high extent. The statistics in Table 4.7 indicate that all teachers adopted standards-based mathematical pedagogical knowledge to some extent.

Table 4.7. Perceived Mathematical Pedagogical Knowledge (MPK) of JSC Teachers’ (n=164)

Statement	M	SD
I can use a wide range of teaching approaches in a classroom setting (collaborative learning, direct instruction)	3.28	0.562
I can adapt my teaching style to different learners; I can assess student learning in multiple ways	3.43	0.638
I know how to assess student performance in a classroom	3.48	0.642
I am familiar with common student understandings and misconceptions	3.4	0.45
I can assess student learning in multiple ways	3.25	0.46

4.7 Teachers Pedagogical Content Knowledge (PCK)

The study asked teachers to indicate their agreement or disagreement on three standards-based pedagogical content knowledge (PCK) concepts that they practiced in their classrooms. The responses were coded as 1 = strongly agree, 2 = agree, 3 = disagree, and 4 = strongly disagree.

Table 4.8. Pedagogical Content Knowledge (PCK) (n = 164)

Statement	M	SD
I know that different mathematical concepts do not require different teaching approaches.	3.21	0.861
I know that different literacy concepts do not require different teaching approaches	3.1	0.807
I know how to select effective teaching approaches to guide student thinking and learning in Mathematics	1.70	0.686

The statistics in Table 4.8 show that the teachers disagreed that these three different mathematical concepts required different teaching approaches. They also disagreed that different literacy concepts required different teaching approaches. However teachers agreed that they knew how to select effective teaching approaches to guide students' thinking and learning in Mathematics.

4.8 Teacher's Beliefs Regarding Classroom Management

The survey asked the teachers to indicate the extent to which they managed standards-based classroom instructions or activities. The responses were coded as 1 = not at all to 4 = to a high extent. The statistics in Table 4.9 suggest that the teachers managed 11 out of 12 standards-based classroom instruction or activities to some extent. Also the teachers indicated that they could assist families only slightly in helping their children to do well in school.

Table 4.9. Teachers Beliefs Regarding Classroom Management (n = 162)

Statement	M	SD
How much can you do to control disruptive behaviour in the classroom	3.57	0.648
How much can you do to motivate students who show low interest in school work	3.36	0.587
How much can you do to get students to believe they can do well in school work?	3.49	0.560
How much can you do to help your students' value learning?	3.41	0.586
To what extent can you draft good questions for your students?	3.44	0.588
How much can you do to get children to follow classroom rules?	3.53	0.588
How much can you do to calm a student who is disruptive or noisy?	3.58	0.520
How well can you establish a classroom management system with each group of students?	3.31	0.593
How much can you use a variety of assessment strategies?	3.43	0.56
To what extent can you provide an alternative explanation or example when students are confused?	3.58	0.565
How much can you assist families in helping their children do well in school?	2.77	0.701
How well can you implement alternative strategies in your classroom?	3.33	0.637

The above discussion on teachers' demographic characteristics and classroom practices raises the question of whether the classroom practices which are understood to be effective are indeed so. "Effectiveness" implies that standards-based classroom instruction would improve students' JSC Mathematics results. This gives rise to the question of whether applications of standards-based activities such as use of whole class discussion, on-going assessment etc., are indeed associated with high student achievement in JSC Mathematics. The next section seeks to answer this

question by linking teachers' inputs, professional development, and classroom practices to students' JSC Mathematics results.

4.9 Linking Teachers' Inputs, Professional Development, and Classroom Practices to Students' JSC Mathematics Results

In this section a correlation analysis was used to determine the extent to which teachers' inputs, professional development, and classroom practices are associated with students' academic achievement, while a regression analysis was used to establish the effects of these teacher variables on students' achievement. For this study, five sets of teacher-related variables that have a potential influence on students' JSC Mathematics results were considered. They are: teachers' inputs, teachers' professional development, teachers' standards-based classroom practices, teachers' pedagogical knowledge and teachers' beliefs regarding classroom management techniques. The independent variables (predictors) were:

Inputs

Teachers' teaching experience, teachers' academic qualifications, teachers' subject specialisation (a major in Mathematics, Science or other subject), teachers' gender, teachers' mathematical content knowledge, teachers' participation in standards-based classroom activities, teachers' perceived mathematical pedagogical knowledge, teachers' perceived pedagogical content knowledge, and teachers' classroom management beliefs)

Outputs

The dependent variable (criterion) was the JSC Mathematics results for 2006 to 2010

The extent of the association between the teacher-related variables (independent variables) and students' JSC Mathematics result (dependent variable) is presented below.

4.9.1 Correlation between Teachers' Demographic Characteristics (Inputs) and Students' Achievement in JSC Mathematics

The statistics in Table 4.10 indicate that there was a significant positive relationship between teachers' inputs (academic qualifications, teaching experience and subject specialisation) and students' results in JSC Mathematics.).

Table 4.10. The Pearson Product-Moment Correlation between Teachers Inputs (Academic Qualifications, Teaching Experience and Subject Specialisation (N = 160)

Variable	Correlation coefficient	Significance
General teaching experience	0.385	0.043*
Academic qualifications	0.594	0.085**
Subject specialisation(maths/minor)	0.478	0.049*
Gender	0.033	0.512
All four constructs combined	0.398	0.094

*Significant at $P < 0.05$; **Significant at $P < 0.10$

The data in Table 4.10 suggest that general teaching experience, academic qualifications and subject specialisation had a moderate positive and significant relationship with students' academic achievement in JSC Mathematics.

The findings are in agreement with the previous findings of Darling-Hammond (2000; Darling-Hammond & Sykes, 2003) which indicate that teacher qualifications are significantly and positively correlated with student achievement. Furthermore, Darling-Hammond found that uncertified teachers and those with the most non-standard certifications had negative effects on student achievement gains. Darling-Hammond & Sykes (2003) concluded that qualified teachers are a critical national resource that requires federal investment and cross-state coordination as well as other state and local action. Goe (2002; 2007), reporting on a 2002 study on California schools, found a direct negative correlation between the number of teachers who held emergency permit (EP) teacher certification and student achievement at school level. Similarly, Rice (2003) makes the point that teacher certification seems to matter for high school Mathematics, but that there is little evidence of its relationship to student achievement in the lower grades. Kaine, Rockoff & Staiger (2006) found that the proportion of lower-performing students at a school was related to the proportion of teachers at that school who were not certified to teach in any of the subjects which they were currently teaching. Boyd, Grossman,

Lankford, Loeb & Wyckoff (2006) conclude that teacher preparation programmes in either traditional or alternative pathways had an influence on student gains in New York State achievement tests.

With regard to teaching experience, it is important to keep in mind that some research suggests that the positive effects of teaching experience in relation to students' achievement are not constantly additive, but instead tend to level off after a few years (Ravin, Hanushek & Kain 2002). To test whether there was any significant variance in the effects of teachers' teaching experience and students' performance in Mathematics in the schools in this study, the Pearson product-moment correlations for teachers' teaching experience for the intervals 2-5 years, 5-10 years and 10 years were computed, as indicated in Table 4.11.

Table 4.11. The Pearson Product-Moment Correlation between Teachers Teaching Experience, and Students' Academic Achievement (N = 160)

Teaching experience	r	Significance
2-5 years	0.402	0.094**
6-10 years	0.417	0.039*
10 years and above	0.325	0.12
All three constructs combined	0.343	0.094**

*Significant at $P < 0.05$; ** Significant at $P < 0.10$

The findings in Table 4.11 suggest that the effect of teachers' teaching experience is not constantly additive, but seems to level off after approximately 10 years or more.

4.9.2 Pearson Product-Moment Correlation between Amount of Time Teachers Spent on Standards-Based Professional Development and Students' Achievement in JSC Mathematics

Professional development affects students' achievements in three ways. First, professional development enhances the teacher's knowledge, skills, and motivation. Second, better knowledge and skills, and more motivation improve classroom teaching. Third, improved teaching raises student achievement. If one link is weak or missing, better student learning cannot be expected. If a teacher fails to apply new ideas from professional development to classroom instruction, for example, students will not benefit from the teacher's professional

development. In other words, the effect of professional development on student learning is possible through two mediating outcomes: teachers’ learning, and instruction in the classroom.

To determine the extent to which the amount of time teachers spent on standards-based professional development was associated with students’ JSC Mathematics results, a Pearson product-moment correlation was conducted. The independent variables (predictors) were the amount of time the teachers spent in professional development programmes, and the dependent variable (outcome) was the students’ JSC Mathematics results for 2006 to 2010. The statistics in Table 4.12 depict the Pearson product-moment correlation between the amount of time teachers spent on professional development programmes and students’ JSC Mathematics results.

Table 4.12 Pearson Product-Moment Correlation between Amounts of Time Teachers Spent on Standards-Based Professional Development and Students’ Achievements in JSC Mathematics

Variable	r	Significant
Amount of time spent on standards-based professional development	0.085	0.653

***Significant at $P < 0.05$; * Significant at $P < 0.10$*

The statistics in Table 4.12 reveal that there was a weak positive but insignificant relationship between the amount of time teachers spent on standards-based professional development programmes and students’ JSC Mathematics results.

4.9.3 Correlation between Teacher’s Participation in Standards-Based Professional Development and Students’ Achievement in JSC Mathematics

The statistics for the Pearson product-moment correlations between teachers’ participation in standards-based professional development and students’ achievement in JSC Mathematics are presented in Table 4.13.

Table 4.13. The Pearson Product-Moment Correlation between Teachers’ standards-based professional development and Students’ JSC Mathematics Achievement. (N = 109)

Type of Standards-based professional Development Programme	r	significant
Problem solving	0.037	0.350
Use of manipulatives	0.224	0.45
Understanding students’ thinking	0.228	0.217
Classroom management	0.076	0.304
Cooperative learning	0.301	0.263
Cultural diversity	0.064	0.254
Higher-order thinking skill	0.047	0.312
Limited English proficiency	0.028	0.387
Interdisciplinary instruction	0.394	0.034*
Performance-based assessment	0.188	0.025*
Special-needs students	0.013	0.445
All eleven constructs combined	0.097	0.28

**Significant at $P < 0.05$*

Table 4.13 reveals that only two out of 11 standards-based professional training programmes which teachers indicated that they had participated in had a significant positive relationship with students’ results in JSC Mathematics. The Pearson product-moment correlation coefficients for the other ten standards-based classroom practices used by teachers had either a negative or a positive relationship with student’s results in JSC Mathematics.

4.9.4 Correlation between Teachers Application of Standards-Based Classroom Practices and Students’ Achievement in JSC Mathematics

The Pearson product- moment correlation coefficients between each of the standards-based classroom activities used by teachers and students’ are presented in Table 4.14.

Table 4.14. The Pearson Product-Moment Correlation between Teachers' Standards-Based Classroom Practices and Students' JSC Mathematics (N = 109)

Type of Standards-based classroom activities	r	significant
Teacher presentation	-0.064	0.47
Posing open-ended questions	-0.237	0.61
Using whole class discussions	0.415	0.007**
Assessment using short/long answers	0.309	0.84
Assessment using individual projects	-0.294	0.35
Assessment using portfolios	-0.28	0.74
Assessment using multiple-choices	0.087	0.57
Using textbooks	0.028	0.76
Giving homework	0.18	0.39
Reviewing students' homework	0.37	0.091**
Students working with objects	0.188	0.025*
Students solving real-life problem	0.027	0.41
Students taking Mathematics tests	0.08	0.56
Students discussing Mathematics with other students	0.34	0.08**
Use of calculators/computers by students	0.47	0.49
Students designing their own activities	-0.32	0.75
Students listening and taking notes	0.247	0.094*
Recording/representing/analysing of data by students	0.21	0.05
Helping students see connection between maths and other disciplines	-0.318	0.66
All nineteen constructs combined	0.178	0.423

*Significant at $P < 0.05$; ** Significant at $P < 0.10$

Table 4.14 reveals that teachers' use of whole class discussions, reviewing of students' home work, discussion of Mathematics problems among students, and students listening and taking notes from teachers had a positive and significant relationship with students' results in JSC Mathematics.

4.9.5 Correlation between Teachers Mathematical Content Knowledge (MCK) and Students' Academic Achievement in JSC Mathematics

Research has shown that teachers' mathematical content knowledge is important to students' achievement. Darling-Hammond (2000) found that teachers with mathematical subject-matter knowledge contributed positively to students' results in Mathematics in the National Assessment of Education Progress (NAEP). To test the validity of Darling-Hammond's findings, I conducted a correlation analysis on the effects of teachers' perceived level of knowledge of eight concepts, namely, numbers, money and finance, mensuration, geometry, algebra, graphs and functions, statistics and probability, and trigonometry, on students' results in JSC Mathematics. Table 4.15 depicts the extent of the effect of teachers' perceived knowledge of concepts in the JSC Mathematics curriculum on students' achievement as represented by partial correlation coefficients.

Table 4.15. The Pearson Product-Moment Correlation between Teachers Mathematical Content Knowledge (MCK) and Students' Academic Achievement in JSC Mathematics

Variables	Correlation coefficient (r)	significant
Numbers	0.343	0.192
Money and finance	0.235	0.047*
Mensuration	-0.019	0.08*
Geometry	0.25	0.45
Algebra	0.435	0.052*
Graphs and functions	0.015	0.554
Statistics and probability	0.217	0.048*
Trigonometry	0.013	0.361
All eight constructs combined	0.283	0.498

*Significant at $P < 0.05$; **Significant at $P < 0.10$,

4.9.6 Correlation between Teachers Perceived Pedagogical Knowledge and Students' Achievement in JSC Mathematics

The Pearson product-moment correlation coefficients between teachers' use of pedagogical techniques in class and students' results in JSC Mathematics are presented in Table 4.16.

Table 4.16. The Pearson Product-Moment Correlation between Teachers Perceived Pedagogical Knowledge and Students' Academic Achievement in JSC Mathematics

Variable	r	significant
Use of multiple teaching approaches	0.15	0.65
Adaptation of teaching styles to different students	-0.037	0.534
Knowledge on how to assess students in class	0.23	0.68
Familiarity with students' understanding and misconceptions	-0.05	0.61
Assessment of student learning in multiple ways	0.218	0.453
All five constructs	0.267	0.523

The results in Table 4.16 reveal that the level of control teachers had over their teaching strategies showed a very weak positive and insignificant relationship with students' achievement in JSC Mathematics.

4.9.7 Correlation between Teachers Beliefs in Classroom Management and Students' Achievement in JSC Mathematics

Teachers were asked to indicate the extent of their belief in the practice of standards-based classroom management techniques. Their responses were coded as 1 = not at all, 2 = only slightly, 3 = to some extent, and 4 = to a high extent. The Pearson product-moment correlations coefficients are presented in Table 4.17.

Table 4.17. Correlation between Teachers’ Beliefs in Classroom Management and Students’ Achievement in JSC Mathematics

Variable	r	sig
Control of disruptive behaviour in classroom	0.061	0.229
Motivating students with low interest in school work	0.090	0.136
Motivating students in their beliefs for excellence achievement	0.232	0.002***
Motivating students to value learning	0.025	0.380
Crafting good questions for students	0.161	0.024*
Students’ compliance with school rules	0.023	0.388
Calming students who are disruptive or noisy	0.002	0.491
Establishment of classroom management systems	0.075	0.178
Using a variety of assessment strategies	0.027	0.370
Provision of alternative explanation when students are confused	0.003	0.483
Assistance to families in motivating students to study	-0.033	0.342
Implementation of alternative strategies in classroom	-0.28	0.367
All twelve constructs combined	0.049	0.34

Significant at $P < 0.05$; **Significant at $P < 0.10$, *Significant at $P < 0.01$*

The results in Table 4.17 reveal that motivating students in their belief in excellent achievement, and crafting good questions for students had a very positive and significant relationship with students’ achievement in JSC Mathematics.

The previous sections have shed light on the extent of the association between each of the independent variables and students’ results in JSC Mathematics for 2006 -2010.

In Section 4.9.8 the correlation between combined indices of teachers’ inputs, processes and students’ achievement in JSC Mathematics are presented.

4.9.8 Correlation between Teachers Demographics, Professional Development, Standards-Based Classroom Practices, Pedagogical Content Knowledge and Belief in Classroom Management and Students' Achievement in JSC Mathematics

Table 4.18 shows the Pearson moment correlation coefficients for sets of independent variables such as teachers' inputs (qualifications, teaching experience, gender, subject specialisation) and processes, including amount of time spent on professional development (PD), standards-based professional development (SBPD), standards-based classroom instruction/activities (SBCA), mathematical content knowledge (MCK), mathematical pedagogical knowledge (PK), pedagogical content knowledge (PCK) and classroom management beliefs (CMB) against the dependent variable, students' achievement in JSC Mathematics for 2006 to 2010.

Table 4.18. The Pearson Product Correlation between Combined Teachers Inputs and Processes and Students' Academic Achievements in JSC Mathematics

Variables	r	% contribution to JSC results	sig
Teachers' demographics	0.398	15.8%	0.094
Amount of times spent on PD	0.08	0.64%	0.296
SBPD	0.197	3.9%	0.28
SBCA	0.214	4.6%	0.398
MCK	0.283	8.0%	0.498
PK	0.139	1.9%	0.434
PCK	0.267	7.1%	0.456
CMB	0.194	3.6%	0.257
All eight constructs combined	0.224	5.01%	0.41

From Table 4.18, it is evident that the Pearson product-moment correlation co-efficient ($r=0.224$, $p=0.41$) between students' JSC Mathematics results and a combination of teachers' inputs (academic qualifications, teaching experience, subject specialization) processes (duration of professional development, standards-based classroom instruction, standards-based classroom management) were positive but not significant for students' achievement in Mathematics. The eight constructs, when combined together, only contribute 5.01% to students' achievement in

JSC Mathematics, implying that 95% of the variance in students' achievement was not explained by the linear combination of the eight constructs. However, the following eight constructs, namely, the extent to which teachers understand algebra, teachers' participation in interdisciplinary instruction, teachers' use of whole class discussion, teachers' review of students' home work/assignments, students talking to each other about how to solve mathematics problems, students listening and taking notes from teachers, and students recording and representing data, showed a moderate ($r = 0.423$) and significant relationship with the students' achievement in JSC Mathematics. See Figure 4.1, Tables 4.19 and 4.20 for the statistics.

4.9.9 Combination of Teachers-Related Variables that Significantly Affect Students' Achievement in Mathematics

The main aim of this study was to identify a set of teacher-related variables that contribute significantly to students' JSC Mathematics results. To achieve this aim, several correlation analyses were conducted between different combinations of sets of teacher-related variables and students' JSC Mathematics results. The set of linear combinations of the eight teacher-related variables such as extent to which teachers understand Algebra, teachers' participation in interdisciplinary instruction, teachers' use of whole class discussion, teachers' review of students homework/assignments, students talking to each other about how to solve Mathematics problems, students listening and taking notes from teachers, and students recording and representing data was identified as a significant predictor for students' academic achievement in JSC Mathematics. See Figure 4.1 and multi-regression analysis in Table 4.19.



Figure 4.1 Combined Indices Pearson Product-Moment Correlation Coefficients between Teachers' Inputs and Processes and Students' Achievement in JSC Mathematics .

P-value= 0.002

Figure 4.1 shows the correlation coefficients between the eight teacher constructs and students' achievement in JSC Mathematics.

Correlations can be a very useful research tool, but they tell us nothing about the predictive power of the variable. In regression analysis, we fit a predictive model to our data and use that model to predict values for the dependent variable (DV) from one or more independent variables (IVs). Simple regression seeks to predict an outcome variable from a single predictor variable, whereas multiple regressions seek to predict an outcome from several predictors. Multiple regression analysis using SPSS software programme was conducted between the variables in Figure 4.1 and students' JSC Mathematics results.

Table 4.19. Parameter Estimates of Predictors of Students Achievement in Mathematics

Variable	B (unstandardised)	Standard error b	Beta Standardised(β)	t	Significance of t
Constant	38.48	25.23	-	1.53	0.135
Professional Development in Interdisciplinary instruction	-3.84	2.58	-0.15	-1.491	0.014**
Use of whole class discussion	9.35	3.434	0.246	2.72	0.007**
Students listen and take notes during presentation by teacher	-4.85	2.92	-0.17	-1.66	0.099**
Students talk with other students during class about how they solve mathematic problems	0.98	0.555	0.13	1.77	0.08**
Review of homework/worksheet assignment	0.84	0.49	0.15	1.70	0.091**
Students record, represent, and/or analyse data	6.22	3.17	0.21	1.96	0.05*
Teachers' Mathematics major	13.59	6.85	0.46	1.98	0.049*
Teacher's knowledge of algebra:	11.12	5.98	0.20	1.86	0.065**

From Table 4.19, it is evident that some teacher constructs such as students listening and taking notes during presentation by teachers, and interdisciplinary instruction by teachers had a negative influence on the students' JSC Mathematics results. Nonetheless, teachers' major, teachers' use of whole class discussion and teachers' knowledge of algebra had a significant and positive impact on students' JSC Mathematics results. The effect sizes (beta) for each of the constructs were: Interdisciplinary instruction (-0.15), use of whole class discussion (0.246), students listen and take notes during presentation by teacher (-0.17), students talk with other students during class about how they solve mathematic problems (0.153), review of homework or assignment (0.15), students record, represent, and/or analyse data (0.21), teachers' Mathematics major (0.46), and teachers' knowledge of algebra (0.20).

Table 4.20. Multiple Regression Parameters Estimates of Teacher-Related Variables that had an Impact on Students' Achievements in JSC Mathematics

Multiple R	=	0.423
Multiple R ²	=	0.179
Multiple R ² (adjusted)	=	0.126
Standard error of estimate	=	25.66572

Analysis of variance [ANOVA]

Source of variation	Degree of freedom (DF)	Sum of squares (SS)	Mean square (MS)	F-ratio
Due to regression	8	17822.109	2227.764	3.382
Due to residential	124	81682.398	658.729	
Total	132	99504.507		

P =0.002

The correlation analyses and regression analyses outputs were used to answer the research questions and test the hypotheses. From Table 4.20, it is evident that the multiple regression square R^2 is 0.179. This means that 17.9% of the variance in the students' JSC Mathematics results is explained by a linear combination of eight constructs in Table 4.19. The remaining 82.1% may be linked to other teachers related variables or students background variables and school factors such as climate and leadership styles of principals etc.

The F-ratio is 3.382 at significance under 0.05 level. This observed F-ratio implies that the multiple correlation obtained between the eight constructs and students' JSC Mathematics results is not by chance.

This section has discussed the findings in Tables 4.19 and 4.20. The next section will use the data in Table 4.19 to fit the regression equation that shows the relationship between the dependent variable (Y), students' JSC Mathematics results and the eight teacher-related variables.

4.9.10 Fitting the Regression model for the Parameter Estimates of a Linear Combination of Eight Teacher Constructs with Students' JSC Mathematics Results

4.9.10.1 Description of the Regression Model Used in the Study

The general form of the regression equation linking each of the eight teacher-related variables with the students' JSC Mathematics result is stated below as:

$$Y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7 + b_8 x_8 \dots \dots \dots \text{Equation 4.1}$$

where:

Y_c = computed value of the dependent variable

b_0 = Y intercept when x equals zero

b_1 and $b_2 \dots b_8$ = partial regression coefficients

$x_1, x_2 \dots x_8$ = independent variables.

Definition of independent variables:

x_1 = Teachers' major in Mathematics

x_2 = Teachers' Content Knowledge of algebra

x_3 = Students record, represent, and/or analyse data in class

x_4 = Teachers' use of whole class discussion

x_5 = Teachers' review of students' homework/ assignments

x_6 = Students discuss Mathematics with other students

x_7 = Students listen and take notes from teachers

x_8 = Teachers' professional development in interdisciplinary instructions in class

Y = Students' JSC Mathematics results

4.9.10.2 Explanation of b-values in Table 4.19

B_0 = constant, b_1 , b_2 , b_3 , b_4 , b_5 , b_6 , b_7 and b_8 values tell us the relationship between JSC Mathematics results of students and each of the eight predictors. If the b-value is positive, it implies that there is a positive relationship between the predictor (teacher-related variable) and the outcome (JSC Mathematics results). However, a negative coefficient represents a negative relationship between the predictor and the outcome. From the data in Table 4.19, it is evident that those two predictors, namely, interdisciplinary instruction and students listening and taking notes during presentation by the teacher, had negative b-values, indicating negative relationships. So, as the predictors increase by one unit, there is a decrease of 0.15 and 0.17 units respectively in the students' JSC Mathematics results. The other six predictors, as revealed in Table 4.19, have positive b-values, indicating positive relationships. A brief discussion of the effect of the predictors on students' JSC Mathematics results using standardised coefficient in Table 4.19 is presented below:

- **Teachers' major in Mathematics (b=0.46):** This b-value indicates that as the teachers' major in Mathematics increases by one unit, the students' JSC Mathematics result increases by 0,46 units. This implies that a teacher's major contributes 21% (b^2) to students' JSC Mathematics results. The interpretation is true if the effects of the seven other predictors are held constant.
- **Teachers' content knowledge of algebra (b=0.20):** This b-value indicates that as the teachers' knowledge of algebra increases by one unit, the students' JSC Mathematics result increases by 0,20 units. These units are measured in hundreds. This implies that teachers' content knowledge in algebra contributes 4% (b^2) to students' JSC Mathematics results. The interpretation is true if the effects of the seven other predictors are held constant.
- **Use of whole class discussion by teachers (b=0.246):** This b-value indicates that as the teachers' usage of whole-class discussion increases by one unit, the students' JSC Mathematics result increases by 0,246 units. These units are measured in hundreds. This implies that teachers' use of whole-class discussions contributes 6.1% (b^2) to students' JSC Mathematics results. The interpretation is true if the effects of the seven other predictors are held constant.
- **Students talk with other students during class about how they solve mathematic problems (0.13):** This b-value indicates that as the students' discussion with other students in class about how they solve problems increases by one unit, the students' JSC Mathematics result increases by 0,13 units. This implies that when students talk with other students in class about how they solve Mathematics, this contributes 1.7% (b^2) to students' JSC Mathematics results. The interpretation is true if the effects of the seven other predictors are held constant.
- **Teachers' review homework/worksheet assignment of students (b=0.15):** This b-value indicates that as the teachers' review of homework/ worksheet assignments increases by one unit, the students' JSC Mathematics result increases by 0,15 units. These units are measured in hundreds. This implies that teachers' review of homework contributes 2.3% (b^2) to students' JSC Mathematics results. The interpretation is true if the effects of the seven other predictors are held constant.
- **Students record, represent, and/or analyse data (b=0.21):** This b-value indicates that as the students record, represent and /or analyse data increases by one unit, the students' JSC

Mathematics result increases by 0,21 units. These units are measured in hundreds. This implies that teachers' review of homework contributes 4.4% (b^2) to students' JSC Mathematics results. The interpretation is true if the effects of the seven other predictors are held constant.

The b-values from Table 4.19 will be substituted into equation 4.1 to produce the equation 4.2 below.

$$Y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_{6+} + b_7 x_{7+} + b_8 x_8 \dots \text{Equation 4.1}$$

Using the standardised coefficients (β) discussed above and in Table 4.19 and Section 4.9.10.2 above, equation 4.1 can be defined as:

$$Y = b_0 + 0.46 x_1 + 0.20_2 x_2 + 0.21_3 x_3 + 0.246_4 x_4 + 0.15_5 x_5 + 0.13_6 x_{6+} + -0.17_7 x_{7+} + -0.15_8 x_8$$

The relative contribution of each of the predictor variables in the multiple regression model in Table 4.19 was determined by examining the standardised regression coefficients or beta weights. From Table 4.19, it is evident that the teachers' major in Mathematics contributed most in the model with a standardised regression coefficient of 0.46 or approximately an effect size of 21.2% in the model. The contributions of the other seven variables in the linear regression model are as follows: Teachers' content knowledge in algebra, beta weight of 0.20 (effect size 4%); use of whole class discussion by teacher, beta weight 0.246 (effect size 6.1%); students talk with other students during class about how they solve mathematics, beta weight 0.13 (effect size 1.7%); teachers' review homework/work sheet assignment of students, beta weight 0.15 (effect size 2.3%); students record, represent, and/or analyse data, beta weight 0.21 (effect size 4.4%); students listen and take notes during presentation by teacher, beta weight -0.17 (effect size 2.9); and professional development in inter disciplinary instruction, beta weight -0.15 (effect size 2.3%).

The final statistically significant prediction equation for this study with the standardised regressions (beta) for the multiple regression model was : -0.15, professional development of

teachers; +0.246, use of whole class discussion; -0.17, students listen and take notes during teacher presentation; +0.13, students talk with other students during class on how they solve mathematics; +0.15, teachers' review homework/work sheet assignment of students; +0.21, students record, represent, and/or analyse data; +0.46, teacher major in Mathematics; +0.20, teacher knowledge in algebra.

The standardized beta values provide a better insight into the importance of a predictor in the model. They tell us the number of standard deviations that the outcome will change as a result of one standard deviation change in the predictor.

4.10 Testing the research questions

This study addressed three questions:

1. To what extent does the type of teacher input (paper qualifications, teaching experience, subject specialisation etc.) affect students' results in the JSC Mathematics examinations for 2006 to 2010?
2. How are teacher-reported standards-based knowledge, participation in professional development and practice of standards-based instruction associated with students' results in the Mathematics examination at JSC level for 2006 to 2010?
3. What combination of the five variables (teacher experience, teacher level of education, teacher professional development, teacher classroom practices, teacher subject specialization) predict achievement for students, as measured by students' JSC Mathematics scores?

The findings related to these three questions are presented below:

Question1

To what extent does type of teacher input (paper qualification, teaching experience, and subject specialisation etc.) affect students' results in the JSC Mathematics examinations for 2006 to 2010?

To answer the first question, two analyses were conducted. The first was a correlation analysis using the JSC Mathematics results for each school as a unit analysis. The teachers' qualifications, teaching experience, subject major and mathematical content knowledge were the independent variables. The results in Table 4.10 reveal a moderate positive and significant relationship between teachers' academic qualifications ($r = 0.594$; $P < 0.10$), teaching experience ($r = 0.385$; $P < 0.05$), and subject specialization ($r = 0.594$; $P < 0.05$). Several syntheses of empirical studies have identified subject-matter knowledge as measured by subject major as significantly associated with higher student achievement (Wayne & Youngs, 2003; Rice, 2003; Darling-Hammond & Youngs, 2002). Also, Goldhaber & Brewer (2000) found that those Grade 10 and Grade 12 students who were taught Mathematics by teachers with an undergraduate Mathematics major made greater achievement gains than those who were taught Mathematics by teachers with non-Mathematics majors.

Question 2

How are teacher-reported classroom practices (standards-based classroom practices), teachers' perceived pedagogical knowledge, and teachers' beliefs in practice of standard-based classroom management and participation in professional development associated with students' results in the Mathematics examination at JSC level for 2006 to 2010?

The extent to which teachers' reported standards-based instruction relates to students' JSC Mathematics results is presented in Table 4.14. The statistics in Table 4.14 reveal that most of the standards-based constructs had both weak positive and weak negative significant relationships with students' achievement in JSC Mathematics. The construct that had a moderate and significant relationship was the use of whole class discussions in teaching Mathematics in secondary schools. The Pearson product-moment correlation coefficient and the p-value between whole class discussion instruction and students' academic achievement were ($r = 0.415$; 0.007).

The finding supports previous findings of Ball (1993), Wood (1999) and Grouws & Cebulla (2001) who found that whole-class discussion can be an effective diagnostic tool for determining the depth of student understanding and identifying misconceptions. Furthermore, they maintain that it helps teachers to identify areas of students' success or progress.

Question 3

What combination of the six variables (teacher experience, teachers' level of education, teachers' professional development, teachers' classroom practices, teachers' subject specialisation and teachers' perceived mathematical content knowledge) predict achievement for students as measured by students' JSC Mathematics scores?

To test this question, correlation and regression analyses were conducted using teacher-related variables as independent variables and students' achievement in JSC Mathematics as the dependent variable. The following constructs showed a moderate and significant relationship ($r = 0.423$) with students' JSC Mathematics results: teachers' major in Mathematics, the extent to which teachers understand algebra, teachers' participation in interdisciplinary instruction, teachers' use of whole class discussion, review of students' home work/assignments, students talking to each other about how to solve Mathematics problems, students listening and taking notes from teachers, students recording and representing data. See Figure 4.1 for the model.

4.11 Testing of research hypotheses

The next section will report the regression analyses output that determined the effect of each of the five teacher-related variables on students' JSC Mathematics results. This study addressed five hypotheses. The data in Tables 4.10, 4.14, 4.15, 4.19 and 4.20 were used to address the hypotheses.

Hypothesis 1

There is no significant correlation at the 0.05 level between teachers' experience and the achievement of students as measured by JSC Mathematics scores.

To address this hypothesis, the data in Table 4.10 showing the correlation between teachers' inputs (academic qualification, teaching experience, subject specialisation and gender) was used.

The statistical significance for the test was fixed at 5 % ($\alpha = 0.05$). As indicated in Table 4.10, the Pearson product –moment correlation coefficient and p-value for the relationship between teachers’ teaching experience and students’ academic achievement were ($r = 0.385$; $p = 0.043$). As the probability is less than the 5% significance criterion that was employed, the null hypothesis is rejected and the alternate hypothesis is accepted. From the findings of this study, it is evident that there was a significant relationship between teachers’ teaching experience and students’ JSC Mathematics results at $P < 0.05$. The P- value of 0.043 implies that 4 times out of 100, the result was obtained by chance.

Hypothesis 2

There is no statistically significant correlation at the 0.05 level between teachers’ level of education and the achievement of students as measured by JSC Mathematics scores.

To test hypothesis two, the data for the correlation analysis between teachers’ inputs and students’ JSC Mathematics results as shown in Table 4.10 was used. The statistical significance criterion of 10% ($\text{Alpha} = 0.1.$) was used to specify the probability of accepting or rejecting the null hypothesis. The results in Table 4.10 reveal that there was a moderate positive and significant relationship between teachers’ academic qualification and students’ JSC Mathematics results. Since the p-value of 0.085 is less than 10% ($\text{Alpha} = 0.1.$), we reject the null hypothesis and accept the alternate hypothesis. Hence, we conclude that there was a significant relationship between the teachers’ academic qualifications and students’ JSC Mathematics results.

Hypothesis 3

There is no statistically significant correlation at the 0.05 level between teachers’ classroom practices and the achievement of students as measured by the JSC Mathematics scores.

To address this hypothesis, the data shown in Table 4.14 for correlation between teachers’ application of standard-based classroom instructions and students’ JSC Mathematics results was used. The statistical significance for the test was fixed at 5 % ($\alpha = 0.05$). From Table 4.14, it can be seen that the Pearson product-moment correlation coefficient and p-value for the relationship between teachers’ teaching experience and students’ achievement in Mathematics

were $r = 0.278$; $p = 0.423$. The P- value of 0.423 is not significant at the acceptable levels of 5%, 10% and 1%. Hence, the null hypothesis is accepted and the alternate hypothesis is rejected. We conclude that there was no significant relationship between teachers' standards-based classroom instructions and students' achievement in JSC Mathematics .

Hypothesis 4

There is no statistically significant correlation at the 0.05 level between teachers' subject specialisation and the achievement of students as measured by the JSC Mathematics scores.

To address hypothesis four, the data shown in Table 4.10 for the correlation between teachers' inputs (academic qualification, teaching experience, subject specialisation and gender) was used. The statistical significance for the test was fixed at 5 % ($\alpha = 0.05$). From Table 4.10 it can be seen that the Pearson product-moment correlation coefficient and p-value for the relationship between teachers who majored in Mathematics and students' achievement in Mathematics were $r = 0.478$; $p = 0.044$. As the probability is less than the 5% significance criterion that was employed, the null hypothesis is rejected and the alternate hypothesis is accepted. We conclude that there was a significant relationship between teachers' teaching experience and students' achievement in JSC Mathematics at $P < 0.05$. The P- value of 0.044 implies that 4 times out of 100, the result was obtained by chance.

Hypothesis 5

There is no statistically significant relationship between a linear combination of the six predictor variables of teachers' experience, teachers' level of education, teachers' professional development, teachers' classroom practices, teachers' subject specialization and teachers' perceived mathematical content knowledge and the achievement of students as measured by the JSC Mathematics scores.

To address hypothesis five, the data in Figure 4.1 , and Tables 4.19 and 4.20 for the correlation between teachers' inputs (academic qualification, teaching experience, subject specialisation and gender) was used. The statistical significance for the test was fixed at 1 % ($\alpha = 0.001$). From Table 4.19, it can be seen that the Pearson product-moment correlation coefficient and p-

value for the relationship between seven teacher constructs that had an impact on students' academic achievement were $r = 0.423$; $p = 0.002$. As the probability is less than the 5% significance criterion that was employed, the null hypothesis is rejected and the alternate hypothesis is accepted. We conclude that there was a significant relationship between teachers' major in Mathematics, use of whole group class discussion in teaching Mathematics, reviewing of students homework and assignments, professional development in interdisciplinary instruction, teachers' mathematical content knowledge in algebra, students talking to other students about how to solve Mathematics problems etc. and students' achievement in JSC Mathematics at $P < 0.05$. The P- value of 0.002 implies that 0.2 times out of 100, the result was obtained by chance.

4.12 Conclusion

This chapter has presented the results of the data analysis and interpretation based on the three research questions and five hypotheses. The next chapter presents the discussion of the primary findings by linking them to the literature review, as well as the summary, conclusion and recommendations.

CHAPTER 5

DISCUSSION OF FINDINGS AND LINKAGES TO LITERATURE REVIEW, SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter discusses the results in the previous chapters and places them in the context of the existing literature. Also, this chapter discusses the implication of the findings and makes recommendations based on the findings.

5.2 Summary of the Study

The present study was designed to investigate teacher characteristics that affect students' Mathematics results as measured by the JSC Mathematics scores. More specifically, this study examined the relationship between teachers' classroom practices, professional development and characteristics external to classroom practices, and students' academic achievement as measured by the JSC Mathematics results. Furthermore, this study sought to determine the impact of these identified teacher characteristics on students' academic performance regarding JSC Mathematics results, and to develop a regression model for predicting student achievement in JSC Mathematics examinations. The data was collected by means of a self-administered questionnaire given to JSC Mathematics teachers in Namibia. The findings in this study revealed weak correlations between teacher-related variables and students' academic achievement in JSC Mathematics. Nonetheless, teachers' variables such as subject specialisation and academic qualifications had a significant impact on students' academic achievement in JSC Mathematics at alpha under 0.05 or 0.10 respectively.

The questionnaire items sought to obtain information from JSC Mathematics teachers with regard to their biographical information, exposure to standards-based professional development, knowledge about the use of standards-based classroom instruction, mathematical content knowledge, and beliefs about the usefulness of pedagogical content knowledge and classroom management techniques. The secondary data, the JSC Mathematics results for the target schools for 2006 to 2010, were obtained from the Directorate of National Examinations and Assessment. Three set questions and five hypotheses were posed, aimed at establishing the extent to which

each of the identified teacher-related variables affect students' achievements in JSC Mathematics.

Descriptive statistics such as percentages means and standard deviations were used to determine the extent to which teachers used standards-based classroom instruction in their Mathematics lessons, and their beliefs about the use of pedagogical content knowledge. Also, descriptive statistics were used to determine the extent of teachers' knowledge about certain topics in the JSC Mathematics curriculum. Similarly, correlation and regression analyses were used to determine the strength and effect of teacher-related variables on students' achievement in JSC Mathematics. A summary of the findings is presented below:

Correlation between teachers' demographic characteristics and students' achievement in JSC Mathematics

There was a statistically positive and significant relationship between teachers' academic qualifications, teaching experience, and subject specialisation (Mathematics major) at $0.05 \leq \alpha \leq 0.10$ levels of significance. On the other hand teachers' gender was not found to be a predictor of students' achievement in Mathematics.

Mathematical Content knowledge (MCK) of concepts in JSC Mathematics curriculum by teachers

Teachers' perceived knowledge of concepts such as money and finance, algebra, statistics and probability had a positive and significant relationship with students' achievement in Mathematics. However, teachers' perceived knowledge of mensuration (volumes of cones, cylinders, sphere circles etc.) had a negative and significant relationship with students' achievement in JSC Mathematics, indicating that this was not a significant factor affecting students' performance.

Standards-based professional development (SBPD) of Mathematics teachers

Teachers' exposure to standards-based professional development in interdisciplinary instruction and performance assessments had a positive and significant relationship with students' achievement in JSC Mathematics, indicating that such exposure has a significant influence on student performance, while on the other hand, teachers' exposure to higher-order thinking skills was shown to have no influence, since it was found to have a negative relationship with students' achievement in JSC Mathematics.

Standards-based classroom practices of JSC Mathematics teachers

Standards-based instruction such as use of whole class discussion, reviewing students' home work/assignments, students listening and taking notes from teachers and students' discussion of how to solve Mathematics problems with other students had a positive and significant relationship with students' achievement in JSC Mathematics. However, standards-based instruction, such as posing open-ended questions, assessment of students using portfolios/individual projects, and students designing their own activities was not found to play a role since it had a negative relationship with students' achievements in JSC Mathematics.

Standards-based classroom management techniques

Teachers' beliefs about motivating students in their beliefs for excellence had a positive and significant relationship with students' achievement in JSC Mathematics, whereas teachers' beliefs about assistance to families and implementation of alternative strategies in the classroom had a negative relationship with students' achievement in JSC Mathematics, and thus was not a significant factor.

Combination of sets of variables that affect student's academic achievement in JSC Mathematics

Combinations of a number of variables were identified as predictors of students' achievements in JSC Mathematics. These included teachers' major in Mathematics (teacher inputs), teachers' usage of whole class discussions (standards-based classroom activities) and perceived knowledge

of algebra (mathematical content knowledge), as well as teachers' participation in interdisciplinary instruction (standards-based professional development) and teachers' review of students homework/assignments (standards-based classroom activities). A further predictor of students' achievement was students talking to other students about how to solve Mathematics problems (standards-based classroom activities).

The above variables, when combined together, significantly affected students' achievement in JSC Mathematics.

5.3 Discussions of Findings and Linking to Empirical Literature

This study examined the relationship between teachers' academic qualifications, teaching experience, subject specialisation, mathematical content knowledge, standards-based knowledge, professional development and instructional practices and students' JSC Mathematics results for 164 secondary schools in the country. The findings on the five sets of teacher-related variables will be discussed separately.

5.3.1 Discussion on the Effect of Teachers Teaching Experience on Achievement in Mathematics

The findings from the correlation analysis in Table 4.10 confirm that teachers' teaching experience had a positive and significant relationship with students' achievement in JSC Mathematics. The extent of the association between the teachers' teaching intervals was: 2-5 years ($r=0.402$; $p=0,094$), 6-10years ($r=0.417$; $p=0.039$), and 10 years and above ($r=0.325$; $p=0.12$). The findings of this study confirmed the findings of Goe (2007), Kane, Rockoff & Staiger (2006) and Darling- Hammond (2000) that teachers' teaching experience had a significant positive influence on students' achievement in Mathematics within the first four or five years. However, the findings of this study revealed that although there was a significant difference in students' JSC Mathematics results for students whose teachers had more than five years teaching experience, there was no significant difference in JSC Mathematics achievement among students whose teachers had more than ten years teaching experience.

With regard to the Namibian context, these findings indicate that the most effective Mathematics teachers are those with 5 -10 years of experience, followed by those with 2-5 years of experience. Surprisingly, with regard to participants in this study, the least effective teachers appeared to be those with more than 10 years of experience. Since there is no data on new teachers with 0-2 years of experience, this group cannot be evaluated here.

This suggests that there is little or no additional professional development after the first few years on the job, and /or that teachers continue to learn on the job, but because the more effective teachers leave the profession more frequently (due to poor working conditions) than less effective teachers, the typical teacher with more experience who remains in teaching is no more effective than one with a few years of experience. Although the findings support the justification for trying to retain experienced teachers in the teaching force, this should not be misinterpreted in general to mean that the most highly experienced teachers are significantly more effective than teachers with limited experience. More detail research into variables involved in a teacher's experience could shed further light on this issue and its potential implications for appropriate policy and practice

5.3.2 Effects of Teachers' Academic Qualifications on Students Achievement in JSC Mathematics

The findings of this study supported the expected positive relationship between teachers' academic qualification and students' achievement in JSC Mathematics. The data reflected in Table 4.10 reveal that teachers' academic qualifications contributed 35% to students' JSC Mathematics results. These findings seem to confirm the reports of NCHE (2007) and NHRDP (2002) which noted weaknesses in the Namibian BETD Mathematics education programmes, namely, teachers' lack of competence due to inadequate training at the lower level, the inadequacy of the structure and curriculum of BETD programmes in equipping teachers with competency in content and pedagogical knowledge, particularly in terms of school-relevant subject content, and the inefficiency of the teaching methods advocated for Mathematics.

5.3.3 Effects of Teachers' Practice of Standards-Based Classroom Instruction on Students' Achievements in JSC Mathematics

The teachers' reported use of standards-based instruction was not significantly associated with students' achievement in JSC Mathematics. From the findings of the study, it was evident that some of the standards-based activities had either a very weak association or a negative impact on students' JSC Mathematics results. Several empirical studies (Akiba, Chiu, Zhuang, & , 2008) have revealed that when students were exposed to classroom activities such as solving mathematics problems with other students or in a group, using measuring instruments or geometric solids, writing about solving mathematics problem, or talking with the class about solving mathematics problems, they were more likely to achieve higher Mathematics scores than students who did not work on standards-based classroom activities . The findings of my study, however, did not confirm the expected positive relationship between standards-based classroom practices and students' achievement in Mathematics. This suggests that Namibian Mathematics teachers do not effectively apply standards-based pedagogical practices. There are several possible reasons for this. It may be that the teachers do not have access to the necessary standards-based guidelines, or that they have not been adequately trained in these practices.

Several questions thus arise from the findings of this study and suggest avenues for further research. These are: Do the teachers themselves really understand the concept and aim of standards-based activities? Do teachers encourage a problem-solving thinking culture, or do they simply follow the textbooks? Do cultural attitudes and values influence students' approach to problem solving? Is this perhaps at the root of why teachers with 5-10 years of experience are more effective? (Older teachers may not have had adequate training in standards-based approaches). In order to address these questions, future studies should use a sequential exploratory strategy in a mixed method approach in which qualitative results assist in explaining and interpreting the findings of the quantitative research adopted in this study.

Research has shown that there are variations in teachers' usage of standards-based pedagogical strategies and standards-based instruction (Lauer, et al., 2005). A possible explanation for these variations is the degree of difficulty that teachers experience when they attempt to align their practices with the intent of national standards, or it might relate to teachers' erratic access to learning opportunities and instructional resources (Lauer, et al. 2005).

In support of the findings of Lauer et al. (2005), Dittmar et al. (2002) reveal that most JSC Mathematics teachers are professionally isolated due to the isolation and size of schools in Namibia. For example, there is only one Grade 10 Mathematics teacher in 75% of schools (three out of four schools) which offer Grade 10 Mathematics. Similarly, 83% of schools that offer Grade 7 Mathematics have only one Grade 7 Mathematics teacher (Dittmar et al., 2002). The researchers found that most teachers prepared their lessons and examinations in isolation year after year. Most teachers were unable to share ideas with other teachers who were doing the same work, or to benefit from the experience of other colleagues. Most teachers prepared and interpreted the JSC mathematics syllabus differently, prepared different schemes of work and set different standards for examinations. It is then hardly surprising that the results of national examinations are often poor (p3).

Similarly, Coupe & Goveia (2003) found that most schools adopted traditional pedagogical teaching strategies. Furthermore, the researchers observed that most schools trained their students to be professional and some trained their students for subordinate positions in society. Also, the researchers maintained that learner-centred education, education for democracy, and constructivist teaching approaches, encouraged by the Ministry of Education, were not being implemented in most schools. The findings seem to suggest that most schools are not utilising the learner-centred approach to problem solving in teaching and learning for JSC Mathematics. This may be due to the deficiency in the teacher training programmes with regard to content and pedagogical knowledge (NCHE 2007). Thus, further research should examine teachers' pedagogical content knowledge and learner-centred approach to determine if there is any significant relationship to students' JSC mathematics results.

The findings of this study and the observations of Dittmar et al. (2003) and Coupe & Goveia (2003) seem to suggest that Namibian students at the JSC level are being deprived of opportunities to engage in worthwhile and meaningful mathematical activities. This is a fundamental curriculum flaw which the policymakers and curriculum designers need to pay attention to.

5.3.4 Effects of Teachers' Subject Specialization (Mathematics Major) on Students' Achievement in Mathematics

According to Betts et al. (2003), teachers with a Mathematics major positively impact secondary students' achievement in Mathematics. Also, Goldhaber & Brewer (1996) found that any type of subject-certification in Mathematics contributed to students' Mathematics scores. The findings of this study supported the expected positive relationship between teachers having a major in Mathematics and students' JSC Mathematics results, as is evident from the descriptive statistics in Table 4.10, which show that 22.8% of the students' JSC Mathematics results can be attributed to teachers having a major in Mathematics. The statistics in Table 4.1 reveal that 93.3% of the teachers majored in Mathematics at both diploma and degree level. This gives rise to the question of what could be the possible explanation for the low relationship between the teachers' subject matter specialisation and students' academic achievement in Mathematics, and whether part of the problem could possibly be attributed to lack of mathematical content knowledge (MCK), or lack of mathematical pedagogical content knowledge (PCK), or non- alignment of the curriculum with the content knowledge. Table 4.1 reveals that 93.3% of teachers majored in Mathematics at both BETD and B.Ed. level, and almost 80% of the teachers were professionally trained. This implies that the JSC Mathematics teachers were exposed to MCK and PCK at the under-graduate levels, but such training in MCK and PCK did not have a strong significant relationship with students' achievement in JSC Mathematics. From the literature study with regard to Namibia, it is evident that the Mathematics training programmes for the BETD

are deficient in both MCK and PCK contexts. For example, the studies of NCHE (2007), Marope (2005), and NHRDP (2002) revealed that the BETD programme was very weak in both these aspects.

Research has shown that teachers' mathematics subject matter knowledge conceptualised in terms of content knowledge (CK) and pedagogical content knowledge (PCK) are significant predictors of students' academic achievements in Mathematics (Baumert et al.2010). The authors found that a combination of teachers' MCK and mathematical PCK had a significant positive relationship with students' academic achievements in Grade 10 schools in Germany. Similarly, Hill et al. (2005) found that teachers' mathematical knowledge for teaching positively predicted students' academic achievement in Mathematics.

The findings of this study have implications for Mathematics educators to ensure that pre-service teachers align MCK with PCK. The content knowledge defines the possible scope for the development of the PCK and for the provision of instruction offering both cognitive activation and individual support (Baumert et a. 2010).

5.3.5 Effect of Linear Combination of Set of Teacher-Related Variables in Students' Achievement in Mathematics

The main purpose of this study was to determine which combination of teacher-related variables significantly predicts students' JSC Mathematics results in Namibian secondary schools. From Table 4.19, it is evident that six out of the eight predictors have a positive and significant effect on students' JSC Mathematics results. The multi-regression analysis in Table 4.20 reveals that a linear combination of teachers having a major in Mathematics, use of whole group class discussion in teaching Mathematics, reviewing of students' homework and assignments, professional development in interdisciplinary instruction, teachers' mathematical content knowledge in algebra, and students talking to other students on how to solve Mathematics problems contributed 17.9% to students' achievement in JSC Mathematics at $P < 0.05$. The P-value of 0.002 implies that 0.2 times out of 100, the result was obtained by chance.

The questions arising from these findings that require further research are: Why would each of these factors have an impact on students' achievement in JSC Mathematics? For example, how does peer engagement influence students' achievement in Mathematics? Or, how does reviewing of students' homework influence students' Mathematics results? Furthermore, why would a major in Mathematics make a teacher more effective?

5.4 Policy implications

Pedagogical knowledge and practices

Further research should be conducted on the most effective kinds of pedagogical content and practices, using consistent definitions and data-gathering techniques, and taking into account the diverse learning styles and /or aptitude of students at various grade levels. Research has shown that teacher knowledge is an important factor that influences instructional practices and student achievement.

The JSC Mathematics teachers' reports of some of the standards-based practices did not predict students' achievements in Mathematics. For standards-based practices to be perceived as effective by students, Mathematics teachers need to first understand their students' prior Mathematics content knowledge.

Recommendations

The following sets of recommendations emanate from the present study:

Teachers' inputs (academic qualifications teaching experience, subject specialization):

From Table 4.10, it is evident that teachers' academic qualifications, teachers' having a major in Mathematics and teachers' teaching experience have positive and significant relationships with students' achievement in JSC Mathematics. The descriptive statistics in Table 4.1 reveal that 93.3% of the teachers majored in Mathematics at both diploma and degree levels, 57.5% of the teachers had a three-year post secondary education and 33.5% of the teachers had taught for 10 years or more. Based on these statistics the Ministry of Education in Namibia /stakeholder of teacher education should consider the following:

1. The Ministry of Education should fully fund the University of Namibia Mathematics and Science Teachers Extension Programme (MASTEP) in terms of tuition fees and other necessary logistics. The MASTEP programme of the University of Namibia focuses on enhancing the BETD Mathematics teachers' mathematics content and pedagogical content knowledge to enable them to teach Mathematics up to grade 12 level.
2. Direct assessment of teachers' actual mathematical knowledge provides the strongest indication of a relation between teachers' content knowledge and their students' academic achievement. More precise measures are needed to specify in greater details the relationship among the JSC mathematical knowledge, their instructional skills and students' academic achievement.
3. Incentives should be provided for teachers of Mathematics working in locations where it is difficult to attract staff.

Standards-based classroom practices:

Standards-based policies influence teaching and students' learning in school. However, the nature of the influence depends on how the policies are perceived and implemented by teachers. If standards-based reforms are to achieve their promises of high standards for all students in Namibia, then more attention and resources are needed for the instructional support systems in Namibian schools, including curriculum, instruction, professional development and interventions for slow learning students.

Constructivist theory argues that teachers' efforts to understand students' daily experiences and connect them with school mathematics are crucial. Therefore, professional development training for JSC Mathematics teachers should focus on making sure that these teachers have a good understanding of cultural experiences, including the cultural objects, values and languages of Namibian students, in order to connect their day-to-day experiences and understanding of Mathematics at home with new mathematical concepts to be taught in the classroom.

Professional development

The findings of this study revealed that teachers' reports of some types of professional development activities which they had experienced had a significant and negative relationship with students' achievement in JSC Mathematics. These findings seem to suggest that these teachers were likely to participate in such professional development activities either voluntarily or by requirement from the Ministry of Education. Hence, professional development needs to focus on diverse aspects of activities that will shape the learning experiences of teachers so as to identify and produce useful information on what specific features of professional development are effective in promoting effective learning for both teachers and students.

Recommendation

Studies are needed which are designed to generate knowledge about the impact of different approaches to professional development and which permit comparison with other potential impacts on teacher capacity and their effectiveness (e.g., experience, curriculum policy). Such studies will depend not only on rigorous design, but also on valid and reliable measures of the

key outcome variables, i.e. teachers' mathematical knowledge, and skills, instructional quality and student learning.

5.5 Conclusion

This study was able to determine the extent to which teacher-related variables correlated with students' achievement in JSC Mathematics. Nonetheless, certain limitations to this study are worth describing:

The study was cross-sectional and not longitudinal. The information about teachers' inputs (qualifications, characteristics, and professional development), and processes (classroom practices) were collected at the same time as the students' JSC mathematics results.

Secondly, the study employed only a structured questionnaire (closed-ended) to capture the teacher-related variables. Teachers' content knowledge, pedagogical knowledge and classroom instruction techniques were captured through proxies (such as teachers' perceptions of the knowledge of JSC Mathematics curriculum, their perception of the usage of standards-based classroom practices etc.). This approach cannot ascertain the full complexity of classroom environments, the lively interaction among students and teachers, and /or teachers' reasoning and decision-making in relation to choice of standards-based instruction and classroom management. Further, this study used fairly crude measures in determining teachers' mathematical content knowledge and pedagogical content knowledge, use of standards-based instruction and beliefs about use of standards-based classroom management. A qualitative dimension to this study would have helped to fill the gap.

Finally, apart from the fact that the researcher carried out neither the observations nor the interviews with key informants, he was not able to control for school factors such as leadership style of the principal and school cultural norms and values. Consequently, future studies should use a sequential exploratory strategy in a mixed method approach in which qualitative results assist in explaining and interpreting the findings of the quantitative study. The procedure should not only include a baseline control for outcome measure (e.g. prior student mathematics achievement), but should also use multivariate analyses (e.g., ordinary least square (OLS) or hierarchical linear modelling (HLM), as well as a strong outcome measure (e.g., standardised test

to measure student mathematics achievement). The sample size should be larger, using at least 1000 or more observations of students' Mathematics achievement. For statistical control, the design should contain a pre-test control for student mathematics achievement and teachers' characteristics, and there should be multiple model specification or other robustness checks on results.

Despite the above limitations, this study confirmed the advantage of extending past research on teachers' effectiveness. Although much past research has focused on the link between student outcomes and teachers' classroom practices (Akiba et al 2008), few studies have investigated the link between teachers' different standards-based practices and inputs, and students' outcomes. However, some previous studies have established that teacher' standards-based practices, teacher's input and students' socio-economic background (SES) each make a unique contribution to variance in student academic achievement (Wenglinsky 2002; Lankford, Loeb & Wyckoff , 2002; Greenwald, Hedges & Laine, 1996). Furthermore, it appears that aligning the forces of the teachers' inputs, teachers' classroom practices and teachers' classroom management skills to mutually support each other can have a beneficial effect on students' academic achievement (Wenglinsky 2002).

With regard to the current study, the findings that standards-based practices in general were not significantly correlated with students' performance in Mathematics are consistent with research reported by Akiba et al (2008), who analysed data from American Indian/Alaska Native (AIAN) tribes in public schools in USA. Using multi regression techniques (ANOVA), they found that while teachers' reported standards-based instruction was not significantly associated with the Mathematics achievement of AIAN students, standards-based activities reported by students themselves did in fact affect their performance in Mathematics. Wenglinsky (2002), extending this research, found a link between a combination of teachers' reported standards-based practices and teachers' inputs in improving students achievement in Mathematics. An important finding of the current study was that similarly, in Namibia, teachers' inputs (a major in Mathematics) in combination with specific aspects of standards-based classroom practices had the largest effect on students' achievement in JSC Mathematics.

However, this study has also established that in Namibia, contrary to expectation based on research carried out in other countries (e.g. Hill et al., 2005; Baumert et al., 2007), teacher's pedagogical content knowledge (PCK) does not translate into high performance by learners. As discussed earlier, this suggests a deficiency in the preparation and training of Namibian Mathematics teachers which urgently needs to be identified and addressed.

Due to a positive and significant relationship revealed between teacher variables and student achievement, it is likely that the findings from this study may be of benefit to policymakers and researchers who may want to implement effective teacher-training programmes targeting the improvement of the identified teacher variables and/or who may want to conduct further research based on the findings of this study.

Finally, in order for the government of Namibia to succeed in its desire to secure for Namibia a scientific and technological revolution, action must be directed towards improving mathematics teaching in secondary schools, and providing Namibian students with competitive skills for success in the global village. It is hoped that the findings of this study will motivate a concerted effort from all stakeholders in education towards the on-going improvement of mathematics education in Namibian secondary schools.

REFERENCES

- Aaronson, D., Barrow, L., & Sanders, W. (2003). *Teachers and student achievement in the Chicago public high schools* (Working paper No. 2002.28). Chicago: Federal Reserve Bank of Chicago. Retrieved March 25, 2011, from <http://www.chicagofed.org/publications/workingpapers/papers/wp2002-28pdf>
- Ainley, J. & McKenzie, P. (2000). School Governance: Research on Educational and Management Issues. *International Education Journal*, 1(3), 144-148.
- Akiba, M., Chiu, Y-F., Zhuang, Y., & Eastman-Mueller, H. (2008). Standards-based mathematics reforms and mathematics achievement of American Indian/Alaska Native eighth graders. *Education Policy Analysis Archives*. 16 (20).
- Aksoy, T., & Link, C.R. (2000). A panel analysis of students' Mathematics achievement in the USA in the 1990s: Does increasing the amount of time in learning activities affect Mathematics achievement? *Economics of education review*, 19, 126-277.
- ALausa, Y.D. (1997). *An Investigation into the structure and implementation of Senior Secondary further Mathematics curriculum in Ogun State, Nigeria*. Unpublished PhD thesis.
- Andrew, M., Duncombe, W., & Yinger, J. (2002). Revisiting economies of size in American education: Are we any closer to a consensus? *Economics of Education Review*, 21(3).
- Archer, J. (1998). Students' fortunes rest with assigned teachers. *Education week*, 17 (23, 24).
- Babbie, E. (2001). *The practice of social research*. WADA Worth publishing Co Inc. Belmont: California.
- Ball, D. L. (1993). With an eye on the mathematical horizon: Dilemmas of teaching elementary mathematics. *Elementary School Journal*, 93(4), 373-397.
- Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., et al. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. *American Educational Research Journal*, 47(1), 133-180.
- Betts, J. R., Zau, A. C., et al. (2003). *Determinants of student achievement: New evidence from San Diego*. San Francisco: Public Policy Institute of California.
- Birkmire, K.J. (1993). *Ninth grade proficiency, Is it the best measure of learning: A survey of teacher attitudes*. ERIC Document Reproduction Services No. ED 361 406.
- Bishop, A.J. et al. (Eds). *International handbook of Mathematics education*. London: Kluwer Academic press. 565-614.

- Bless C. and Higson-Smith, C. (1995). *Fundamentals of social research methods: An African Perspective* (2ndEd.). Cape Town: Juta and Co Ltd.
- Boardman, A. E., Davis, O. A., & Sanday, P. R. (1977). A simultaneous equations model of the educational process. *Journal of Public Economics*, 7, 23-49.
- Bodin, A., & Copponi, B. (1996). Junior secondary school practices. In A.J. Bishop et al. (Eds). *International handbook of Mathematics education*. London: Kluwer Academic press. 565-614.
- Bogdan, R.C. & Biklen, S.K. (1998). *Qualitative research in education: An introduction to theory and methods* (3rded..). Needham heights, MA: Allyn and Bacon.
- Borg, W. R & Gall, J.P. (1989). *Educational research: An introduction*. New York, USA: Longman Publishing. Co.
- Boyd, D., Grossman, P., Lankford, H., Loeb, S., & Wyckoff, J. (2006). *How changes in entry requirements alter the teacher workforce and affect student achievement*. Albany, NY: Teacher Policy Research.
- Boyd, D., Lankford, H., Loeb, S., Rockoff, J. & Wyckoff, J. (2008). *The narrowing gap in New York City teacher qualifications and its implications for student achievement in high poverty schools*. (Working Paper 14021). Cambridge, MA: National Bureau of Economic Research.
- Bransford, J.D., Brown, A.L, & Cocking R.R. (Eds). (1999). *How People Learn: Brain, Mind, Experience, and School*. Washington, DC: National Academy Press.
- Brophy, J. (1986). Teacher Influences on student achievement. *American Psychologist* (October 1986), 1069-1077.
- Brown, A.L., & Campione, J.C. (1994). Guided discovery in a community of learners. In K. (Ed.), *Classroom lessons: Integrating cognitive theory and classroom practice* (pp. 229-270). Cambridge, MA: MIT Press.
- Bryman, A. & Cramer, D. (2001). *Quantitative Data Analysis*. Rutledge, New York.
- Carmines, E.G. & Zeller, R.A. (1979). *Reliability and validity assessment*. Beverly Hills, CA: Sage.
- Carpenter, T., & Lubinski, C. (1990). Teachers' attributions and beliefs about girls, boys and Mathematics. *Educational Studies in Mathematics*, 21, 55-69.
- Clotfelter, Ladd & Vigdor, (2006, Fall). Teacher-student matching and the assessment of teacher effectiveness. *Journal of Human Resources*, 41(4), 778-820.

- Clotfelter, C.T, Ladd, H.F. & Vigdor, J.L. (2007). *How and why do teacher credentials matter for students achievement?* (Working paper 2). Washington, DC: Urban Institute, National Centre for Analysis of Longitudinal Data in Education Research. Retrieved January 11, 2011 from http://www.caldercenter.org/pdf/1001058_teacher_credentials.pdf
- Cochran, K., DeRuiter, J. & King, R. (1993). Pedagogical content knowing: An integrative model for teacher preparation. *Journal of Teacher Education*, 44 (40), pp.263-272.
- Cohen, J. & Cohen, P. (1983). *Applied multiple regression correlation analysis for behavioural sciences*. Hillsdale, N.J.: Lawrence Erlbaum Associations.
- Cohen, M. (1983). Instructional, management and social conditions in effective schools. In A. Odden & L.D. Webb (Eds.), *School Finance and school improvement linkages for the 1980's*. (p.p. 17 - 50). Cambridge: Ballinger.
- Cohen, D. K., & Hill, H. C. (1998, January). State policy and classroom performance: Mathematics reform in California. *CPRE Policy Briefs*. RB-23, 1–10.
- Coleman, J.S. (1966). *Equality of Educational opportunity*. Washington, DC: Office of Education, U.S. Department of Health, Education and Welfare.
- Coleman, J.S. (1990). *Equality and achievement in education*. Boulder: Westview Press.
- Coleman, J.S. (1996). *Equality of educational opportunity*. Washington, DC: Office of Education, U.S. Department of Health, Education and Welfare.
- Connell, J. (1990). Context, self, and action: A motivational analysis of self-system processes across the life-span. In D. Cicchetti & M. Beeghly (Eds.), *The self in transition: From infancy to childhood* (pp. 61–67). Chicago: University of Chicago Press.
- Cooper, H.M. (1994). *The battle over homework: An administrators' guide to setting sound and effective policies*. Thousand Oaks, CA: Corwin.
- Cooper, P.S. & Schindler, D.R. (2001). *Business research methods*. (8th.ed.). New York: McGraw Hill.
- Coupe, J. & Goveia, J. (2003). Using technology to support teacher training at a distance in Namibia. Reform Forum: *Journal for Education Reform in Namibia*, 15, 15-30
- Danielson, C. (2007). *Enhancing professional practice: A framework for teaching*. Alexandria, VA: Association for Supervision & Curriculum Development.
- Darling-Hammond, L (1999). *Teacher quality and student achievement: A review of state policy evidence*. Seattle, WA: Centre for the Study of Teaching and Policy, University of Washington.

- Darling-Hammond, L. (2000). *Teacher quality and student achievement: A review of state policy evidence*. Education Policy Analysis Archives, 8 (1), 50.
- Darling-Hammond, L. & Ball, D. L. (January, 1998). *Teaching for high standards: What policymakers need to know and be able to do*. Consortium for Policy Research in Education, Philadelphia, PA, National Commission on Teaching & America's Future, New York, NY
- Darling-Hammond, L. & Sykes, G.. (2003, September 17). Wanted: A national teacher supply policy for education: The right way to meet the "Highly Qualified Teacher" challenge. *Education Policy Analysis Archives*, 11(33).Retrieved June22, 2011 from <http://epaa.asu.edu/epaa/v11n33/>.
- Darling-Hammond, L. (1991).The implications of testing policy for quality and equality. *Phi Delta Kappan*, 73 (3), 220-225.
- Darling-Hammond, L., Berry, B. & Thoreson, A. (2001). Does teacher certification matter? Evaluating the evidence. *Educational evaluation and policy analysis* 23, 57 - 77.
- Davidson, N. (1985).Small group cooperative learning in Mathematics: A selective view of the research. In Slavin, R., (Ed).*Learning to cooperate, cooperating to learn*.211-230.New York:Plenum Press.
- Denga, D.I. & Ali, A.(1989). *An introduction to research methods and statistics in education and social sciences*(Eds,). Calabar, Nigeria: Rapid Educational publishers limited.
- Dittmar, F., Mendelson, J. & Ward,V. (2002). *The cluster system in Namibia: Framework for quality education*. Windhoek: RAISON
- Denzin, N.K. & Lincoln, Y.S. (1998). *The landscape of qualitative research: Theories and issues*. Thousand Oaks: Sage Publications.
- Desimone, L. M., Porter, A. C., Garet, M. S., Yoon, K. S., & Birman, B. F. (2002). Effects of professional development on teachers' instruction: Results from a three-year longitudinal study. *Educational Evaluation and Policy Analysis*, 24(2), 81-112.
- De Vos, A.S (1998). *Research at grass root*. Pretoria: J.L Van Schaik Publishers.
- Directorate of National Examinations and Assessment. (2000). *New Assessment Schemes for the JSC Examination and the submission for assessment mark for implementation from 2000*. (DNEA Circular: 25/2000).
- Dossey, J., Mccrones, S., Giordano, F., & Weir, M. (2002). *Mathematics methods and modelling for today's Mathematics classroom: A contemporary approach to teaching grades 7-12*. Pacific Grove, CA: Brooks/Cole.

- Dreeben, R. (2000). *Structural Effects in Education: A History of an Idea. Handbook of the Sociology of Education*. M. Hallinan. New York, Kluwer Academic/Plenum Publishers: 107-135.
- Druva, C.A., & Anderson, R.D. (1983). Science teacher characteristics by teacher behavior and by student outcome: A meta-analysis of research. *Journal of Research in Science Teaching*, 20(5), 467-479.
- Easton-Brooks, D. & Davis, A. (2009). Teacher qualification and the achievement gap in early primary grades. *Education Policy Analysis Archives*, 17 (15). Retrieved July 14, 2011 from <http://epaa.asu.edu/epaa/v17n15/>.
- Eberts, R.W., & Stone, J.A. (1984). *Unions and public schools: The effects of collective bargaining on American education*. Lexington, MA: Heath.
- Ehrenberg, R.Y., Brewer, D.J. (1995). Did teachers' verbal ability and race matter in the 1960s? Coleman revisited. *Economics and Education Review*. 14, 1 - 21.
- Ehrenberg, R.G. & Brewer, D.J. (1994). Do school and teacher characteristics matter? Evidence from high school and beyond. *Economics of Education Review*. 13(1): 1-17.
- Entwistle, N. & Entwistle, D. (2003). Preparing for examination: the interplay of memorising and understanding, and the development of knowledge objects. *Higher Education Research and Development*, 22, 19-41.
- Eren, O. R., & Henderson, D.J. (2006). *The impact of homework on students achievement*. Retrieved May 30, 2010 from <http://people.smu.edu/oeren/document/research/oren-henderson.pdf>.
- Erwee, P. (1997). *Survey reveals poor quality Mathematics education*. Namibian Mathematics Institute.
- Ministry of Education. (2005). *The Strategic Plan for the Education and Training Sector Improvement Programme (ETSIP): 2005 - 2020 - Planning for a Learning Nation*. Ministry of Education: Windhoek.
- Ferguson, R.F. (1991). Paying for public education: New evidence on how and why money matters. *Harvard Journal on Legislation*. 28, 465 - 498.
- Ferguson, R.F., & Ladd, H.F., (1996). How and why money matters: An analysis of Alabama Schools. In (Ed.), *Holding schools accountable: performance based reform in education* (pp 265 - 298). Washington, DC: Brookings Institution.
- Ferguson, R.F., & Womack, S.T. (1993). The impact of subject matter and education coursework on reaching performance. *Journal of Teacher Education*, 44(1), 55-63.

- Flanders, J.R. (1987). How much of the contents in Mathematics textbooks is new? *Arithmetic Teacher*. (Reston, VA). 30, 555-583.
- Gall, M.D., Borg, W.R & Gall, J.P. (2006). *Educational Research: An Introduction*, 8th Ed. Allyn & Bacon.
- Garet, M. S., Porter, A. C., Desimone, L., Birman, B., & Yoon, K. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, 38(4), 915-945.
- Glenn, J.C.C. (2000). *Before it's too late. A report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century*. Jessup: Education Publications Centre.
- Glewwer, P., & Kremmer, P. (2006). Schools, teachers, and education outcomes in developing countries. *Handbook of the economics of education*. Elsevier. Retrieved May 12, 2011 from <http://ideas.repec.org/h/eee/educhp/2-16.html>.
- Goe, L., & Croft, A. (2009). *Methods of evaluating teacher effectiveness*. Washington, DC: National Comprehensive Center for Teacher Quality. Retrieved October 20, 2011 from <http://tqcenter.learningpt.org/publications/RestoPracticeEvaluatingTeacherEffectiveness.pdf>.
- Goe, L. (2007). *The link between teacher quality and student outcomes: A research synthesis*. Washington, DC: National Comprehensive Centre for Teacher Quality. Retrieved August 3, 2011 from <http://www.tqsource.org/publications/LinkBetweenTQandStudentOutcomes.pdf>.
- Goe, L., & Stickler, L. (2008). *Teacher quality and student achievement: Making the most of recent research* (TQ Research & Policy Brief). Washington, DC: National Comprehensive Centre for Teacher Quality. Retrieved May 21, 2011 from <http://www.tqsource.org/publications/March2008Brief.pdf>
- Goe, L., Bell, C., & Little, O. (2008). *Approaches to evaluating teacher effectiveness: A research synthesis*. Washington, DC: National Comprehensive Center for Teacher Quality. Retrieved May 21, 2011, from <http://www.tqsource.org/publications/EvaluatingTeachEffectiveness.pdf>
- Goldhaber, D. & Anthony, E. (2004). *Can Teacher quality be effectively Assessed?* Unpublished. Seatle: University of Washington.
- Goldhaber, D. D., & Brewer, D. J. (1996, July). *Evaluating the effect of teacher degree level on education performance*. Paper presented at the NCES State Data Conference.

- Goldhaber, D.D. & Brewer, D.J. (1997a). *Evaluating the effects of teacher degree level on educational performance*. In W.J. Fowler (Ed.), *Development in school finance*, 1996 (pp. 197 - 210). Washington, DC: National Centre for Educational Statistics, U.S. Department of Education.
- Goldhaber, D.D., & Brewer, D.J. (1997b). Why don't schools and teachers seem to matter? Assessing the impact of unobservable on educational productivity. *Journal of Human Resources*, 32, 505 - 523.
- Goldhaber, D.D., & Brewer, D.J. (2000). Does teacher certification matter? High school certification status and student achievement. *Educational Evaluation and Policy Analysis*, 22, 129 - 146.
- Goldhaber, D.D., & Brewer, D.J., (2001). Evaluating the evidence on teacher certification: A rejoinder. *Educational Evaluation and Policy Analysis*, 23, 79 - 86.
- Goldhaber, D., & Eide, E. (2003). Methodological thoughts on measuring the impact of private sector competition on the educational workplace. *Educational Evaluation and Policy Analysis*, 25(2), 217-232.
- Goodlad, J.I. (1984). *A place called school: Prospects for the future*. Thomas Quinn Michael Hennelly (Ed.). NYC: McGraw-Hill Book Co.
- Grasso, A., & Epstein, I. (1992). *Research utilisation in social services: innovation for practice and administration*. New York: Haworth press.
- Gray, L.R & Diehi, P. L. (1992). *Research methodology for business and management*. New York: Maxwell Macmillan, Inc.
- Greenwald, R., Hedges, L.V., & Laine, R.D. (1996). The effects of school resources on student achievement. *Review of Educational Research*, 66 (3), 361 – 396.
- Guthrie, J.T., Van Meter, P.G.R., Solomon, A., Anderson, E., & McCann, A. (1998). Does concept-oriented reading instruction increases strategy use and conceptual learning from text? *Journal of Educational Psychology*, 90 (2), 261 – 278.
- Grouws, D. A. (2001). Homework. In L.S. Grinstein & L.I. Lipsey (Eds), *Encyclopedia of Mathematics Education*. 330-331. New York: Routledge Falmer.
- Grouws, D.A., & Cebulla, K.J. (2000). *Improving students' achievement in Mathematics part 1: Research findings*. Columbus OH: Eric/Csmee.
- Hafiner, A.L. (1993). Teaching methods scales and Mathematics-class achievement: What works with different outcomes? *American educational research Journal*, 330(1), 71-94.

- Hagood, M.G. & Price, D. O. (1957). *Statistics for sociologists*. New York: Henry Hill and Company.
- Hallinan (Ed.). *Handbook of the Sociology of Education* (pp.107 – 135). New York: Kluwer Academic.
- Hanushek, E. (1990). *The impact of differential expenditure on school performance...*
- Hanushek, E.A. (1992). The trade-off between child quantity and quality. *Journal of Political Economy*, 100, 85 - 117.
- Hanushek, E.A. (1986). The economics of schooling: Production and efficiency in public schools. *Journal of Economic Literature*, 49 (3), 1141-1177.
- Hanushek, E.A. (1989). The Impact of Differential Expenditures on School Performance. *Educational Researcher* 18(4): 45-65.
- Hanushek ,E.A., Kain, J.F., O'Brien, D.M and Rivkin, S.G. (2005). The market for teacher quality. *National Bureau of Economic Research*. Working paper 11154.
- Harnisch, D.L. (1987). Characteristics associated with effective public high schools. *Journal of Educational Research*, 80, 233 - 241.
- Hartel, G.D., Walberg, H.J. & Weinstein, T. (1983). Psychological models of educational performance: A theoretical synthesis of constructs. *Review of Educational Research*, 53(1), 75-90.
- Hawk, P., Coble, C. R., & Swanson, M. (1985). Certification: it does not matter. *Journal of Teacher Education*, 36(30), 13-15.
- Haycock, K. (1998). Good teaching matters: How well-qualified teachers can close the gap. *Thinking K-16*. 3(2), 1 – 14.
- Hill, H. C., Rowan, B., & Ball, D. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal*, 42(2), 371–406.
- Hoepfl, M.C. (1997). Choosing qualitative research: A primer for technology education researchers. *Journal of Technology Education*, 9(1), 47-63. Retrieved October 30, 2009, from <http://scholar.lib.vt.edu/journals/JTE/v9n1/pdf/hoepfl.pdf>.
- Howie, S.J.(2001). Mathematics and Science Performances in Grade 8 in South Africa 1988/1999: Third International Mathematics and Science Survey, Executive Summary, Pretoria: Human Sciences Research Council.

- Howie, S.J. (2002). English Language proficiency and contextual factors influencing mathematics achievement of secondary school pupils in South Africa. *Doctoral dissertation*, University of Twente.
- Husen, T. (1967). *International study of achievement in Mathematics*. Vol.2. New York: Willey.
- Horizon Research Inc, (2001). *Local Systemic Change through Teacher Enhancement, Year Six Cross-Site Report*. Retrieved June 12, 2011 from <http://www.horizonresearch.com/reports/2001/year6.php>
http://tqcenter.learningpt.org/publications/RestoPractice_EvaluatingTeacherEffectiveness.pdf.
- Ingvarson, L., Meiers, M. & Beavis, A. (2005, January 29). Factors affecting the impact of professional development programs on teachers' knowledge, practice, student outcomes & efficacy. *Education Policy Analysis Archives*, 13(10). Retrieved July 17, 2011 from <http://epaa.asu.edu/epaa/v13n10/>.
- INSTANT Project MBESC. (1995). Workshop for Mathematics resource teachers. Windhoek.
- Ismail, N.A & Anwang H. (2009). Differences in *mathematics* achievement among eight-grade students in Malaysia. *Journal International Education Studies*. 2, 8-11.
- Jacobson, C., & Lehrer, R. (2000). Teacher appropriation and student learning of geometry through design. *Journal for Research in Mathematics Education*, 31, 71-88.
- Jonassen, D.H., & Grabowski, B.L., (1993). *Handbook of Individual differences; Learning and instruction*. Hillsdale, NJ: Lawrence Erlbaum.
- Joppe, M. (2000). *The research process*. Retrieved November 2009 from <http://www.ryerson.ca/~mjoppe/rp.htm>.
- Kahle, J.B. (199). *Teacher professional development: Does it make a difference in learning?* Testimony to the US House of Representative Committee on Science. Washington Dc, 1999. Retrieved May 2009, from <http://gos.sbc.edu/k/kahle.html>
- Kain, J.F., Singleton, K. (1996). Equality of educational revisited. *New England Economic Review*. (May - June, pp. 87 – 111).
- Kaplan, D., & Elliot, R.P. (1997). A model-based approach to validating education indicators using multilevel structural equation modelling. *Journal of Educational and behavioural Statistics*, 22(3), 323-346.
- Kaplan, D., & Kreisman, M. B. (2000). The validation of indicators of mathematics education using TIMSS: An application of multiple covariance structure modelling. *International Journal of Educational Policy*, 1(2), 217-243.

- Kane, T. J., Rockoff, J. E., & Staiger, D. O. (2006). *What does certification tell us about teacher effectiveness? Evidence from New York City* (NBER Working Paper No. W12155). Cambridge, MA: National Bureau of Economic Research. Retrieved February 19, 2011, from <http://gseweb.harvard.edu/news/features/kane/nycfellowsmarch2006.pdf>
- Kasanda, C.D. (1996). Improving student performance on the IGCSE examinations. *Proceedings of the IGCSE In-service workshop for Teachers*. In C.D. Kasanda, & A.F.
- Keeves, J.P. (1976). Curriculum factors influencing school learning. *Studies in educational evaluation*. (Kidlington, UK). Vol.2s.187-184.
- Keeves, J.P. (1994). *The world of school learning: Selected key findings from 35 years of IEA research*. The Hague, Netherlands: International Association for the evaluation of Educational Achievement (IEA).
- Kennedy, M. M. (1998). *Form and substance in in-service teacher education*. Madison, WI: National Institute for Science Education, University of Wisconsin-Madison. Retrieved September 20, 2011, from <http://www.msu.edu/~mkennedy/publications/PDValue.html>
- Kennedy, M.M. (2004). Examining teacher quality. In Lester Jr. and J. Ferrini- Mundy (Eds). *Proceedings of NCTM Research Catalyst Conference*. Washington DC: National Council of Teachers of Mathematics.
- Kennedy, M.M. (2008). Sorting out teacher quality. *Phi Delta Kappan*. 90(1), 59-63.
- Kingdom G. (2006). Teacher characteristics and student performance in India: A pupil fixed effects approach. Global poverty research group working paper 059.
- Kirk, J. & Miller, M.L. (1986). *Reliability and validity in qualitative research*. Beverly Hills: Sage Publications.
- Kulm, G., Morris, K., & Grier, L. (1999). *Middle grade Mathematics textbooks: A benchmarks-based evaluation*. Washington, DC: American Association for the Advancement of Science.
- Laine, S.W.M. (2009). From highly qualified to Highly Effective: Research on the Impact of Educators on Student learning. Available on <http://www.tqsource.org>. Retrieved on May 20th, 2010.
- Lapsley, I. (2006). *Managerial and Decision Economics*, London: John Wiley & Sons, Ltd.
- Lauer, P.A., Snow., Stoutemyer, K., Martin-Glenn, M., & snow-Renner, R (2005). The influence of standards on K-12 Teaching and Student Learning: A research synthesis. Retrieved November 5, 2011 from http://www.mcrel.org/PDF/Synthesis/5052_RSInfluenceofStandards.pdf

- Leder, G. (1992). Attitudes to Mathematics. *Mathematics Education Research Journal*, 4, 1-7.
- Lee, V.E., & Smith, J.B. (1993). *Effects of high school restructuring and size on gains in achievement and engagement for early Secondary School students*. Madison, WI: Wisconsin Centre for Educational Research.
- Leedy, P.D., & Ormod, J.E.. (2010). *Practical Research*. New Jersey. Pearson Prentice Hall. Uta Academic: Cape Town
- Link, C.R., & Ratledge, E.C. (1979). Student perceptions, I.Q. and achievement. *Journal of Human Resources*, 14, 98 - 111.
- Little, J. W. (1993). Teachers' professional development in a climate of educational reform. *Educational Evaluation and Policy Analysis*, 15(2), 129-151.
- Loucks-Horsley, S., Hewson, P., Love, N., & Stiles, K. (1998). *Designing professional development for teachers of science and Mathematics*. Thousand Oaks, CA: Corwin Press.
- Marope, M.T. (2005), Namibia human capital and knowledge development for economic growth with equity. *Africa Region Human Development Working Paper Series - No. 84*, The World Bank.
- Marzano, R.J., Pickering, D.J., & Pollock, J.E. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement*. Alexandria, VA: association for supervision and curriculum development.
- Mayer, J.D. (September 1999). [*Shared Perspectives Emotional*. Column] Washington, DD; American Psychological Association.
- MBESC (March 1996).The Task Force: HIGCSE and IGCSE 1995:1 – 54.
- MBESC (November 2002). Improving mathematics in Namibia. *Report of a National Consultative Process with Recommendations*.
- McCaffrey, D. F., Lockwood, J. R, Koretz, D. M, & Hamilton, L. S. (2003). *Evaluating value-added models for teacher accountability*. Santa Monica, CA: RAND Corporation.
- McColsky, W., Stronge, J. H., Ward, T. J., Tucker, P. D., Howard, B., Lewis, K., et al. (2005). *Teacher effectiveness, student achievement, and National Board Certified teachers*. Arlington, VA: National Board for Professional teaching Standards.
- McLaughlin, M., & Talbert, J. (1993). *Contexts that matter for teaching and learning*. Stadford, CA: Center for Research on the Context of Secondary School Teaching, Stanford University.

- McLeod, D. B. (1992). Research on affect in Mathematics education: A reconceptualisation. In D. A. Grouws (Ed.), *Handbook of research on Mathematics teaching and learning*. (pp. 575-596). New York: Macmillan Publishing Company.
- McKnight, C. C., Crosswhite, F. J., Dossey, J. A., Kifer, E., Swafford, J. O., Travers, K. J., & Cooney, T. J. (1987). *The underachieving curriculum: Assessing U.S. school mathematics from an international perspective*. Champaign, IL: Stipes.
- Meyer, R.H. (1996). Value-added Indicators of School Performance. In E.A. Hanushek & D.W. Jorgenson (Eds.). *Improving America's Schools: The Role of Incentives* (pp. 197-123). Washington, DC National Academy Press.
- Mitchell, W.K. (2005). *Research methodology*. (3rd.ed.). Cape Town: Cape Town University Press.
- Monk, D.H. (1994). Subject area preparation of secondary Mathematics and Science teachers and student achievement. *Economics of Education Review*.13, 125 - 145.
- Monk, D.H., & King J.A. (1994). Multilevel teacher resource effects on pupil performance in secondary Mathematics and Science: The case of teacher subject-matter preparation. In R. G.Ehrenberg (Ed.), *Choices and consequences: Contemporary Policy issues in education*(pp29-59). Ithaca, NY: ILR Press.
- Monk, DH, & King, J (1994). Multi-level teacher resource effects on pupil performance in secondary Mathematics and Science: *The Role of teacher subject-matter preparation in contemporary policy issues: Choices and consequences in Education*, Ronald Ehrenberg (Ed.). Ithaca, NY: ILR Press
- Morris, C. G., & Maisto, A. A. (2005). *Basic Psychology: A Pearson Prentice Hall Portfolio Edition*. Upper Saddle River, NJ: Prentice Hall.
- Msokwa, Z. (2001). *Applied statistics methods*. Dares Salaam, Tanzania: Eastern Africa Statistical Center (EASTC).
- Mullens, J. E., Murnane, R. J., & Willett, J. B (1996). The contribution of training and subject matter knowledge to teaching effectiveness: A multilevel analysis of longitudinal evidence from Belize. *Comparative Education Review*, 40(2), 139-157.
- Murnane, R.J. (1975). *The impact of school resources on the learning of inner city children*. Cambridge, MA: Ballinger.
- Murnane, R.J. & Philips, B.R. (1981). What do effective teachers of inner city children have in common? *Social Science Research*. 10, 83 - 100.

- Namibian Human Resource Development Programme (NHRDP). (2002). *Improving mathematics results in Namibia: Report of National consultative Process with Recommendations*.
- Nation Council of Higher Education (NCHE). (2007). *Consultancy to develop guidelines on teacher education reform in Namibia*, Windhoek Namibia.
- NPC (September, 2008). *Second Millennium Development goals Report/Namibia: Progress at Mid-Term September, 2008*. Retrieved from http://www.npc.na/publications/MDG_Report_sept2008.pdf
- National Research Council. (1999). *Improving student learning: A strategic plan for education research and its utilization*. Committee on a Feasibility Study for a Strategic Education Research Program, Commission on Behavioural and Social Sciences Education. Washington, DC: National Academy Press.
- Newmann, F. M. (1996). *Authentic achievement: Restructuring schools for intellectual quality*. San Francisco: Jossey-Bass.
- NIED. (June 1998). *Evaluation and Monitoring exercise of the Mathematics curriculum in Namibian Primary Schools*.
- Njabili, A.F. (1995). General reflections on teacher training and learning strategies for (H)IGCSE. In Kasanda & Phiri (Eds.); *Proceedings of the (HIGCSE Colloquium on Teacher Education*. University of Namibia, Windhoek, 27-29 March.
- Noell, G. H. (2006). *Value added assessment of teacher preparation*. (Annual Report). Baton Rouge: Louisiana State University. Retrieved March 30, 2011, from <http://asa.regents.state.la.us/TE/2005-technical-report.pdf>
- Norusis, M.J. (1997). *SPSS base systems. User guide*. Chicago: SPSS Inc.
- Odden, A. & Webb, L.D (Eds.).(1983). *School Finance and school improvement linkages for the 1980's* Cambridge, MA: Ballinger.
- Oaks, J. (1986). *Educational indicators: A guide for policymakers*. Wisconsin-Madison, USA: Center for Policy Research in Education.
- Patton, M.Q. (2001). *Qualitative evaluation and research methods (3rd ed.)*. Thousand Oaks, CA: Sage Publications, Inc.
- Peterson, P.L. (1998). Teaching for higher-order thinking in mathematics: The challenge for the next decade. In D.D. Grows & T.T. Cooney & D. Jones (Eds), *Perspectives on research on effective mathematics teaching*, 1,35-57.

- Parsad, B., Lewis, L., Farris, E. (2001). *Teacher preparation and professional development: 2000*. (NCES Publication No. 2001-088). Washington, DC: National Center for Education Statistics.
- Porter, A.C. & Brophy, J. (1988). Synthesis of Research on good teaching: Insights from the work of the institute for research on teaching: *Educational Leadership* (May 1988), 74 - 85.
- Porter, A.C. & Smithson, J.L. (2000). Alignment of State Testing Programmes, NAEP and Reports of Teacher Practice in Mathematics and Science in Grades 4 and 8. Paper Presented at The American Educational Research Association. New Orleans, LA. Public schools. *Journal of Economic Literature*, 24(3), 1141-78.
- Quinn, M., (2002). *Qualitative Research & Evaluation Methods*. 3rded. USA: Sage Publications.
- Quinn, M.P, (2002). *Qualitative Research & Evaluation Methods*. 3rd Edition, London: Sage Publications Inc.
- Rajecki, D. W. (1982). *Attitudes: Themes and Advances*. Sunderland MA: Sinaur Associates.
- Relich, J. Way, J., & Martin, A. (1994). Attitudes to teaching Mathematics: Further development of a measurement instrument. *Mathematics Education Research Journal*, 6(1), 56-69.
- Resnick, L. B. (1999). *The effective Teaching of Mathematics: A review of research*. *School leadership and Management*, 19(3) 273-288.
- Reynolds, D., & Muijis D, (1999). *Worlds apart? A review of international studies of educational achievement involving England*. London: HMSO.
- Rice, J. K. (2003). *Teacher qualities: understanding the effectiveness of teacher attributes*. Washington DC: Economic Policy Institute.
- Rivkin, S. G., Hanushek, E.A., & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, 73(2), 417-458.
- Rockoff, J. (2004). The impact of individual teachers on students achievement: Evidence from panel data. *American Economic Review*, 94(2), 247-252
- Rosnick, D. (2005). Scorecard on Development: 25 Years of Diminished Progress. In: Center for Economic and Policy Research (CEPR). / CEPR Reports and Issue Briefs. *RePEc: epo: papers: 2005-30*.
- Rowan, B., Chiang, F.S., & Miller, R.J. (1997). Using research on employees' performance to study the effects of teachers on students' achievement. *Sociology of Education*, 70, 256 – 284.

- Rowan, B., Chiang, F.S., & Miller, R.J., (1996). *Using research on Employee performance to study teaching effect on student achievement in Mathematics using NELS: 88 Data*. Paper presented at the American Education Research Association, New York.
- Rowan, B., Correnti, R., & Miller, R. J. (2002). What large-scale, survey research tells us about teacher effects on student achievement; Insights from the Prospects Study of Elementary Schools. *Teachers College Record*, 104(8), 1525-1567.
- SACMEQ (2005). *The SACMEQ 11 project in Namibia: A study of the conditions of schooling and quality of education*. Windhoek, Namibia.
- Salau, M.O. (1995). The Effects of class size on the achievement of different ability groups in Mathematics. *Journal of Science Teachers Association of Nigeria*, 31, 57 – 63.
- Sanders, W., Wright, W., & Horn, S. (1997). Teacher and classroom context effects on student achievement: Implications for teacher evaluation. *Journal of Personnel Evaluation in Education*, 4(1), 3-7.
- Schulman, K. (1978). *What is an effective teacher?* Paper presented at the Conference of the International Association for Educational Assessment, Baden, Austria.
- Schmidt, W.H., McKnight, C.C., Raizen, S.A. (1997). *A splintered vision: an investigation of U.S. Science and Mathematics education*. Dordrecht, Netherlands: Kluwer Academic Publishers.
- Schoen et al., (2003). In: Cox, S. (Ed.). *A Neural Network for the Analysis and Monitoring of Stress Call of Pigs, Precision Livestock Farming*, Wageningen Academic Publishers. pp. 143-148.
- Sekaran, U. (1992). *Research methods for business: A skill-building approach*. 3rd ed. Brisbane: John Wiley & Sons Inc.
- Sekaran, U., & Bougie, R. (1992). *Research Methods for Business*, 5th Edition, and Chichester: Wiley.
- Shulman, L. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher*, 15(2), 414.
- Shavelson, R.J., McDonnell, L.M. & Oakes, J.(1987). *Indicators for monitoring mathematics and science education: A sourcebook*. Santa Monica (USA): The Rand Corporation
- Shulman, L. S. (1995). Those who understand: knowledge growth in teaching. In B. Moon & A.S. Mayes (Eds). *Teaching and Learning in the Secondary School*, London: Routledge.

- Slavin, R.E. (1990). Student team learning in Mathematics. In Davidson, N., (Ed.). *Cooperative learning in Mathematics: A handbook for teachers*. pp. 69-102. Reading, MA: Wesley.
- Snipes, J., Doolittle, F., Herlihy, C. (2002). *Foundations for success: Case studies of how urban schools system improves student achievement*. Washington, DC: Council of Great City Schools. Retrieved September 10, 2011, from <http://www.cgcs/pdfs/Foundations.pfd>
- Sparks, D. (2000). Issues at the Table: Teacher quality and student achievement becoming bargaining matters: An interview with Julia Koppich. *Journal of Staff Development*, 21(2).3-18
- Stein, M. K., Smith, M. S., & Silver, E. A. (1999). The development of professional developers: Learning to assist teachers in new settings in new ways. *Harvard Educational Review*, 69, 237-269.
- Stiggins, R. J. (1994). *Student-centered classroom assessment*. New York: Macmillan Publishing Company.
- Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York: Free Press.
- Stols, G. (2003). The correlation between teachers and their learners' mathematical knowledge in rural schools. *Proceedings of the 11 Annual SAARMSTE Conference*, University of Swaziland, Swaziland. 11 - 15 January 2003.
- Strauss, R. P., & Sawyer, E. A. (1986). Some new evidence on teacher and student competencies. *Economics of Education Review*, 5(1), 41-48.
- Strauss, R. P., & Vogt, W. (2001, March). *It's what you know, not how you learned to teach it: Evidence from a study of the effects of knowledge and pedagogy on student achievement*. Paper presented at the American Educational Finance Association, Cincinnati.
- Stronge, J.H. (2002). *Qualities of effective teachers*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Stronge, J. H., Ward, T. J., Tucker, P.D., McColsky, W., Howard, B., & Lewis, K.(2005). *Do National Board certified teachers have a value-added effect on student learning?* Paper presented at the annual conference of the American Educational Research Association, Montreal, CAN.
- Suarez, T.M., et al. (1991). Enhancing effective instructional time: a review of research. *Policy brief*, vol.1 (2).Chapel Hill, NC: North Carolina Educational Policy Research Center.
- Sullivan, J (1989). Self Theories and Employee Motivation. *Journal of Management (JofM)*, 15(2), 345 - 363.

- Summers, A.A., & Wolfe, B.L., (1975a). *Equality of educational opportunities quantified: A production function approach*. Philadelphia: Federal Reserve Bank of Philadelphia. Department of Research.
- Summers, A.A., & Wolfe, B.L., (1975b). *Which school resources help learning? Efficiency and equity in Philadelphia public schools*. Philadelphia: Federal Reserve Bank of Philadelphia.
- Summers, A.A., & Wolfe, B.L., (1977). Do schools make a difference? *American Economic Review*, 67, 639 - 652.
- Taylor, P. (1992). *Australian Mathematics Competition, Book 2, 1985-1991*, Canberra: AMT Publishing.
- Taylor, N. & Vinjevd, P. (1999). *Getting learning right*. Johannesburg: Joint Education trust.
- Tharp, R., Estrada, Dalton, S., & Yamauchi, L. (2000). *Teaching transformed: Achieving excellence, fairness, inclusion, and harmony*. Boulder CO: Westview Press.
- Thomas, A. (1998). *Educating Children at Home*. London and New York, Continuum.
- Thurén T., (1991). *Vetenskapsteoriförnybörjare*. Liber, Malmö.
- UNESCO Institute for Statistics. (2006). *Teachers and educational quality: Monitoring global needs for 2015*. Montreal, Canada
- Vaus, D.A, (2001). *Research Design in Social Research*. London: Sage Publications.
- Wainer, H. & Braun, H.I. (1998). *Test validity*. Hilldale, NJ: Lawrence Earlbaum Associates.
- Wang, M. C., Haertel, G. D., & Walberg, H. J. (1993). What helps students learn? *Educational Leadership*, 51(4), 74-79.
- Wayne, A.J., & Young, P. (2001, November 2, 2001). *Teacher characteristics and student achievement gains*. A review paper presented at the Association for Public policy and management. Washington, DC.
- Wayne, A.J., & Young, P. (2002). Teacher inequality: New Evidence on disparities in teachers' academic skills. *Education Policy Analysis Archive*, 10(30).
- Webster, W.J., Mendro, R.L., Orsak, T., Weerasinghe, D. & Bembry, K. (1997). Little practical difference and pie in the sky: A response to Thum and Bryk and a Rejoinder to Sykes. In (Ed.). *Grading Teachers, Grading Schools: Is student achievement a valid measure?* (pp. 120 - 130). Thousand oaks: Corwin Press.
- Weglinsky, H. (2002). *How teaching matters: Bringing the classroom back into discussion of teacher quality*. Princeton, NJ: Educational Testing Services.

- Wenglinsky, H. (2002). *How teaching matters: Bringing the classroom back into discussion of teacher qualifies* (Policy Information Centre Report). Princeton, NJ: Educational Testing Services. Retrieved February 29, 2011, from http://www.nocheating.org/Media.Education_Topics.pdf/teamat.pdf
- Western, W.J., Mendro R.L., Orsak, T.H. & Weerasinghe, D. (1998, April 13 - 17, 1998). *An Application of Hierarchical Linear Modelling to Estimation of School and Teacher Effect*. Paper presented at the American Education Research Association, San Diego, CA.
- Wiley, D. E., & Yoon, B. (1995). Teacher reports on opportunity to learn: Analyses of the 1993 California Learning Assessment System (CLAS). *Educational Evaluation and Policy Analyses*, 17(3), 355-370.
- Williams, W. V. (1988). Answers to questions about anxiety. *School Science and Mathematics*, 88,95-105.
- Whitehurst, G. (2002). *Research on teacher preparation and professional development*. Paper presented at White House Conference on Preparing Tomorrow's Teachers, Washington, DC. Retrieved October 9, 2011, from <http://www.ed.gov/inits/preparingteachersconference/whitehurst.html>
- Wright, S.P., Horn, S.P., & Sanders, W.L. (1997). Teacher and classroom context effect on students' achievement: implication for teacher evaluation. *Journal of Personnel Evaluation in Education*, 11 (3), 57 - 67.
- Wood, T. (1999). Creating a context for argument in Mathematics class. *Journal for Research in Mathematics Education (Reston, VA)*.Vol.30.171-191.
- Yackel, E., Cobb, P., & Wood, T. (1991). Small-group interactions as a source of learning opportunities in second-grade Mathematics. *Journal for Research in Mathematics Education (Reston, VA)*.vol.22, 390-408.
- Yamane, T. (1967).*Statistics: An Introduction Analysis*. 2nd Edition, New York: Harper & Row.
- Yin, R.K. (2003). Applications of case study research. *Applied Social Research Methods Series* Volume, 2nd Edition, London: Sage Publications Inc.
- Young, P. (1962). *Scientific Social Survey and Research*. Tokyo: Prentice Hall, Inc.,
- Zemelman, S., Daniels, H., Hyde, A. (1998). *Best practice: New standards for teaching and learning America's schools* (2nded.). Portsmouth, NH: Heinemann.

Appendices

Appendix 1: Questionnaire for the JSC Mathematics teachers

Questionnaire: Impact of Teachers' related Variables on students' academic achievement in Junior School Certificate Mathematics results

Dear Mathematics Teacher

I am Simon E. Akpo, a PhD student in the School of Education, University of South Africa. I am interested in determining the influence of teachers' Characteristics (Attributes) (e.g. demographic data, Content Knowledge, (CK) Pedagogical Content Knowledge (PCK), professional Development (PD) and teaching practices on students' achievement in Mathematics in Namibia.

The enclosed questionnaires are designed to obtain information about you and your Mathematics teaching during the past 4 years. Your participation in this study is voluntary and your responses to this questionnaire will be kept confidential. The information gathered here will help in identifying different means of how to improve the teaching of Mathematics in Namibia and how to enhance students' performance in Mathematics.

I realize that your schedule is very busy but I would highly appreciate your completion of the attached questionnaire. . It will take you approximately 25 minutes to complete this questionnaire. If you agree to participate in this research study, please kindly complete the attached consent form and return it together with the complete questionnaire.

Thank you in advance for your participation.

Yours truly
Simon Akpo

MATHEMATICS TEACHERS QUESTIONNAIRE

Directions

1. This questionnaire consists of two sections: Section A and Section B. Section A asks you to describe your Biographical information, Participation in standards-based professional development and practice of standards-based classroom teaching strategies between 2006 and 2010. Your answers will not be treated as either rights or wrong. Rather, any information you provide will be highly appreciated.
2. For each question that require you to choose, “mark” (✓) on what applies, if you make a mistake cross out and mark another option.
3. Now turn to the pages that follow and please try to give an answer for every question.

SECTION1 Demographic Information

- 101 Indicate your sex: [1] Male [2] Female
102 Educational Regions

Please indicate your educational region. (Please tick)

Regions	Code
Karas	1
Hardap	2
Khomas	3
Omaheke	4
Erongo	5
Otjozondjupa	6
Kunene	7
Omusati	8
Oshana	9
Ohangwena	10
Oshikoto	11
Kavango	12
Caprivi	13

103 Name of Current School you are teaching

What is the name of JSC School you are currently teaching? Please write the school name in full.

104 Educational Qualifications

What is your highest professional/academic qualification?

Professional Qualification	Code
No teacher training (or still studying to become qualified)	1
1-year teacher training certificate	2
2-year teacher training certificate	3
3-year teacher training certificate	4
4-year teacher training degree (B.Ed)	5
4-year academic bachelor's degree/ honours' degree	6
5-year (or more) master's degree	7
Other. Please specify	

105 Subject Specializations

Please indicate the field of study in your professional/academic qualification

Please tick only one item

Subject	Code
Mathematics	1
Computer Science	2
Mathematics	3
Biology	4
Geography	5
Chemistry	6
Physics	7
Other specify	

GENERAL TEACHING EXPERIENCE

106 What is the total number of years you have taught in the classroom? Please tick.

Number of years	Code
Less than 1 year	1
2 years	2
3 years	3
4 years	4
5 years	5
6 years	6
7 years	7
8 years	8
9 years	9
10 years and above	10

107 Indicate how many years you have taught mathematics at the following school levels

School Level	Number of years
Junior Secondary (Grade 8-10)	
Senior Secondary (Grade 11-12)	

108 Please indicate, by ticking, the grade you are currently teaching mathematics for 2011.

Mathematics	Grade 8	Grade 9	Grade 10	Grade 11-12
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109 Please indicate how long you have been teaching mathematics in grade 10 at your current school.

Please tick as many options as possible the appropriate options.

Year	Code
2006 Grade 10	1
2007 Grade 10	2
2008 Grade 10	3
2009 Grade 10	4
2010 Grade 10	5

SECTION 2: Teacher Professional Development

201 What is the total amount of time you have spent on professional development in mathematics or the teaching of mathematics since 2006? (Include attendance at professional meetings, workshops and conferences, but **do not** include formal courses for which you received college credit or time you spent providing professional development for other teachers).

- [1] Less than 5 hours [2] 6 – 15hours [3] 16-20 Hours
 [4] 21-40 Hours [5] 41-59 Hours [6] 60_Hours and above

SECTION 3: Standards –Based Professional Development

In the past 3 years, have you participated in any of the following activities related to mathematics or the teaching of mathematics?

		1=yes	2=no
301	Problem solving in mathematics		
302	Use of manipulatives (e.g. counting blocks, algebra tiles or geometric shapes) in mathematics instructions		
303	Understanding students’ thinking about mathematics in professional development workshops or seminars		
304	Classroom Management		
305	Cooperative Learning		
306	Cultural Diversity		
307	Higher-Order Thinking Skills		
308	Limited English Proficiency		
309	Interdisciplinary Instruction		
310	Performance-based Assesment		
311	Special-needs Students		

SECTION 4: Standards-based Classroom Activities

About how often do you do each of the following during your mathematics instruction?

		1=Never or hardly ever	2=1-2times a month	3=1-2 times a week	4=almost everyday
401	Introduce content through formal presentations (teacher presentation)				
402	Pose open-ended questions				
403	Use whole class discussions				
404	Require students to explain their reasoning when giving an answer				
405	Ask students to explain concepts to one another				
406	Ask students to consider alternative methods for solutions				
407	Ask students to use multiple representations (e.g. numeric, graphic, geometric, etc).				
408	Allow students to work at their own pace				
409	Help students see connections between mathematics and other disciplines				
410	Assign mathematics homework				
411	Read and comment on the reflections students have written, e.g. in journals				
412	Assessment Using Multiple-Choice Questions				
413	Assessment using Short/Long Answers				
414	Assessment Using Portfolios				
415	Assessment Using Individual Projects				

SECTION 5: About how often do your students in this mathematics class take part in the following types of activities?

		1= never or hardly ever	2=1-2 times a month	3=1-2 times a week	4=almost everyday
501	Listening and taking notes during presentation by teacher				
502	Working in groups				
503	Reading from a mathematics textbook in class				
504	Talking with other students during class about how they solve mathematics problems				
505	Engaging in mathematical activities using concrete materials				
506	Reviewing homework/worksheet assignments				
507	Following specific instructions in an activity or investigation				
508	Designing their own activity or investigation				
509	Using mathematical concepts to interpret and solve applied problems				
510	Answering textbook or worksheet questions				
511	Recording, representing, and/or analyzing data				
512	Talking to the class about their mathematics work				
513	Making formal presentations to the rest of the class				
514	Working on extended mathematics investigations or projects (a week or more in duration)				
516	Using calculators or computers for learning or practicing skills				
517	Taking Mathematics Tests				
518	Discussing solutions to mathematics problems with other students				
519	Solving and discussing mathematics problems that reflect real-life situations				

SECTION 6: Mathematics Content Knowledge

The purpose of this study is to find out your understanding of the new mathematics curriculum standards. The information gathered is used for educational research only and has no relation to the evaluation of our teaching ability and teaching performance in school. All results will be kept strictly confidential. Please read each statement carefully and write your answers in the spaces provided.

To what extent do you understand and can explain the following mathematical concepts to students. Each degree is categorized on a 4 – point scale presented this:

Please tick one per statement

601	Numbers: I can solve problems involving direct and indirect proportions (e.g. draw straight line graphs of relationships that are in direct or indirect proportion)	Little or no knowledge =1	Somewhat knowledgeable =2	Knowledgeable =3	Very knowledgeable =4
602	Money and Finance: I can interpret municipal bills hire purchase and personal income tax(e.g. calculate the compound interest earned on an amount over a period of 2or 3 years)				
603	Mensuration: I can use and teach the concepts of volumes and surface area of a cylinder and a cuboids in problems and structured questions (e.g. calculate the unknown dimensions of the cuboids and cylinders, if the volume or surface area and sufficient other information are given).				
604	Geometry Construct and describe enlargements, scale drawings and nets; apply the properties of similar triangles, regular and irregular polygons, angles in circles				
605	Algebra Carry out the four basic operations with algebraic fractions; solve linear equations which contain brackets and fractions; solve quadratic equations by factorization.				
606	Graphs and Functions Draw and interpret $y = mx + c$, find the equation of a straight line graph; draw parabola and hyperbola from tables and interpret graphs. (e.g. construct tables of values of functions of the				

	form $y = ax^2 + bx + c$ and $y = \frac{a}{x}$				
607	Statistics and probability Draw and interpret histograms with equal intervals; find the modal class of a frequency distribution; calculate the probability of a simple event occurring.				
608	Trigonometry Use the sine (sin), cosine (cos) and tangent (tan) ratios to solve problems in right-angled triangles; interpret angles of elevation and depression (e.g. solve problems in two dimensions using angles of elevation and depression)				

Section 7: Perceived Mathematical Pedagogical Knowledge

MATHEMATICAL PEDAGOGICAL KNOWLEDGE (PK)

		1=Not at all	2=Only slightly	3=To some extent	4= To a high extent
701	I can use a wide range of teaching approaches in a classroom setting (collaborative learning, direct instruction)				
702	I can adopt my teaching style to different learners				
703	I know how to assess student performance in a classroom				
704	I am familiar with common student understandings and misconceptions				
705	I can assess student learning in multiple ways				

Section 8: Pedagogical Content Knowledge (PCK)

801	I know that different mathematical concepts do not require different teaching approaches				
802	I know that different literacy concepts do not require different teaching approaches				
803	I know how to select effective teaching approaches to guide student thinking and learning in mathematics				

SECTION 9: CLASSROOM MANAGEMENT TEACHERS BELIEFS

This questionnaire is being used by the researcher to gauge your opinion about the Management of classroom activities in Mathematics lessons. I understand that my participation is voluntary, that I will not be identified in any written report, and the results of this questionnaire will not impart my teacher evaluation.

Directions: Please indicate your opinion about each of the question below by marking one of the four options in the columns on the right side. The response scale ranges from:

- 1="none at all"
- 2=only slightly
- 3=To some extent
- 4= to a hight extent.

You may choose any of the four possible responses, as each represents a degree on the continuum. Please respond to each of the questions by considering the combination of your current ability, resources, and opportunity to do each of the following in your present position. Your answers are confidential.

	Not at all	Only slightly	To some	To a high extent
901. How much can you do to control disruptive behaviour in the classroom				
902. How much can you do to motivate students who show low interest in school work				
903. How much can you do to get students to believe they can do well in school work?				
904. How much can you do to help your student's value learning?				
905. To what extent can you craft good questions for your students?				
906. How much can you do to get children to follow classroom rules?				
907. How much can you do to calm a student who is disruptive or noisy?				
908. How well can you establish a classroom management system with each group of students?				
909. How much can you use a variety of assessment strategies?				
910. To what extent can you provide an alternative explanation or example when students are confused?				
911. How much can you assist families in helping their children do well in school?				
912. How well can you implement alternative strategies in your classroom?				

Thank you very much. Your participation is greatly appreciated.

**Appendix 2: Letter of authorisation / introduction from Permanent Secretary of
Ministry of Education (MoE) to 13 Regional Directors of Education**



REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION

Tel: 264 61 2933200
Fax: 264 61 2933922
E-mail: mshimho@mec.gov.na
Enquiries: MN Shimhopileni

Private Bag 13186
Windhoek
NAMIBIA
21 September 2010

File: 11/2/1

Mr Simon E Akpo
P. O. Box 1939
WINDHOEK

Dear Mr Akpo

RE: REQUEST TO CARRY OUT A REASERCH

Your letter on the subject above dated 15 September 2010 has reference.

Kindly be informed that the Ministry does not have an objection to your request to carry out a research at some schools in the regions.

Nevertheless, you are advised to approach the Regional Councils, Directorate of Education, for permission to carry out your study in the schools. It is advisable to have schools you intend to visit identified already before you approach the Regional Council for permission. This will assist with proper communication and coordination for the necessary arrangements to be made at the selected schools.

Kindly take note that your research activities should not interfere with the normal school programmes.

By copy of this letter the Regional Councils; Directorates of Education are made aware of your request.

Yours faithfully

A Ilukena

PERMANENT SECRETARY

cc: Regional Councils; Directors of Education



Appendix 3: Letter from Caprivi Education Director (MOE) to Principals of sampled JSC Schools



Republic of Namibia
Caprivi Regional Council
Directorate of Education



Private Bag 5006, Katima Mulilo, Namibia

Enquiries: Mr L S Lupalezwi
File No:

Tel: 066 253002/253210
Fax: 066 253187

27 May 2011

Mr Simon E Akpo
PO Box 1939
Windhoek
Namibia

Attention: Mr Simon Akpo


Re: Permission to carry out an outreach Research in Schools: Caprivi Region

The subject matter above refers.

Your letter dated 13 January 2011 has reference. Permission is hereby granted to you to visit schools within Caprivi Region respectively conducting an outreach research as per above. However, note that such granted permission should not interfere with the teaching and learning activities at those schools you intend to visit.

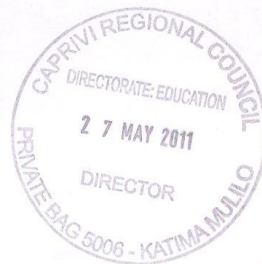
By a copy of this letter the Inspector of Education will be notified.

I thank you,

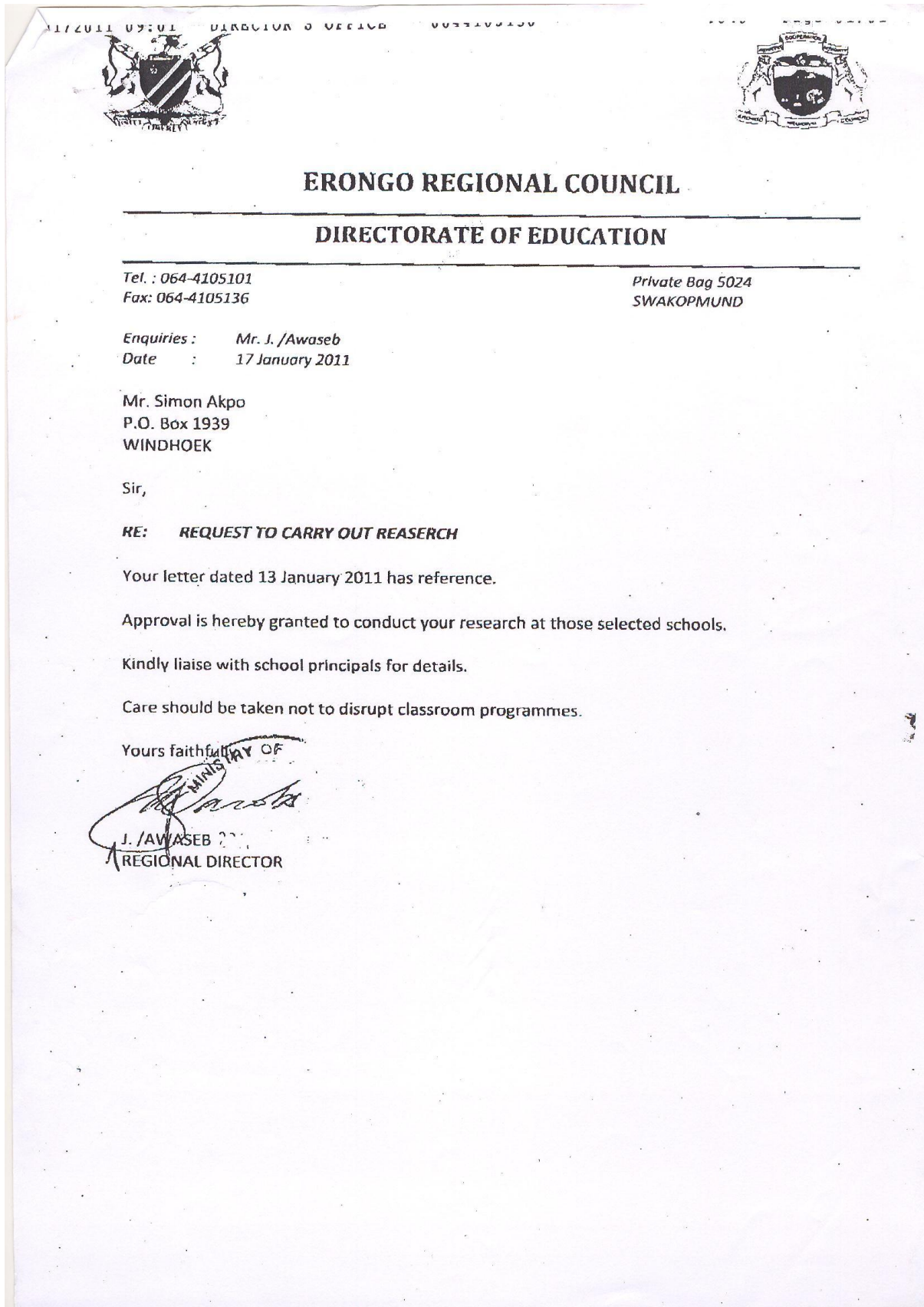


MR L S LUPALEZWI
REGIONAL DIRECTOR

Copy: IOE



Appendix 4: Letter from Erongo Education Director (MOE) to Principals of sampled JSC Schools



Appendix 5: Letter from Hardap Education Director (MOE) to Principals of sampled JSC Schools



REPUBLIC OF NAMIBIA
MINISTRY OF EDUCATION
HARDAP REGION

Enquiries: P E Topnaar
Ref. Number: S.8/2

Private Bag 2122
MARIENTAL

18 January 2011

Mr. Simeon E. Akpo
Flat 501 Polyheights
13 Storch Sreet
Windhoek

Dear Mr. S. E. Akpo

RE: REQUEST TO CARRY OUT A RESEARCH

Your letter dated 13 January 2011 on the abovementioned issue bears reference.

Kindly be informed that the Hardap Regional Education Office does not have any objection to your envisaged visit to the schools in the region to carry out research. You are however advised to approach the schools individually in advance of your intended visit for appropriate arrangements.

We further advice that your research activities should not interfere with the normal school programme.

Yours in Quality Education

.....
MR.B.BOYS
DIRECTOR



CC: MRS. Y.BOOIS: CHIEF REGIONAL OFFICER

Appendix 6: Letter from Karas Education Director (MOE) to Principals of sampled JSC Schools



**REPUBLIC OF NAMIBIA
MINISTRY OF EDUCATION**

Tel: (063) 227000
Fax: (063) 223800

Private Bag 2160
KEETMANSHOOP

Enquiries: C A Mostert
Reference: 12/2/6/1

10 February 2011

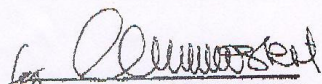
Mr. Simon Akpo
Department of Business Management
Polytechnic of Namibia
Windhoek
Fax: 061 – 2072445 / 2072087

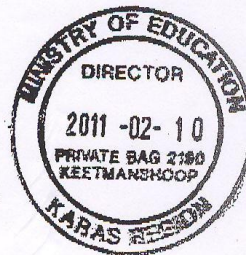
RE: REQUEST TO CARRY OUT A RESEARCH

Your e-mail with regard to the above refers.

Approval is herewith granted to do research in the region. It is trusted that confidentiality of information is guaranteed and that this exercise will not infringe on teaching and learning activities at the schools.

We wish you all the best with your project.


DIRECTOR OF EDUCATION
KARAS REGIONAL COUNCIL



Appendix 7: Letter from Kavango Education Director (MOE) to Principals of sampled JSC Schools



**Republic of Namibia
Kavango Regional Council
Directorate of Education**



PRIVATE BAG 2134, RUNDU, NAMIBIA

Enquiries : Fanuel Kapapero Telephone No. : +264-66-2589111
Email : kapapero@iway.na Fax No. : +264-66-258 9213/258 9320
Ref. No. :

28 March 2011

Mr. Simon E. Akpo
P.O. Box 1939
WINDHOEK

Dear Mr. Akpo

RE: REQUEST TO CARRY OUT A RESEARCH

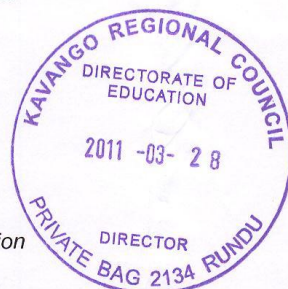
Kindly be informed that permission has been granted to your request to carry out a research at schools with grade 10 in this region.

However, please take note that the research activities should not interfere with the normal school programmes.

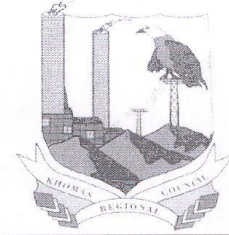
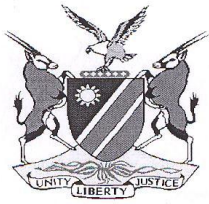
Yours faithfully


.....
Alfons M. Dikuua
DIRECTOR

Cc: Inspectors of Education



Appendix 8: Letter from Khomas Education Director (MOE) to Principals of sampled JSC Schools



**KHOMAS REGIONAL COUNCIL
DIRECTORATE OF EDUCATION**

Tel: (09 264 61) 293 4364
Fax: (09 264 61) 231 367

Private Bag 13236
WINDHOEK

19 January 2011

Mr. Simon E. Akpo
PO Box 1939
Windhoek

Dear Sir

RE: Administer a Grade 10 questionnaire for Mathematics teachers.

Your proposal on the above mentioned subject has reference.

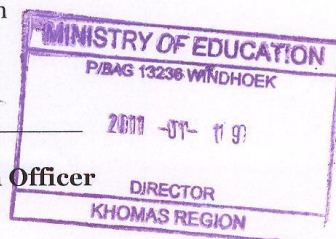
Permission is hereby granted to you to administer a questionnaire to Grade 10 Mathematics teachers only. Based on the following conditions:

- The Principal of the school to be visited must be contacted before time and an agreement must be reached between you and the principal.
- The school programme will not be disrupted.
- Teachers who will take part in this exercise will do so voluntarily.
- A copy of your final report/thesis will be provided to the Regional Office.

We wish you all the success in your endeavour.

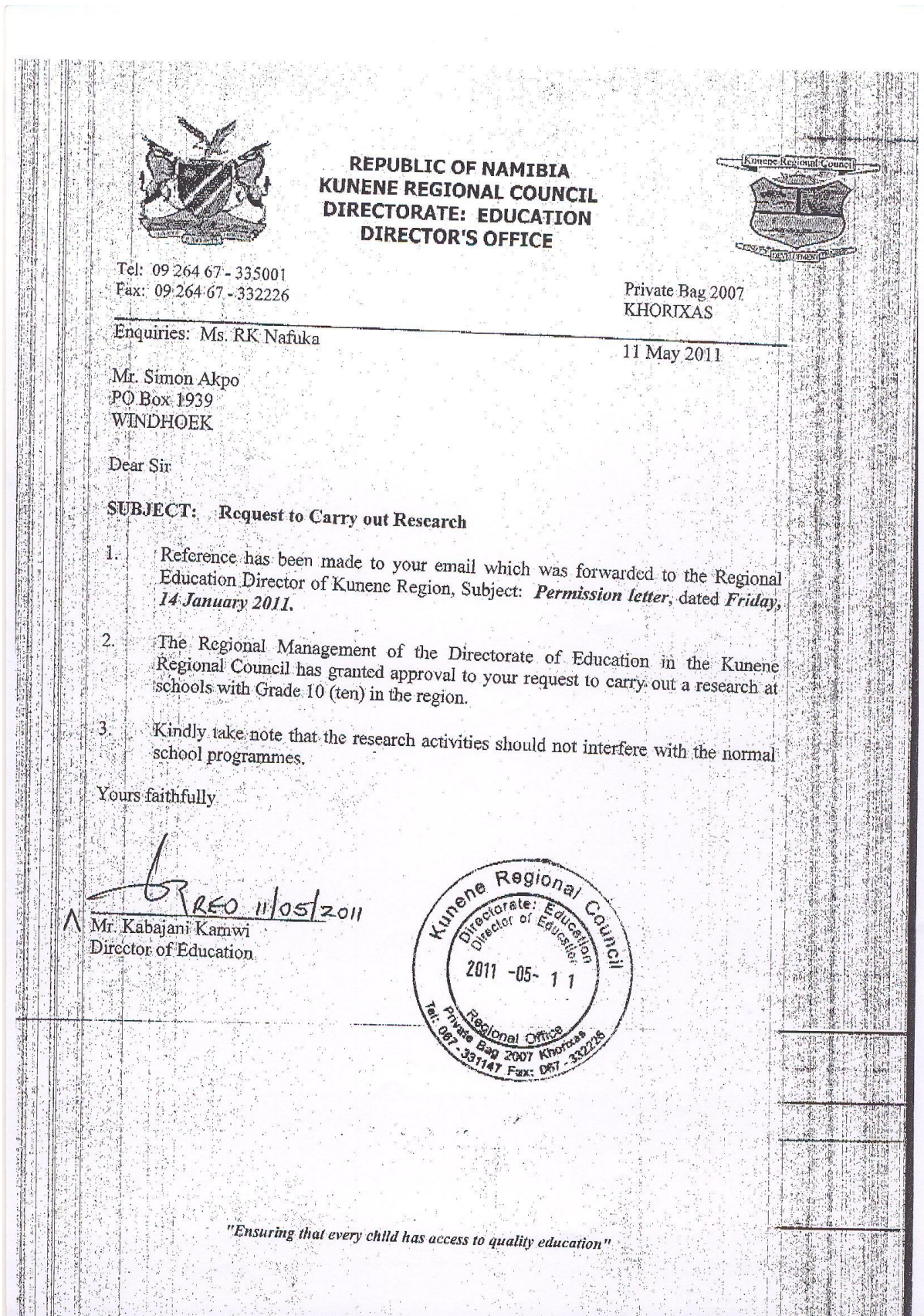
Yours in Education

Mrs. T. Seefeldt
Chief Education Officer
Khommas Region



ALL OFFICIAL CORRESPONDENCE MUST BE ADDRESSED TO: THE DIRECTOR, KHOMAS REGION

Appendix 9: Letter from Kunene Education Director (MOE) to Principals of sampled JSC Schools



**REPUBLIC OF NAMIBIA
KUNENE REGIONAL COUNCIL
DIRECTORATE: EDUCATION
DIRECTOR'S OFFICE**



Tel: 09 264 67 - 335001
Fax: 09 264 67 - 332226

Private Bag 2007
KHORIXAS

Enquiries: Ms. RK Nafuka

11 May 2011

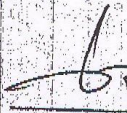
Mr. Simon Akpo
PO Box 1939
WINDHOEK

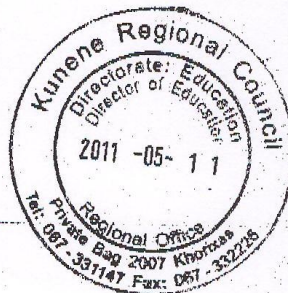
Dear Sir

SUBJECT: Request to Carry out Research

1. Reference has been made to your email which was forwarded to the Regional Education Director of Kunene Region, Subject: *Permission letter*, dated *Friday, 14 January 2011*.
2. The Regional Management of the Directorate of Education in the Kunene Regional Council has granted approval to your request to carry out a research at schools with Grade 10 (ten) in the region.
3. Kindly take note that the research activities should not interfere with the normal school programmes.

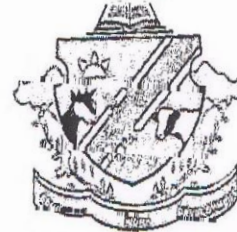
Yours faithfully


11/05/2011
Mr. Kabajani Kamwi
Director of Education



"Ensuring that every child has access to quality education"

Appendix 10: Letter from Ohangwena Education Director (MOE) to Principals of sampled JSC Schools



OHANGWENA REGIONAL COUNCIL
OHANGWENA EDUCATION DIRECTORATE
Advisory Services

Ohangwena, Tel. 065 242 516, Fax. 065 242 552

24 January 2011

Enquirer: Mr. C. DC. Nambury
0812755078

To: Mr Simon E Akpo
P.O Box 1939
WINDHOEK

Dear Mr Akpo

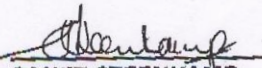
RE: PERMISSION TO CARRY OUT A RESEARCH

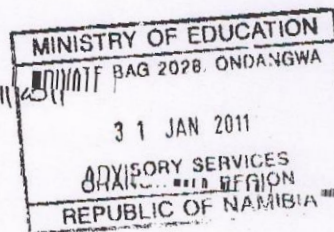
Your letter on the subject above dated 13 January 2011 refers. You are kindly informed that the region has granted you permission to carry out your study in the listed schools with the following conditions:

- Your study should not (under any circumstance) interfere with the normal school programs
- The school staff members should be assured of anonymity in the final research report
- The research findings should be shared with regional staff members



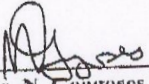
Your cooperation in this regard will be highly appreciated

Thank you,


SANET STEENKAMP
DIRECTOR MOE
OHANGWENA REGION



Appendix 11: Letter from Omaheke Education Director (MOE) to Principals of sampled JSC Schools

	
OMAHEKE REGIONAL COUNCIL OMAHEKE DIRECTORATE OF EDUCATION	
Tel: 062-562465 Fax: 062-564210 E-mail: ngoagoses@gmail.com	P/Bag 2004 Gobabis Namibia
Enquiries: Ms. N. Gogoses File no: 12/2/6/1	10 February 2011
Mr. S.E. Akpo P.O.Box 1939 Windhoek	
RE: PERMISSION TO VISIT SELECTED SCHOOLS IN THE OMAHEKE REGION	
Your letter dated 13 January 2011 bears reference.	
Permission is hereby granted to your request to administer a questionnaire to Grade 10 Mathematics teachers at the selected schools in the Omaheke Region. However, we appeal to you to conduct these sessions during intervals or outside official school hours, so as to prevent interruptions of the teaching/learning programs.	
By copy this letter to the selected schools, all schools are thus made aware of your intended visits. Therefore it is advisable to arrange the detailed logistics with the principals of the respective schools, inter alia the date, time of the visit etc.	
Enclosed hereto please find the profiles of the schools for ease of reference.	
Wishing you all the best with your intended visits to our schools.	
Yours faithfully	
 Ms. N. Gogoses Director of Education: Omaheke	MINISTRY OF EDUCATION P.O. BOX 1293, GOBABIS 10 FEB 2011 OMAHEKE REGION
CC: The Principals	
All official correspondence must be addressed to The Director Omaheke Region	

Appendix 12: Letter from Omusati Education Director (MOE) to Principals of sampled JSC Schools



REPUBLIC OF NAMIBIA



OMUSATI REGIONAL COUNCIL

DIRECTORATE OF EDUCATION

Team Work and Dedication for Quality Education

19 January 2011

Enq: Apollonia Nakale

To: Simon E Akpo
P.O.Box 1939
Windhoek

Att: Mr. Akpo

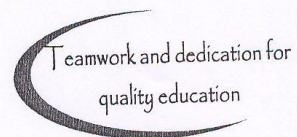
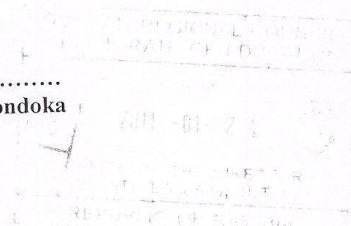
Subject: Permission to carry out a research in Omusati Region

This letter serves to acknowledge your letter dated 13 January 2011, on the above said subject. The Omusati Directorate is pleased to inform you that permission is granted as per your request. You are kindly requested to make sure that the research should by no means whatsoever disrupt teaching and learning.

We hope and trust this exercise will enhance quality education in the region.

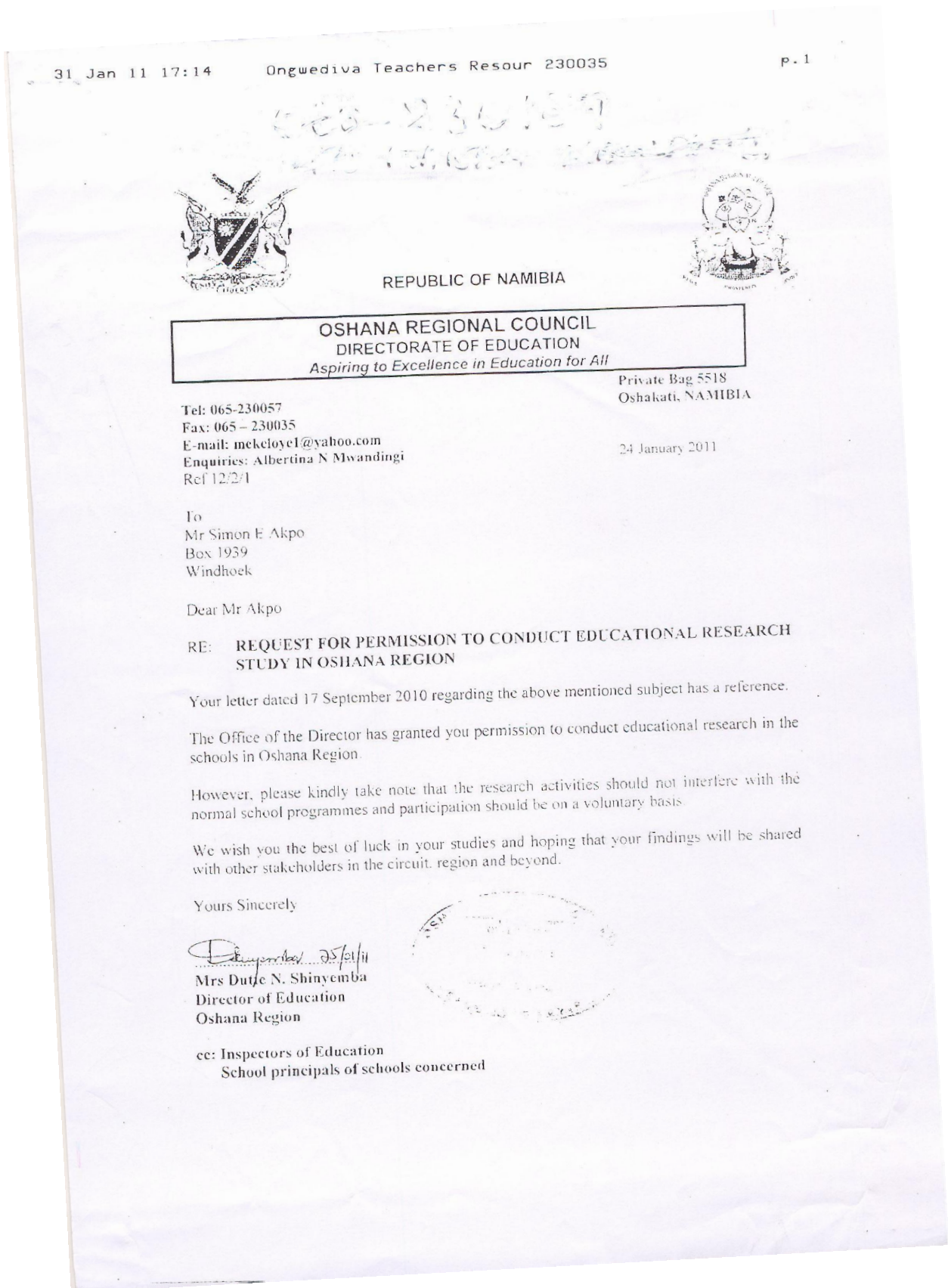
Yours faithfully

Mrs. Ester Anna Nghipondoka
Regional Director



All official correspondence must be addressed to the Regional Director.

Appendix 13: Letter from Oshana Education Director (MOE) to Principals of sampled JSC Schools



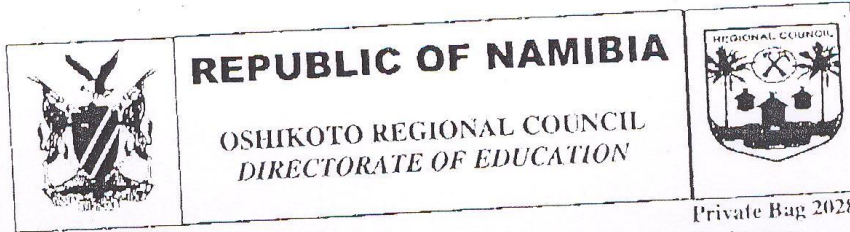
Appendix 14: Letter from Oshikoto Education Director (MOE) to Principals of sampled JSC Schools

10 FEB 2011 11:51 From: OSHIKOTO

065240315

To: 129161 20110004

P.2/2



Tel (065) 281900
Fax (065) 240315

Private Bag 2028
Ondangwa

2011-02-10

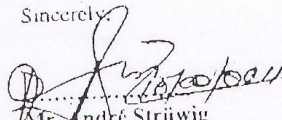
Mr. Simon E Akpo
P O Box 1939
Windhoek

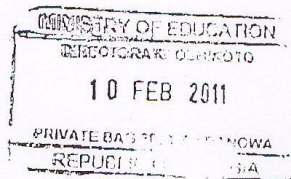
RE: RESEARCH PROJECT AT SCHOOLS – OSHIKOTO REGION.

Be informed that permission is duly granted to visit the 17 listed schools in the Oshikoto Educational Region under the following conditions:

1. You have to make an appointment in time with the principal of the proposed to be visited school.
2. The exercise must not interfere with the normal school programme.
3. Any interviews to be conducted will be on a voluntary base.

Sincerely,


Mr. André Strüwig
Acting Director



Appendix 15: Letter from Education Otjozondjupa Director (MOE) to Principals of sampled JSC Schools



Republic of Namibia
**OTJOZONDJUPA
REGIONAL COUNCIL**



Tel: 264 67 308000/14
Fax: 264 67 304871

Private Bag 2618
Otjiwarongo
NAMIBIA

DIRECTORATE OF EDUCATION

Enq: Mr. S. Tsuseb
Ref no: 11/2/1

15 February 2011

To: Flat 501 Polyheights
13 Storch Street
P.O. Box 1939
Windhoek

Attention. Mr. Simon Akpo

REQUEST TO CARRY OUT A RESEARCH

This office want to acknowledge the receipt of your letter dated 13 January 2011. Permission is hereby granted to your office to conduct your research in the Otjozondjupa schools.

Kindly ensure that the normal school programmes are not to be disturbed.

We wish you a fruitful time in our schools and we hope that the outcome of your research will benefit our implementation of maths curriculum in the region.

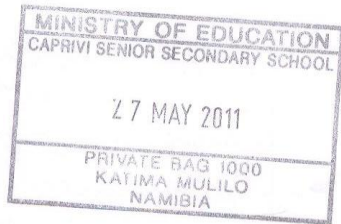
Your in Education

Baley
Mrs. Faustina N. Baley
Director - Education

MINISTRY OF EDUCATION
OTJOZONDJUPA REGIONAL OFFICE
15/02/2011 -02- 15
DIRECTOR
TEL. 007-303212, FAX: 007-304871
PRIVATE BAG 2618, OTJIWARONGO
OTJOZONDJUPA REGION

All official correspondence must be addressed to the Chief Regional Officer

Appendix 16: Sample of acknowledgement /access from the principals of sampled schools.



Flat 501 Polyheights
13 Storch Street
P. O.Box 1939
Windhoek
30 March 2011

The Principal
Caprivi Senior Secondary School
Private Bag 1000
Katima Mulilo
Namibia

Dear Sir/Madam

RE: APPRECIATION FOR PERMISSION TO CONDUCT A STUDY WITH GRADE 10 (JSC) MATHEMATICS TEACHERS

I write to express my appreciation for granting us permission to conduct a study entitled: The impact of teachers related variables on students' academic achievements in JSC mathematics results for 2006 to 2010.

The purpose of this study is to examine the relationship between different types of teachers' related variables such as: educational qualifications, professional development, teachers' instructional practices, and classroom management and the achievement of their students in JSC mathematics results for 2006-2010. It is hoped that the findings of this study will shed light on the impact of specific teachers' related variables on students' academic gain in JSC mathematics results in grade 10 with a view to making informed decision as well as enhancing the effectiveness of the JSC mathematics teachers through capacity development.

The target group is all the grade 10 mathematics teachers in JSC School in Namibia. A sample size of 176 JSC was drawn by probability -systematic sampling method from a sampling frame of 573 JSC schools spread across the 13 educational regions. This approach was deemed necessary to ensure reliability and validity of the study.