

**THE INFLUENCE OF TEACHERS' BACKGROUND,
PROFESSIONAL DEVELOPMENT AND TEACHING
PRACTICES ON STUDENTS' ACHIEVEMENT IN
MATHEMATICS IN LESOTHO**

by

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ABSTRACT

The main purpose of this study was to assess the relationship between students' achievement in mathematics and teachers' background, professional development and teaching practices. A self report instrument - Mathematics Teaching Opinionate Scale (MaTOS) was used to collect data from Form C (Grade 10) mathematics teachers in the Maseru District in Lesotho, Southern Africa. Stratified random sampling technique was adopted for the study in the selection of participants screened on the basis of type of ownership of schools. The simple random format was subsequently utilized to pick 40 teachers on the basis of school population. Out of the total participants of 40 teachers, 18 (45.0%) were males while 22(55.0%) were female. Simple correlation and regression statistics at the 0.01 and 0.05 significance levels were utilized for data analysis. Findings indicated a significant positive relationship between students' academic achievement in mathematics and teachers' background (i.e. teachers' qualifications, subject majors and years of experience especially from six years of teaching) with $r = 0.552$, $P < 0.01$. Furthermore, regression analysis showed that teachers' qualifications ($\beta = 0.77$, $P < 0.05$), subject majors ($\beta = 0.35$, $P < 0.05$) and experience ($\beta = 0.16$, $P < 0.05$) were predictors of students' achievement in mathematics [$F(3,39) = 4.321$; $P < 0.05$]. The findings therefore suggest that if all mathematics teachers have a degree, are specialized in mathematics or mathematics education and have more than five years teaching experience the students' achievement in mathematics would likely improve.

Key terms

Professional development, Students' achievement in mathematics, Teachers' background, Teaching practices, Teachers' qualifications, Teachers' subject majors, Years of experience.

DECLARATION

I declare that THE INFLUENCE OF TEACHERS' BACKGROUND, PROFESSIONAL DEVELOPMENT AND TEACHING PRACTICES ON STUDENTS' ACHIEVEMENT IN MATHEMATICS IN LESOTHO 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.

.....

SIGNATURE

(Ugorji Iheanachor Ogbonnaya)

.....

DATE

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LIST OF ABBREVIATIONS

COSC	–	Cambridge Overseas School Certificate
ECoL	–	Examination Council of Lesotho
JC	-	Junior Certificate
MaTOS	–	Mathematics Teaching Opinionate Scale (MaTOS)
MoET	–	Ministry of Education and Training.
NCDC	-	National Curriculum Development Centre.
SPSS	–	Statistical Package for Social Sciences
TSD	–	Teaching Service Department

CHAPTER 1

ORIENTATION OF THE STUDY

1.1 Introduction

Quality education is a concern and a challenge to all nations of the world. This is due to the rapidly changing technology and hence changing job demands that have forced the focus of education to change. Today, we live and work in an era dominated by computers, world-wide communication and a global economy. Jobs that contribute to this economy will require workers who are prepared to absorb new ideas, to perceive patterns and solve unconventional problems. As a result, today's employers require workers with higher mathematics skills than in the past. Also, the ability to solve problems, to make conjectures, and to communicate verbally and in writing are increasingly valued in the workforce (Murnane and Levy, 1996).

Mathematics is the key to opportunity for these jobs. Through mathematics, we learn to make sense of things around us. Steen (1989) pointed out that as technology has 'mathematicized' the workplace, and as statistics has permeated the arena of public policy debate, the mathematical sciences have moved from being a requirement only for future scientists to being an essential ingredient in the education of all students. Industry expects school graduates to be able to use a wide variety of mathematical methods to solve problems wherever they arise. Therefore, economic necessity demands renaissance of mathematics teaching and learning (Steen, 1989).

Unfortunately, series of examinations reports by Examination Council of Lesotho (ECoL) (see Table 1.0 on page 7) cite serious deficiencies in the mathematics

achievement of Lesotho students. This situation is not only a cause of concern to the parents but also to the government of Lesotho who perhaps wonders about the future of the present generation of students in today's 'mathematicized' world.

Students' achievement in mathematics depends on a complex interplay of factors both within and outside the classroom. These factors range from teacher's background – qualifications, subject majors and years of experience to the professional development the teachers have received to support their teaching and to the teaching practices the teachers use to accomplish their teaching, among other factors.

The predominance of teachers not qualified to teach could be one explanation for the poor academic performances of students in mathematics. Research tells us that the influence of teachers is the single-most important factor in determining students' achievement (Sanders & Rivers, 1996; Collias, Pajak, & Rigden, 2000). Studies also indicate that the impact of a teacher (for good or for bad) is cumulative, having a lasting, measurable effect on students' academic performance (Sanders & Rivers, 1996), and accounting for the discrepancy between "gifted" and "remedial" (Haycock, 1998). Students with less exposure to qualified teachers, therefore, seem far less likely of achieving academic success than those with more. Given the recurrence of disappointing results of Lesotho students in mathematics both at the Junior Certificate (JC) and the Cambridge Overseas School Certificate (COSC) levels, it is likely that too many of the students are not taught by qualified teachers or the teachers' classroom practices do not help the students to achieve good grades in the examinations.

Stigler and Hiebert (1997) reported that classroom instructional practice is an important aspect of students learning. Efforts to improve students learning either succeed or fail inside the classroom. To improve students' learning, mathematics education reforms have described the need for specific changes in teaching the subject. Instead of the traditional lecture method where the teacher gives students information that they have to memorise, teachers are encouraged to introduce active learning activities where students are able to construct knowledge (Artzt, 1999; National Council of Teachers of Mathematics, 2000).

A teacher's teaching practices, the knowledge and the personality of the teacher are very important factors in determining his/her students' academic achievements (Darling- Hammond, 2000; Wenglinsky, 2002). Tsang and Rowland (2005) stated that for a teacher to be effective, he/she must have good mastery of the substantive syntactic structures of the subject. Also, the teacher needs to be able to unpack the subject's content in a way it would be understood and retained by the students. In other words, teachers need the ability to understand a subject well enough to teach the students effectively. The goal of teaching is to establish a foundation of knowledge that allows the students to build on as they are exposed to different life experiences. Regardless of the level of preparation students bring into the classroom, qualitative research asserts that decisions teachers take about classroom practices can either greatly facilitate student learning or serve as an obstacle to it (Wenglinsky, 2002). If this is the case, then classroom practices may indeed explain a substantial portion of the variance in students learning and achievement.

According to Wenglinsky (2002), qualitative studies by their nature are in-depth portraits of the experiences of specific students and teachers. They provide valuable insight into the interrelationships between various aspects of teacher practice and student learning. However, because they focus on one specific setting, it is difficult to generalize the results of such studies to broader groups of students and teachers. This suggests the need for large-scale quantitative studies that can test the generalizability of the insights from qualitative research (Wenglinsky, 2002).

According to research, prominent variables that influence students' achievement include teachers' knowledge (subject matter knowledge and pedagogical content knowledge), professional development, teaching experience and teaching practices (Lubinski, 1993, Varrella, 1997; Farrow, 1999; King, 2002). The aim of this study is to find the extent to which this is also the case in Lesotho. This study therefore investigated the influence of teachers' background (qualifications, subject majors, and years of teaching experience), professional development and the teaching practices of Form C mathematics teachers in the Maseru district on students' achievement in mathematics.

1.2 Context

The Kingdom of Lesotho is a small enclave surrounded by the Republic of South Africa (RSA) with an area of 30 355 square kilometres. It was a former colony of Britain but gained independence in 1966. Lesotho's population is estimated to be about 2 million (CopyWrite, 2005). The Kingdom has 10 districts; Maseru district is the largest in terms of population size. Maseru (in the Maseru district) is the capital of this country. The educational situation in Lesotho was similar to that of other

developing countries. During the colonial era, education was in the hands of churches that controlled primary, secondary and teacher education (teacher training colleges). The government's role was to pay teachers (Ministry of Education, 1988). The purpose of schooling then was for the citizens to communicate with the colonial masters either in their homes as helpers or in offices as public servants (Moeletsi, 2005). Since independence of Lesotho in 1966, there has been an increased determination by Basotho (the people of Lesotho) to restructure the education system to meet the country's development needs. The government wishes to expand access to basic education, including secondary education in order to meet the target of education for all by 2015. Presently, there are 54 registered secondary schools in the Maseru district. The present education system of Lesotho consists of seven years of primary education, three years of secondary education, two years of high school education and 4-6 years of tertiary education. In the colonial era, teacher training colleges were owned by the missions but the colleges were later abolished and the government established a teacher training college that is today known as the Lesotho College of Education. Secondary schooling is from about thirteen years to fifteen years of age (Moeletsi, 2005). The language of instruction at secondary school level is English. There are four types of secondary schools namely private, community, mission, and government schools. From the 54 secondary schools in the Maseru district; 40 (75%) are owned by the missions, 6 (10%) are owned by the government, 4 (7.5%) are owned by the communities, and 4 (7.5%) are owned by private individuals or organisations.

Management of schools is in the hands of the owners through the schools boards, while the Ministry of Education and Training formally known as the Ministry of

Education (MoET) is responsible for administrative and academic control of the formal education and training system through the various departments of the ministry. The curriculum and assessment department of the MoET in conjunction with subject panels on which teachers are represented is responsible for the development of syllabuses, prescription and approval of textbooks and other resources (CopyWrite, 2005).

The Examination Council of Lesotho (ECoL) is a department in the MoET that is responsible for the setting and administration of external examinations in the country. The Junior Certificate (JC) examination is one of the examinations set and administered by ECoL. It is written at the end of the secondary education in Form C (Grade 10 that is 15 to 16 years).

Some teachers in the government, missions and community owned schools are employed by the government through the Teaching Services Department (TSD) of MoET. This is because the government at the moment cannot afford to pay all the teachers, therefore not all teachers are employed by the government but the schools management supplement the teaching force by employing teachers privately and pay them from students' school fees. Employment of teachers is not based on any certification but the requirement is that the teachers must hold a major/minor in the subject either at certificate, diploma, degree or higher degree level. This is the minimum requirement for teachers to be employed.

1.3 Statement of the problem

Students' performance in mathematics in Lesotho has been very poor. According to ECoL's statistics students performance in mathematics in Cambridge Overseas School Certificate (COSC) for the past six years has been below 12% credit (*see Table 1.0 below*). This means that less than 12% of the candidates were able to score up to 50% in the subject in the examination. The implication of this is that only a few of the students would be admissible to study science and technology related courses in the institutions of higher learning. The registrar of ECoL commenting on the situation in 2001 said that:

Mathematics is still a major crisis even for some of the first class candidates with biases towards sciences and commercial subjects. If not given urgent attention this condition might become a hurdle to candidates who are otherwise admissible to institutions of higher learning for further education (ECoL, 2001: iii)

Table 1.0 ECoL's COSC Results Analysis 2000 – 2005

Year	% of candidates that scored above 50%
2000	8
2001	9
2002	10
2003	8
2004	11
2005	11

Table 1.0 revealed that there has been little improvement in students' performance in mathematics in COSC over the past five years. This is also the case for the JC

examination. ECoL statistics¹ for JC 2004 examination showed that there was 10% credit pass in mathematics and the average students' performance in the subject was F+ (ECoL, 2005). For 2005, 4% of the students scored grades A and B while 13% scored grades C and D (ECoL, 2006). See Appendix A for ECoL JC grading.

This alarming situation and the need to improve students learning and achievement in mathematics in Lesotho point to the need to investigate the teaching of mathematics in Lesotho's secondary schools.

1.4 Objective of the study

The objective of this study is to determine the relationship between students' achievement in mathematics in Lesotho and mathematics teachers' background (qualifications, subject majors and years of experience), professional development and teaching practices, and also the extent to which they predict students' achievement in mathematics in Lesotho.

1.5 Hypotheses

- (i) There is a statistically significant relationship between students' achievement in mathematics and teachers' qualifications.
- (ii) There is a statistically significant relationship between students' achievement in mathematics and teachers' subject majors.
- (iii) There is a statistically significant relationship between students' achievement in mathematics and teachers' years of experience.

¹ ECoL's analysis of JC results according to grade per subject was only for 2004 and 2005 and the two years analysis did not follow the same presentation format.

(iv) There is a statistically significant relationship between students' achievement in mathematics and teachers' professional development.

(v) There is a statistically significant relationship between students' achievement in mathematics and teachers' teaching practices.

1.6 Significance of the study

The study will contribute to mathematics education literature; it will open up new possibilities for improving mathematics teaching and students' achievement in mathematics in Lesotho. It will give information about teachers' qualifications, subject majors, years of experience, professional development and teaching practices and how they affect students' achievement in mathematics in the context of Lesotho. Thus, it will provide useful information that can be used to make recommendations to school administrators and secondary schools mathematics curriculum developers in Lesotho for formulating educational policies.

1.7 Definitions of terms

Experience: Experience is defined in terms of a teacher's number of years of teaching experience. That is the number of years the teacher has taught mathematics in secondary school.

Secondary School: In the Lesotho school system, secondary school is school in-between primary school and High school. It starts from Form A (Grade 8) and ends in Form C (Grade 10).

Teachers' background: In this study, teachers' background is used to encompass the qualifications in terms of certificate, diploma and degrees obtained by the teacher, his/her subject major and years of teaching experience.

Teacher education: This is the formal training and instruction teachers received as students in tertiary institutions through which they acquired knowledge and developed skills. It refers to the preparation phase of the teachers; it includes their fields (subjects) of study, courses passed and the qualifications they obtained.

Teaching practices: Teaching practices refer to teaching methods or techniques that teachers use to accomplish their classroom learning objectives. It is the methods of instruction or pedagogy. Teaching practice specifies ways of presenting instructional materials or conducting instructional activities.

1.8 Outline of Chapters

This report is divided as follows in chapters:

Chapter one

This chapter gives the context of the study describing the background of the study, the statement of the problem, the objective of the study, the research hypotheses, significance of the study, and a brief definition of terms.

Chapter Two

In this chapter the conceptual framework guiding the study and review of some related literature are presented. The literature was on teachers' background

(qualifications, subject majors and years of teaching experience), professional development and teaching practices.

Chapter Three

The chapter focused on the methods used in the study including research design, sample selection method, data collection instruments and procedures, data analysis methods and ethical issues considered in the study.

Chapter Four

This chapter presents the results of data analysis and draws together the findings of the study. The results were used to test the research hypotheses.

Chapter Five

Here, the findings of the study were discussed by pointing out the implications. The findings were also used to make recommendations.

1.9 Conclusion

In this chapter the orientation of the study was established. The study was put into context. The problem issue on which the study was based, the objective of the study, the hypotheses tested were briefly addressed. Also, the significance of the study was discussed and finally, the definitions of terms as they were used in the study were presented.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Over the past four decades, the investigation of the teaching and learning of mathematics has been one of the major focuses of educational research studies (Darling-Hammond, 2000; Grouws & Cebulla, 2000). Its current importance is highlighted by the growing evidence of students' poor achievement in mathematics and decline in the interest of young people in pursuing mathematical, scientific and engineering/technological careers (Durant, Evans, & Thomas, 1989; Reynolds & Farrell, 1996). It is also accentuated by the impact of rapidly changing technology and the changing job demands that necessitate organizations and workers to change in response to competitive workplace pressures (Bransford, Brown & Cocking, 1999).

The students' poor achievement in mathematics has become an issue of global concern and for many years educators and researchers have debated which school variables influence students' achievement (Reynolds & Farrell, 1996; Darling-Hammond, 2000). Given the likelihood that educational factors of some kind are implicated, a number of research studies have focused on a wide array of factors presumed to affect students' achievements in mathematics. For instance, some of the studies focused on teachers' qualifications (e.g. Darling-Hammond, 2000; Wenglinsky, 2000; Rice, 2003), some others on teachers' subject majors (e.g. Wilson & Floden, 2003) and some others on classroom instructional practices (e.g. Peterson, 1998; Reynolds & Muijs, 1999; Stiger & Hiebert, 1999; Grouws & Cebulla, 2000).

The need to improve students' achievement in mathematics in Lesotho is very critical. However, the factors that actually affect students' achievement in mathematics in Lesotho have not been identified by any empirical study and so are not well understood. A growing body of research shows that a substantial portion of difference in students' achievement is attributable to teachers and their teaching practices (Darling-Hammond, 2000; Rice, 2003, Ingvarson et al., 2004). According to Sanders & Rivers (1996) and Collias, Pajak, & Rigden (2000) the influence of teachers is the single-most important factor in determining students' achievement and could provide an explanation for the student's poor achievement in mathematics in Lesotho. The present study therefore offers a review of current knowledge about the relationships between students' achievement in mathematics and teachers' background (qualifications, subject majors and years of experience), teacher professional development and teacher teaching practices. Also, it seeks to determine the relationship between students' achievement in mathematics in Maseru Lesotho and mathematics teachers' background (qualifications, subject majors and years of experience), teacher professional development and teacher teaching practices.

It was conceptualised that these variables - mathematics teachers' background (qualifications, subject majors and years of experience), teacher professional development and teaching practices are the main factors that influence students' achievement in mathematics in Lesotho.

Figure 1 shows a schema of the conceptual framework.

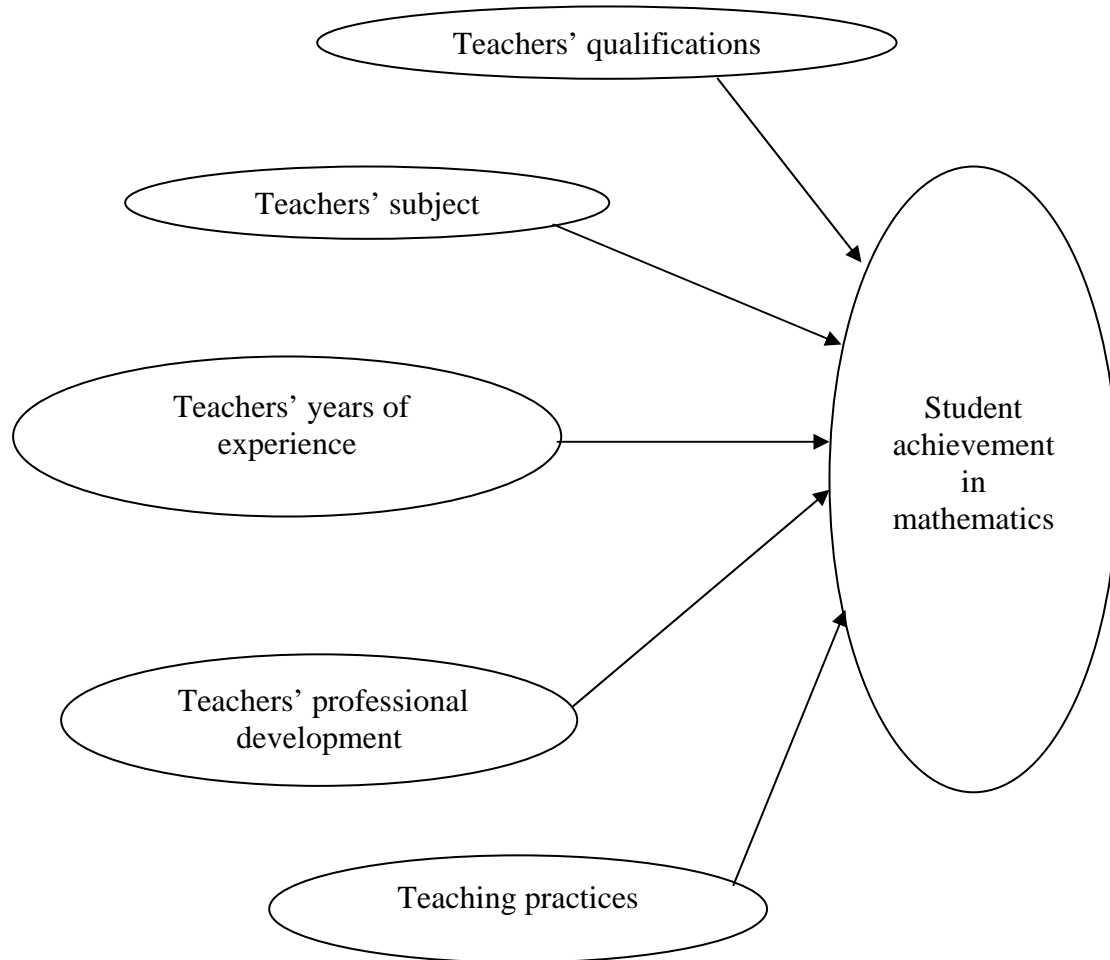


Figure 1: Factors that affect students' achievement

2.2 Review of other similar studies

The following literature review discusses the conceptualised factors that influence students' achievement in mathematics as discussed by different researchers. The factors are teachers' background (qualifications, subject majors and teaching experience), professional development and teaching practices.

2.2.1 Teachers' background

In this study teachers' background is used to encompass the teachers' qualifications (certificate, diploma or degrees obtained by the teachers), their subject majors and years of teaching experience. It is depicted by Figure 2 below.

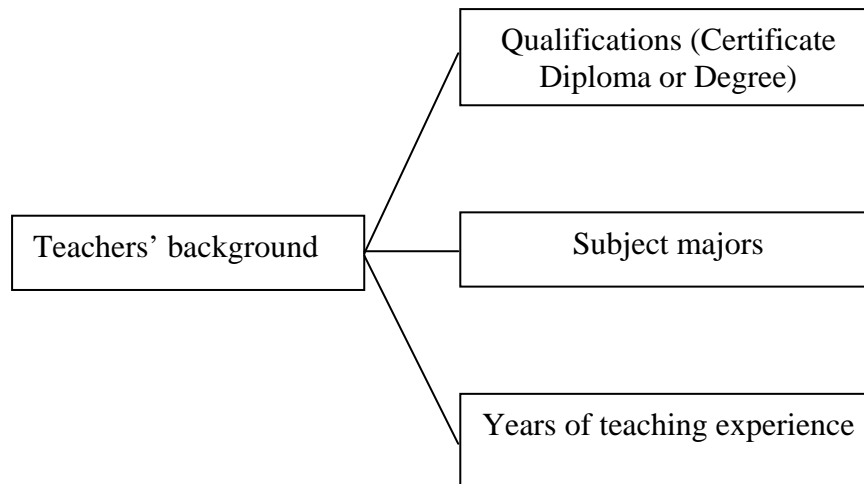


Figure 2: Teachers' background factors

2.2.1.1 Teachers' qualification

Teachers' qualification in this study measures the educational attainment (education level) of the teachers. That is the highest qualification obtained by the teachers in any subject. It was categorised according to the highest qualification the teachers obtained, namely Certificate, Diploma, Bachelors, Masters or Doctoral degrees. A number of studies have examined the ways in which teachers' highest qualifications are related to students' achievement. Many of the studies found that teachers' qualifications correspond positively with students' achievement. For instance, Betts, Zau, & Rice (2003) found that teachers' highest degree correlates positively with students' achievement. Rice (2003) found that when teachers have an advanced

degree in their teaching subjects it will have a positive impact on the students' achievements. Greenwald, Hedges, and Laine (1996) conducted a meta-analysis of studies that examined the relationship between school resources and student achievement; they found that there was a significant and positive relationship between teachers' qualification measured as having a master's degree or not having a master's degree and students' achievement. Goldhaber and Brewer (1996) indicated that an advanced degree that was specific in the subject taught was associated with higher students' achievement. On the contrary, Wenglinsky (2000) and Greenberg, et al. (2004) said that postgraduate qualifications at Masters or higher level were not significantly related to students' achievement. Despite the contrary findings, it is likely that teachers' qualifications play a significant role in determining students' achievement in mathematics.

2.2.1.2 Teachers' subject majors

In this study the mathematics teachers were categorised as having a major in mathematics if they had reported having a college, undergraduate or graduate major in mathematics or mathematics education. The importance of the link between teachers' subject majors and students' achievement have repeatedly been acknowledged by leading education groups such as the Education Trust, the Education Leaders Council, and the National Commission on Teaching and America's Future despite being characterized by their diversity and commitment (Thomas & Raechelle, 2000).

Several other studies in the teacher preparation research have also shown a positive connection between teachers' subject majors and students' achievement in mathematics. For example, Wilson and Floden (2003) found that students of

mathematics teachers with mathematics or mathematics education degrees demonstrate higher academic achievement in mathematics. However, they also indicated that there might be a limit at which more mathematics knowledge does not help the teacher. Goldhaber and Brewer (1996) found that specialisation in ones teaching subject is the most reliable predictor of students' achievement in mathematics and science. A review of a study of high school students' performance in mathematics and science by Darling-Hammond (2000) found that one having a major in his/her teaching subject was the most reliable predictor of students' achievement scores in mathematics and science. Similarly, Wenglinsky (2002) and Greenberg, et al. (2004) said that mathematics teachers having a major in mathematics correlated with higher students' achievement in mathematics. However, a few other researchers reported inconsistent relationships between teachers' subject majors and students' achievement. For example, Ingvarson et al. (2004) reported that a number of studies on the relationship between teachers' subject majors and student's achievement in mathematics reported complex and inconsistent results. Similarly, Martin et al. (2000) and Wenglinsky (2000) found that having a major in mathematics was not associated with teacher effectiveness. The confusing findings bring to bear the need to investigate more into the relationship between teachers' subject majors and students' achievement in mathematics.

2.2.1.3 Teachers' teaching experience

A number of studies found teachers' years of experience to positively correlate with students' achievement. For example, Betts, Zau, & Rice (2003) found that teachers' experience significantly correlates with students' achievement in mathematics. A report by the Centre for Public Education (2005) stated that research has been

consistent in finding positive correlations between teaching experience and higher students' achievement. Teachers with more than five years teaching experience are found to be the most effective while inexperience is shown to have strong negative effect on students' performance. Greenwald, Hedges, and Laine (1996) in their meta-analysis of data from 60 studies found that teachers' years of teaching experience positively correlates with students' achievement. In a related finding, Rivkin, Hanushek, & Kain (2005) showed that students of experienced teachers achieved better than students of new teachers (those with one to three years of experience). Similarly, some other studies, for example Rosenholtz, (1986) quoted in Darling-Hammond (2000), and Hawkins, Stancavage, & Dossey, (1998) found teaching experience to be related to students' achievement but that the relationship may not be linear; students of teachers who had fewer than five years of experience had lower levels of mathematics achievement but there were no difference in mathematics achievement among students whose teachers had more than five years of experience. The implication of that is that the benefit of experience levels off after five years. The curvilinear effect according to Darling-Hammond (2000) could be because older teachers do not continue to grow and learn and may grow tired of their jobs.

Contrary to these findings, a few studies like Hanushek (1997), Martin et al. (2000) and Wenglinsky (2002) found that the number of years in teaching is not associated with students' achievement. These contrary findings could be due to the presence of very-well prepared beginning teachers who were highly effective

2.2.2 Teachers' professional development

Teachers' professional development refers to the opportunities offered to practising teachers to develop new knowledge, skills, approaches and dispositions to improve their effectiveness in their classrooms (Loucks-Horsley et. al., 1998). In other words, it is advancement/enhancement of teachers' knowledge of the students, the subject matter, teaching practices, and education-related legislation (The professional Affairs Department, 1999). It includes formal and informal means of helping teachers not only to learn new skills but also develop new insight into pedagogy and their own practice, and explore new or advanced understanding of content and resources. In this technological age teachers' professional development includes using various kinds of technology to foster teachers' growth. Professional development as used in this study does not include formal college or university training that the teachers received as part of their college or university degrees but it only refers to in-service training. That is that part of professional development that occurs only when the teachers have begun teaching.

Teachers are a key to enhancing learning in schools. In order for them to teach in a manner to meet the current education challenges, they need extensive learning opportunities. Practising teachers can receive professional development through a number of different strategies. They can learn from their own practice. They can also learn through their interactions with other teachers that may take place during formal and informal mentoring. Teachers also can learn by being taught by other teachers outside of schools, for example, during meetings of professional associations and teachers' unions. They can also learn through numerous workshops and presentations

in which teachers share their knowledge with other teachers or being formally taught by educational consultants (Loucks-Horsley et. al., 1998).

In this study, nine measures of teachers' participation in professional development were used. They are the amount of time spent on professional development in the last three years and whether the teachers received any professional development in the last three years by

- taking a formal college or university mathematics course
- taking a formal college or university course in the teaching of mathematics
- observing other teachers teaching mathematics
- meeting with a local group of teachers to study or discuss mathematics teaching issues on a regular basis
- collaborating on mathematics teaching issues with a group of teachers at a distance using telecommunication
- serving as a mentor and/or peer coach in mathematics teaching
- attending workshops or seminars on mathematics teaching
- attending a mathematics teachers association meeting.

The measures of professional development received involved any or the combination of coaching or mentoring, study group, professional network, and attending workshops or courses or seminars. Coaching and mentoring strategy involves working one-on-one with an equally or more experienced teacher to improve teaching through a variety of activities including classroom observation and feedback. Study group means to engage in regular structured and collaborative interactions regarding topics

identified by the group, having opportunity to examine new information, reflect on their practices, or assess and analyse outcome data. Professional networks involves linking with other teachers or groups physically or electronically to explore and discuss topics of interest, identify and address common problems, share strategies, etc. Attending workshops or courses or seminars is where the teachers have opportunities outside of the classroom to focus intensely on topics of interest, including mathematics content and to learn from others with more expertise (Loucks-Horsley et. al., 1998).

Many studies show that professional development for teachers is ineffective. Ball, Lubienski, & Mewborn (2001) indicated that professional development of teachers is intellectually superficial, disconnected from deep issues of curriculum and learning, fragmented, and non-cumulative. Little and McLaughlin (1993) argued similarly saying that professional development programmes just update teachers' knowledge instead of providing an opportunity for sustained learning about issues to do with curriculum, students or teaching. On the contrary, Varella (1997), Varella (2000) and Franke (2002) show that teachers' professional development has positive effects on students' achievement but the issue is that it has to be long-termed. A study by Carpenter et al. (1989) showed that students' achievement was considerably higher in students' basic and advanced reasoning skills. The study also suggested that problem solving skills was greatest when the teachers' professional development was focused on how students learn and how to gauge that learning effectively. This suggests that professional development that is rooted in subject mater and focused on the students learning can have a significant impact on students' achievement. A similar finding was recorded by Kennedy (1998) who reviewed 10 research studies on the impact of

teachers' professional development programmes on students' achievement. The study found that teachers' professional development can improve students' achievement when focused on (i) how students learn particular subject matter, (ii) instructional practices that are related to the subject matter and how students understand it, and (iii) strengthening teachers' content knowledge of the subject.

Cohen and Hill (2001) found that teachers whose professional development focused directly on the curriculum they would be teaching are the ones that adopted the practice they were taught in the professional development interventions and that their students did well on assessment. Similarly, Garet et al. (2001) found that when teachers' professional development is linked directly to their daily experiences and aligned with standards and assessment they would be more likely to change their instructional practices and gain greater subject matter knowledge and improved teaching skills.

In summary, sustained professional development that is linked to the curriculum that the teachers are teaching leads to better instruction and consequently to improved students achievement in mathematics.

2.2.3 Teaching practices

Teaching practices refer to instructional methods or techniques that teachers use to accomplish their classroom learning objectives. It specifies ways of presenting instructional materials or conducting instructional activities. Teachers' teaching practices shape the classroom learning environment. The purpose of teaching is to promote students' learning/achievement. Evidence from research studies have shown

that teaching practices is a critical factor in promoting students' achievement in mathematics (Peterson, 1998; Stigler and Hiebert, 1999; Wenglinsky, 2002).

Wenglinsky (2002) in his study, about the relationship between teaching practices and students' academic achievement, reported that teaching practices are important causes of students learning and achievement. Also, 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 it. Many other researchers have also stressed that teaching practices play an important role in students' cognitive development. For example, Entwistle and Entwistle (2003) said that students' learning outcomes and classroom environment are closely linked, while Bransford, Brown, and Cocking (1999) indicated 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, the research findings of Grouws and Cebulla (2000) on improving students' achievement in mathematics showed that certain teaching practices (like 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 learners. Studies on the design and evaluation of learning environments, among cognitive and developmental psychologists and educators, are yielding new knowledge about the nature of learning and teaching as it takes place in a variety of settings. They are also discovering ways to learn from the "wisdom of practice" that

comes from veteran teachers who can share their expertise. Furthermore, 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 back.

The impact of the new knowledge about teaching and learning on the classroom instructional practices is a shift from teacher-centred to 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. According to Zemelman, Daniels, and Hyde (1998), the goal of teaching mathematics is to help students to develop mathematical power that enables the student to feel that mathematics is personally useful and meaningful, and to feel confident that he or she is able to understand and use mathematics. The Lesotho JC mathematics curriculum is in agreement with this goal of mathematics teaching. It stipulated a learner-centred teaching approach that emphasised understanding and application of mathematical concepts as against rote memorisation and application of formulas. The curriculum also suggests that there should be more hands-on-activities for the students (Ministry of Education, 2002).

Teaching and learning mathematics are complex tasks. The effect of changing a single teaching practice on students' achievement may be difficult to determine because of the simultaneous effects of the other teaching activities that surround it and the context in which the teaching takes place. However, research studies (e.g. Hafner, 1993; Grouws, & Cebulla, 2000; Ingvarson et al., 2004) found that teaching practices that generate high opportunity to learn are related to high students' achievement in mathematics. Opportunity to learn refers to equitable conditions or circumstances

within the school or classroom that promote learning for all students. It includes the provision of adequate instructional experiences that enable students to achieve high standards (Winfield, 1987). Opportunity to learn may be measured by time spent in learning activities (e.g. presenting, reviewing, practicing, or applying a particular concept) or by the amount and depth of content covered with the students. It is also related to the use of homework (Reynolds & Mujis, 1999). A number of teaching practices that appear frequently in literature to be related to students' high opportunity to learn include whole class teaching, whole class teacher-guided discussion, use of group work (collaborative group) and use of homework as an instructional tool.

2.2.3.1 Whole class teaching

This type of practice involves teacher presentation (lecture demonstration), teacher led whole class discussions and individual work that are linked to class work. The teacher spends most of the time presenting information through lecture and demonstration. Teacher-led discussion dominates as opposed to individual work. Teacher takes an active role, conveying information to the students rather than just 'facilitating' learning. The information is conveyed in a brief presentation followed by opportunities for recitation and application. The teacher carries the content personally to the student rather than relying on curriculum materials or textbooks to do so (Reynolds & Muijs, 1999). This type of teaching enables the teacher to focus instruction on meaningful development of important mathematical ideas and also enables the students to learn mathematics content which according to Grouws and Cebulla (2000) help to improve students' achievement in mathematics. According to the constructivist theory, students construct new knowledge and understandings based on what they already know and believe (Topin & Tippen, 1993). This implies that

students' learning can be enhanced when teachers pay attention to the knowledge and beliefs that learners bring to the class and use this knowledge as a starting point for new instruction, and monitor students' changing conceptions as instruction proceeds (Bransford, Brown & Cocking, 1999; Grouws & Cebulla, 2000).

A study by OFSTED (1997) found that students' increased knowledge, understanding and skill were recorded where the teachers used higher proportion of whole class teaching. Croll (1996) showed that teachers that utilised more time in whole-class interactive teaching generated the greatest gains in mathematics. More times teachers spent in whole-class interactive teaching led to high students' task engagement. According to Reynolds and Muijs, (1999) research on American Teacher effectiveness found that students show more achievement gains in classes where they spend more time being taught or supervised by the teacher than working on their own. This is mainly because teachers in these classrooms provide more thoughtful and thorough presentations, spend less time on classroom management, enhance time-on-task and can make more student contacts. Such teachers have also been found to spend more time monitoring students' achievement (Mason and Good 1993; Borich 1996). Achievement is maximized when the teacher not only presents the material but does it in a structured way by beginning with an overview and/or review of the objectives. They give the outline of content to be covered and show transitions between lesson parts. They also review the main ideas at the end of the lesson making the information easily apprehended as an integrated whole (Brophy and Good 1986; Lampert, 1988).

2.2.3.2 Whole class teacher-guided discussion

In this classroom teaching method, the teacher presents the subject matter in an active way by involving students in class discussion through asking a lot of questions. Bransford, Brown, and Cocking (1999) like the American Teacher effectiveness research on mathematics teaching identified teacher guided whole class discussion as a teaching method that enhances students' achievement in mathematics. They said that important ideas are developed when students spend a great deal of time discussing alternative strategies with each other and with the teacher, often participating in the discussion, but almost never demonstrating the solutions to the problems. Similarly, Grouws and Cebulla (2000) asserted that whole class discussion is very effective in improving student's achievement in mathematics. This is because it enables the students to see many ways of examining a situation and the variety of appropriate and acceptable solutions. It could also be an effective diagnostic tool for determining the depth of student understanding and discover their misconceptions. Teachers can identify areas of difficulty for particular students, as well as find out areas of student success or progress. This will help the teacher to make appropriate instructional decisions to assist students to construct knowledge (Bransford, Brown & Cocking, 1999). Stein (2001) stressed this issue of classroom teacher-guided discussion pointing out that "it is now commonly accepted that a productive classroom is one where there is a great deal of talk" (p. 127). She means the type of talk that allows students to grapple with ideas, and to take up positions and defend them. She said that effective mathematics teachers "can set up opportunities for mathematical argumentation in their classroom by selecting tasks that have different solutions or allow different positions to be taken and defended" (p. 129).

According to Wood (1999) the benefit of whole class discussion is best realised in a classroom environment that encourages the students to be active listeners who participate in discussions and feel a sense of responsibility for each other's understanding.

2.2.3.3 Use of group work

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 a less threatening environment to work because they don't 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 & Muijs, 1999: 282). As students work in groups to solve problems and present their work to their groups they will have opportunity to learn from each other. The collaborative group problem solving activities enhances 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 (Bransford, Brown & Cocking, 1999).

Analysis of the results of 122 research studies that focused on the effects of use of peer group work on students' achievement by Marzano et al. (2001) showed that use of group work leads to improved students' achievement. A similar finding was reported by many other studies (e.g. Brahier, 2000; Grouws & Cebulla, 2000).

effectiveness of group work in improving students' achievement in mathematics has also been pointed out in other studies (e.g. Slavin, 1983; Dori, 1995; Abu & Flowers, 1997; Reynolds, 1999; Johnson & Johnson, 2002; Sorensen, 2003). However, the use of group work is associated with some problems, for instance shared students misconceptions can be reinforced by group work (Good, McCaslin & Reys 1992), students might be tempted to engage in off-task social interaction (Good & Galbraith, 1996), some students may feel that they have little or nothing to contribute to the group or that their contributions are not valued and so they become passive (Reynolds & Muijs, 1999). Nevertheless, use of groups generally helps to improve students' achievement in mathematics.

2.2.3.4 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 students which is a very important aspect of teaching (Bodin & Capponi, 1996).

Cooper (1994) reported that homework accounted for 20 percent of the time students spend 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 and

Henderson (2006) indicated that most of the literature on homework is theoretical; that very little empirical research has been completed on the role of homework in students' achievement. However, some studies documented positive relationship between homework and students' achievement. For example, Cooper (1994) said that homework, in addition to other effects, leads to better retention of factual knowledge, increased understanding and better critical thinking. These are vital to improving students' achievement. Betts (1997) studied the relationship between the hours of homework assigned by the teachers to the students and found it to be positively related to students' achievement. Eren and Henderson (2006) reported a similar finding; they said that relative to school factors like class size, homework appears to have a larger and more significant impact on students' achievement. Aksoy and Link (2000) found positive and significant effect of homework on tenth grade mathematics achievement. The study was based on the hours the students reported they spent on homework which is risky in the sense that it may give a spurious correlation since it may reflect unobserved variation in students' ability and motivation. A review of 134 studies by Marzano et al. (2001) reported positive relationship between use of homework and students achievement.

It can be concluded that homework is positively related to students achievement but most of the studies were carried out in environments (like the United States) where parents are educated and the significant role parents play in students homework to make it effective have been documented by many authors and researchers (e.g. OERI, 1996; Chaika, 2000; Cooper, Lindsay, & Nye 2000; Cooper, 2001). Therefore, the effect of home work on students achievement in an environment like Lesotho (where most of the parents are illiterate and cannot help in their children's homework) needs

to be empirically studied as to throw more light on the effect of homework on students' achievement.

2.3 Summary

From the literature discussed, it was seen that teaching practices that give students high opportunity to learn by engaging them in whole class teaching, whole class teacher-guided discussions, collaborative group work, and homework to expand learning time positively impact on students' achievement in mathematics. These teaching practices can possibly influence students' achievement in mathematics in an environment like that of Lesotho.

2.4 Conclusion

The theoretical framework and literature review presented here was aimed at linking research findings and theory about students' achievement in mathematics with the investigation carried out in this study. Research and literature reviewed indicated that:

- Teachers' qualification was positively related to students' achievement.
- Teachers' subject majors in Mathematics or Mathematics Education was related to students' achievement.
- Teachers' professional development on the subject content or the way students learn the subject were positively related to higher students' achievement.
- Teaching experience up to five years positively correlated with students' achievement.
- Extensive use of whole class teaching, whole class (teacher-guided) discussion, collaborative group work and use of homework were positively associated with higher students' achievement in mathematics.

In the study, the aim was to investigate the influence of teachers' qualifications, subject majors, years of teaching experience, professional development and teaching practices on students' achievement in mathematics in the Maseru area in Lesotho and establish whether the findings in the literature are applicable to mathematics teachers in Lesotho.

2.5 Projection for the next chapter

The next chapter presents how the data was collected as well as the research design. The data collection instruments and procedure will be discussed. The chapter will also include a discussion of the ethical issues of the study.

CHAPTER 3

Research Methods

3.1 Introduction

This chapter presents the research design, the research population and sample, data collection instruments, data collection procedure and data analyses methods. It also includes a discussion of ethical issues considered in the study. The research methods were based on the objectives of the research outlined in chapter 1. The purpose of the study was to determine the relationship between students' achievement in mathematics in Lesotho and teachers' background (qualifications, subject majors and years of experience), professional development and teaching practices, and also the extent to which they predict students' achievement in mathematics in Lesotho.

3.2 Research Design

The research design describes the major procedure to be followed in carrying out a research. "It is a specification of the most adequate operations to be performed in order to test a specific hypothesis under given conditions" (Bless & Higson-Smith, 1995:63). It is pertinent in a research study that the researcher specifies the major procedures he/she adopted to realise the research objectives. The study adopted co-relational research design. This was utilised to find the relationship between students' achievement and teachers' background (qualifications, subject majors and years of experience), professional development and teaching practices. Co-relational research design was employed in this study because it is used to find the statistical relationship between two or more variables (Lauer, 2006).

3.3 Research population and sample

The study population is Form C (Grade 10) mathematics teachers in Maseru (Lesotho). There are a total of 54 secondary schools in Maseru district. From the 54 schools 40 (75%) are owned by the Missions, 6 (10%) are owned by the government, 4 (7.5%) are owned by the communities and 4 (7.5%) are owned by private individuals or organisations. A questionnaire was administered in person to all teachers that accepted to participate in the study. The reason for that is that a self administered questionnaire ensures a high response rate. Some schools had more than one Form C mathematics teacher. The questionnaire was handed out to 75 teachers and 53 teachers (6 from government schools, 6 from community schools, 37 from Mission schools and 4 from private schools) completed the questionnaire and also included their students' lists that enabled the researcher to extract the students' results from the JC results published by ECoL. The other teachers either declined completing the questionnaire after repeated visit by the researcher or refused to include their students list. A proportional stratified random sample of 40 teachers based on the schools' ownership was selected from the 53 teachers for data analysis. Proportional stratified random sampling is the technique of selecting a sample in a way that the identified subgroups in the population are represented in the same proportion in the sample as they exist in the population (Gay & Airasian, 2003). This technique was used to eliminate selection bias. The sample of 40 teachers comprised 30 (75%) teachers from mission schools, 4 (10%) from government schools, 3 (7.5%) from community schools and 3 (7.5%) from private schools.

3.4 Data collection Instruments and Procedures

Data was collected in two sections: the first section was about teachers' background (qualifications, subject majors, and years of experience), professional development and teaching practices, and the second was about students' achievement in mathematics. Information about teachers' background, professional development and teaching practices was collected from the teachers using the self-report questionnaire called Mathematics Teaching Opinionate Scale (MaTOS) (see Appendix B). It consists of four parts. The first part is about teachers' demographic information. It asked about the teachers' gender and the number of years they have been teaching. The second part collected information about teachers' qualifications; their certificates, diplomas, degrees and subject majors. The third part of MaTOS collected information about teachers' professional development; the time spent on professional development in the last three years, the mode of delivery of the professional development and emphasis the professional development trainings placed on certain topics of mathematics teaching. The fourth part was about the teaching practices teachers used to accomplish their mathematics teaching.

MaTOS is a modified version of a self report survey questionnaire developed by Horizon Research Incorporated in the United States and was used to carry out National survey of Mathematics Education in the entire United States and the District of Columbia as part of a larger study designed to provide up to date information of Mathematics and Science Education in the United States in 2000. It was designed to identify trends in Mathematics Education by obtaining in-depth information from each teacher about the curriculum and instruction in a class. Among the questions addressed by the questionnaire are:

- What are the mathematics teachers trying to accomplish in their mathematics instruction and what activities do they use to meet the objectives?
- How well prepared are the mathematics teachers in terms of both content and pedagogy?
- What are the barriers to effective and equitable mathematics education?

It was administered to a probability sample of mathematics teachers in grade K-12 in the 50 states and in the District of the Columbia (Horizon research Inc., 2001). This questionnaire was modified to only include the sections that elicited information relevant to the present research study and enabled the researcher test the research hypotheses. A questionnaire was used in the study because questionnaires are the best feasible method of collecting data from a large population of teachers. Mayer (1999) observed that teachers self report instrument remain the most viable means of obtaining information about the status of instructional practice and had been used in large studies.

The data about the students' achievement in mathematics was collected from ECoL 2006 JC examination result list. The average grade of each teacher's students was used as the achievement of the teacher's students. The JC examination is a national external examination conducted by ECoL for students at the end of their Form C. It was based on JC syllabus; it consisted of two papers² – Paper 1 and Paper II.

Paper 1 counted 80 marks and consisted of 30 semi-structured questions that tested students knowledge of basic mathematical skills on fractions and decimals, rounding off numbers to given decimal places, percentages, ratio, proportions and rates, properties of shapes, matrices addition and subtraction, vectors and transformations.

² The question papers were not appended because the researcher didn't have the permission to do so.

Paper II was 19 short structured application questions that required one concept per question. It counted 100 marks and it included questions on sequence, polygon, simultaneous equations, inequalities, measurement and mensuration, trigonometry, proportions and rates, interpretation of statistical data, simple probability, rotation of shapes and drawing of graphs (linear and quadratic).

3.5 Validity and reliability of the instruments

Validity and Reliability are the fundamental components used in assessing the quality of instruments (Cramines & Sellar, 1979 quoted in Mayer, 1999). The validity of an instrument is the degree with which the measured value reflects the characteristic it is intended to measure while the reliability refers to the degree with which repeated measurements, or measures taken under identical circumstances will yield the same result (Lewis, 1999). Reliability of an instrument is based on that instrument's ability to elicit the same response each time the instrument is administered. There are basically three forms of validity: content validity, construct validity and criterion validity. Construct validity refers to the consistency between the questions on a questionnaire and accepted theoretical construct related to the subject being studied. It is based on logical relationship between variables (Babbie, 2001). Criterion validity refers to the degree with which an instrument yields results that are consistent with an independent external criterion. Content validity, which was used in this study, refers to the degree with which the content of a test or questionnaire covers the extent and depth of the topics it is intended to cover. It is a useful concept when evaluating educational tests and research questionnaires (Lewis, 1999).

Reliability can be assessed by the following methods: inter-rater method, test-retest method, split-half method, alternate form method, or by calculating the Cronbach's alpha coefficient. Calculation of the Cronbach's alpha coefficient was the test used in this study. It measures how well a set of items (variables) measures a single unidimensional latent construct (Lapsley, 2006).

3.5.1 Validity of MaTOS

In this study, to ensure that the questionnaire measures what it purports to measure and is a true reflection of the content domain its content validity was tested by involving experts in the field of psychometrics and mathematics education. The experts judged if the questionnaire reflected the content domain of the study. Gronlund reports that content evidence is “a matter of determining whether the sample tasks is representative of the larger domain of tasks it is supposed to represent” (Gronlund, 1998: 202). They did ascertain that the items in the questionnaire explored information concerning teachers' qualifications, subject major, years of teaching experience, professional development, and teaching practices.

3.5.2 Reliability of MaTOS

The reliability of the questionnaire was tested using Cronbach's alpha coefficient. This was seen to be appropriate because it requires only a single test administration and provides a unique quantitative estimate of reliability for the given administration. It is also considered to be a conservative (lower bound) estimate of reliability – meaning that the true relationship is likely to be no lower than this estimate (Lapsley, 2006).

The questionnaire was pre-tested with 13 Form C mathematics teachers and the reliability was calculated using Statistical Package for Social Sciences (SPSS). The reliability of each section was tested separately since each section measures a separate and single unidimensional construct. The internal consistency reliability of score for MaTOS as a whole was found to be 0.92. Table 3.1 shows the Cronbach's alpha (α) values of scores for the three subscales of the instrument; namely teachers' background, professional development and teaching practices. The questionnaire was used for the study because the alpha coefficient (α) value obtained on each section was greater than 0.70. The values agree with the recommendation that for an instrument to be used its internal reliability coefficient - Cronbach's alpha (α) must be at least 0.7 (Gable, 1986; Santos, 1999).

Table 3.1 Coefficient alpha (α) scores

Subscale	Cronbach's alpha (α)
Teachers' background	0.76
Professional development	0.79
Teaching practices	0.92

3.5.3 Validity of JC Examination question papers

The content validity of the question paper was established by experts' judgment of the subject officers, specialists and the subject team members of both ECoL and National Curriculum Development Centre (NCDC). The questions were drawn from a pool of JC examination questions set by mathematics teachers and examiners, the experts judgment was brought to bear on the questions. They established that the questions were in line with the syllabus content and were appropriate for the time allocations before the question papers were adopted for the purpose of the examination.

3.6 Data analysis method

The data were analysed using descriptive statistics, correlation analysis and regression analysis in a three phase methodological approach.

Phase 1 - Descriptive statistics

In this first phase of the data analysis, tables of frequencies were employed to present the data. The frequency tables were also used to determine the most important factors regarding teacher professional development and teaching practices and they were further used in phase 2 of the data analysis.

Phase 2 - Correlation analysis

In this phase, correlation analysis of students' achievement with teachers' background, professional development and teaching practices was carried out. Correlation analysis was carried out in order to find a relationship between the dependent variable (students' achievement) and the independent variables (teachers' background, professional development and teaching practices).

Phase 3 - Regression analysis

In this final phase, regression analysis was carried out between students' achievement and the correlated variables identified in phase 2 to ascertain deterministic relationships between variables. Thus, it was used to find how the variables that significantly correlated with students' achievement in phase 2 can predict students' achievement.

3.7 Ethical Issues

Unethical treatment of the participants was painstakingly avoided in the study. Ethics requires that participation in a social research study to be voluntary. This is because

social research at times involves intrusion into peoples' lives. It may also require people to reveal their personal information to strangers (Babbie, 2001). The teachers' participation was voluntary. No teacher was forced to take part in the study, many of the teachers complained of not having time to complete the questionnaire while some refused to provide their students list. Such teachers were left out of the study. Those that accepted to complete the questionnaire were allowed to do so at their own convenience. Also, ethical principles demand that researchers keep participants informed about the research study and that the researchers make every effort to protect participants from harm (Gay & Airasian, 2003). The participants were well informed about the purpose of the research study. This was done by attaching a cover letter to the questionnaire that stated the purpose of the study. To avoid possible harm to the participants, anonymity was ensured by not collecting their names. They were informed through the cover letter of the questionnaire not to write their names on the questionnaires. In addition, ethics demands that researchers be honest in reporting their research findings (Babbie, 2001). The findings reported in this study were as revealed by the results.

3.8 Summary

The study was conducted in the Maseru District in Lesotho. Stratified random sampling was used to draw a sample of 40 teachers from the population of Form C mathematics teachers in the district. A self report questionnaire – MaTOS was used to collect data from the teachers. The students' achievement scores in mathematics were collected from the JC 2006 examination result list. Participants in this study were 40 Form C mathematics teachers. They comprised 30 (75%) teachers from mission schools, 4 (10%) from government schools, 3 (7.5%) from community schools and 3

(7.5%) from private Schools. Also, 18 (45%) of the sample were male while 22 (55%) were female.

3.9 Projection for the next chapter

The next chapter will present the results and findings after the data was analysed. It presents a descriptive statistics of data collected from the teachers, followed by the correlation and regression analyses of the variables with students' achievement. Finally, the research hypotheses were tested.

CHAPTER 4

RESULTS AND FINDINGS

4.1 Overview

This chapter presents the results of the data analyses. Data were collected from Form C mathematics teachers about their demographic information, qualifications, subject majors, professional development and their mathematics teaching practices using a self report questionnaire. Students' achievement grades were collected from ECoL JC 2006 examination result list. 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 Results from the descriptive statistical analyses

This section presents the data collected in tables of frequencies. The tables were used to present and describe the data collected from the teachers regarding their backgrounds, professional development and teaching practices.

4.2.1 Teachers' demographic information

The teachers' demographic information is shown in Table 4.1. The table shows that the majority of the mathematics teachers are female and accounted for 55% of the mathematics teachers used for the study. It can also be seen that 65% of the teachers have taught for more than 10 years and 80% have got at least a first degree. Only

52.5% of the teachers have majored in Mathematics or Mathematics education. This implies that almost half of the mathematics teachers may not have enough Mathematics knowledge and skills.

Table 4.1 Teachers' demographic information (N = 40)

	Percentage of Teachers
Gender	
Male	45.0
Female	55.0
Teaching Experience	
0 – 5 years	20.0
6 – 10 years	15.0
11 –15 years	32.5
16 –20 years	12.5
Over 20 years	20.0
Qualification	
Certificate	5.0
Diploma	15.0
Bachelors	67.5
Masters	12.5
Doctorate	0.0
Mathematics/Mathematics education	
Major	
Yes	52.5
No	47.5

4.2.2 Teachers' professional development

About teachers' professional development, the study measured:

- a) the professional development duration in the last three years, and

b) teachers participation in professional development programmes in the last three years by

- taking a formal college or university mathematics course
- taking a formal college or university course in the teaching of mathematics
- observing other teachers teaching mathematics
- meeting with a local group of teachers to study/discuss mathematics teaching issues on a regular basis
- collaborating on mathematics teaching issues with a group of teachers at a distance using telecommunication
- serving as a mentor and/or peer coach in mathematics teaching
- attending workshops or seminars on mathematics teaching
- Attending a mathematics teacher's association meeting.

c) Teachers' rating of the emphasis of their professional development activities on the following issues:

- Deepening their mathematics content knowledge
- Understanding student thinking in mathematics
- Learning how to teach mathematics in a class that includes students with special needs
- Learning how to use technology in mathematics instruction
- Learning how to assess student learning in mathematics
- Learning how to use inquiry/investigation-oriented teaching strategies

The duration of teachers' participation in professional development in the last three years is shown in Table 4.2. The table shows that only 20 percent of the teachers have spent 35 or more hours in professional development in the last three years.

Table 4.2 Duration of professional development in the last three years (N = 40)

Time	Percentage of Teachers
None	22.5
Less than 6 hours	17.5
6-15 hours	25.0
16-35 hours	15.0
More than 35 hours	20.0

Table 4.3 shows the various professional development programmes the teachers' reported participating in during the preceding three years. Observing other teachers teaching mathematics either formally or informally was the most commonly reported form of professional development. Meeting with a local group of teachers to study or discuss mathematics teaching issues on a regular basis was the second most frequently used professional development programme. Attending a workshop focused on mathematics teaching was the third most common form of professional development programme that the teachers reported they have participated in.

Table 4.3 Teachers participation in professional development programme (N = 40)

programme	Percentage of Teachers
Taken a formal college/university mathematics course.	22.5
Taken a formal college/university course in the teaching of mathematics	25.0
Observed other teachers teaching mathematics as part of your own professional development (formal or informal).	70.0
Met with a local group of teachers to study/discuss mathematics teaching issues on a regular basis.	65.0
Collaborated on mathematics teaching issues with a group of teachers at a distance using telecommunications.	32.5
Served as a mentor and/or peer coach in mathematics teaching, as part of a formal arrangement that is recognized or supported by the school or district.	32.5
Attended a workshop on mathematics teaching.	52.5
Attended a mathematics teacher association meeting.	37.5

Table 4.4 shows the teachers' report of the emphasis of their professional development activities on various issues. The table shows that only 5 percent of the teachers reported that their professional development largely emphasised deepening their mathematics content knowledge while 12.5 percent reported that their professional development activities largely emphasised understanding student thinking in mathematics.

Table 4.4 Emphasis of teachers' professional development activities (N = 40).

Professional development activity	Percentage of Teachers					
	No response	Not at all	Slightly	Moderately	Largely	To a great extent
Deepening my own mathematics content knowledge	7.5	5.0	30.0	52.5	5.0	0
Understanding student thinking in mathematics	7.5	5.0	27.5	47.5	12.5	0
Learning how to use inquiry/investigation-oriented teaching strategies	7.5	5.0	10.0	62.5	15.0	0
Learning how to use technology in mathematics instruction	7.5	20.0	25.0	45.0	2.5	0
Learning how to assess student learning in mathematics	7.5	5.0	12.5	62.5	12.5	0
Learning how to teach mathematics in a class that includes students with special needs	7.5	27.5	25.0	12.5	10.0	17.5

4.2.2.3 Mathematics teaching practices

This section presents the data regarding classroom teaching practices. Teachers' teaching practices comparison report (as shown on Table 4.5) shows that 62.5% of the teachers assigned mathematics homework in all or almost all mathematics lessons while 95% did that at least once a week, 70% used formal presentations to introduce content at least once a week, 62.5% engaged students in collaborative groups work at least once a week and 60% used whole class discussion at least once a week.

Table 4.5 Teaching practices comparison (N = 40).

Teaching practice	Percentage					
	No response	Never	Rarely (e.g. a few times a year)	Sometimes (e.g. once or twice a month)	Often (e.g. once or twice a week)	All or almost all mathematics lessons
Introduce content through formal presentations	0.0	5.0	5.0	20.0	52.5	17.5
Engage the whole class in discussions	2.5	0.0	0.0	37.5	32.5	27.5
Assign mathematics homework	0.0	2.5	2.5	0	32.5	62.5
Read and comment on the reflections students have written, e.g., in journals	0.0	20.0	30.0	17.5	20.0	12.5
Students Work in groups	0.0	0.0	5.0	32.5	52.5	10.0

4.2.2.4 Amount of Homework

The teachers were asked to indicate the amount of mathematics homework they assigned to their classes in a week. Table 4.6 shows the amount of mathematics homework the teachers assigned to the classes in a week. In the majority of the classes (67%), students were assigned to at least one hour homework every week but only in 18% of the classes were students assigned to extensive homework of at least three hours every week.

Table 4.6 Amount of mathematics homework (N = 40).

Amount of Homework in a week	Percentage of classes
No response	2.5
0-30 minutes	5.0
31-60 minutes	27.5
61-120 minutes	25.0
2-3 hours	22.5
More than 3 hours	17.5

4.3 Results of correlation analysis

The initial analysis involved establishing a relationship between students' achievement in mathematics and the indices of (i) teachers' background namely qualifications, subject majors and teaching experience, (ii) professional development namely observing other teachers, meeting to study or discuss mathematics teaching and attending workshops on mathematics teaching, and (iii) teaching practice namely teacher presentation, whole class discussion, homework and group work. Pearson product-moment correlation was utilised in the correlation analyses. Students' achievement was quantified using the grading point scale (appendix A) while the qualifications, teaching experience, professional development and teaching practices were quantified using Likert scale as shown in the questionnaire (appendix B). Subject majors were quantified as "2" for teachers that majored in mathematics or mathematics education and "1" for those that did not major in either mathematics or mathematics education. The correlation result being significant at $p < 0.5$ means that the probability of obtaining the correlation by chance is less than five out of 100 (5%). The correlation result being significant at $p < 0.01$ means that the probability of obtaining the correlation by chance is less than one out of 100 (1%).

(i) Correlation between students' achievement and teachers' background

Table 4.7 shows the Pearson product-moment correlation between students' achievement and the variables defining teachers' background. The table shows that there was a significant positive relationship between students' achievement and teachers' background variables (qualifications, subject majors and teaching experience). These results agree with prior findings by Goldhaber and Brewer (1996),

Betts, Zau & Rice (2003), Darling-Hammound (2000), Wilson & Floden (2003), and many others.

Table 4.7 Pearson product-moment correlation between students' achievement and variables defining teachers' background (N = 40).

Variables	r
Teaching experience	0.393*
Qualifications	0.547**
Mathematics or mathematics education majors	0.467*

*significant at $p < 0.05$, ** significant at $p < 0.01$

It was indicated in the literature review that Rosenholtz, (1986) quoted in Darling-Hammond (2000), and Hawkins, Stancavage, & Dossey, (1998) reported that there were no difference in mathematics achievement among students whose teachers had more than five years of experience. To test if this applies to the study population the effect of teachers' years of experience greater than five years and greater than ten years respectively were tested. The result is shown in Table 4.8. The result shows that there was a significant difference in mathematics achievement among students whose teachers had more than five years of experience but there was no significant difference in mathematics achievement among students whose teachers had more than ten years of experience. In other words the effect of experience levels off after about ten years.

Table 4.8 Pearson product-moment correlation between students' achievement in mathematics and teaching experience greater than 5 years and greater than 10 years.

Variables	r
Teaching experience >5 years	0.416*
Teaching experience >10 years	0.313

*significant at $p < 0.05$, ** significant at $p < 0.01$

The Table shows that the effect of experience seems to level off after about 10 years.

(ii) Correlation between students' achievement and professional development.

Table 4.9 shows the Pearson product-moment correlation between students' achievement in mathematics with variables defining professional development programmes. The table shows that there was no significant relationship between students' achievement in mathematics and variables defining professional development programmes namely observing other teachers, meeting to study or discuss maths teaching and attending workshops.

Table 4.9 Pearson product-moment correlation between students' achievement in mathematics and variables defining professional development programmes (N = 40).

Variables	r
Observing other teachers	0.05
Meeting to study or discuss maths teaching	0.10
Attending workshop	0.27

* $p < 0.05$, ** $p < 0.01$

To find a relationship between time teachers spent on professional development in general and students' achievement correlation between the two variables was carried out. Table 4.10 shows the Pearson product-moment correlation between students' achievement in mathematics with time teachers spent on professional development. The table shows that there was a very weak positive but insignificant relationship

between students' achievement and time the teachers spent on professional development

Table 4.10 Pearson product-moment correlation between students' achievement in mathematics and time teachers spent on professional development.

Variables	r
Time on professional development	0.063

* $p < 0.05$, * * $p < 0.01$

The teachers were asked to indicate how much emphasis was placed on the various professional development activities they participated in past three years. Table 4.11 shows the correlation between emphasis on the professional development activities and students achievement. The table shows that professional development activities where deepening teachers' mathematics content knowledge, understanding students thinking in mathematics and learning how to assess student learning in mathematics were emphasised to a great extent correlate positively but insignificantly with students achievement in mathematics. The table also shows that professional development activities where learning how to use inquiry/investigation-oriented teaching strategies, learning how to use technology in mathematics instruction and learning how to teach mathematics in a class that includes students with special needs were emphasised to a great extend have negative insignificant relationship with students achievement in mathematics.

Table 4.11 Pearson product-moment correlation between students' achievement and professional development activities (N = 40).

Variables	r
Deepening my own mathematics content knowledge	0.318

Understanding student thinking in mathematics	0.353
Learning how to use inquiry/investigation-oriented teaching strategies	-0.224
Learning how to use technology in mathematics instruction	-0.047
Learning how to assess student learning in mathematics	0.125
Learning how to teach mathematics in a class that includes students with special needs	-0.048

*p < 0.05, * *p < 0.01

(iii) Correlation between students' achievement and teaching practices.

Table 4.12 shows the Pearson product-moment correlation between students' achievement in mathematics and variables defining teaching practice. The table shows that there were very weak negative relationship between students' achievement and teacher presentation (teacher centred teaching), there is fairly positive relationship between students' achievement and each of whole class discussion and group (collaborative) work. A very weak positive relationship was found between students' achievement and use of homework.

Table 4.12 Pearson product-moment correlation between students' achievement and teaching practices indices (N=40)

Variables	r
Teacher presentation	-0.015
Whole Class discussion	0.245
Homework	0.072
Group work	0.345

*p < .05, * *p < .01

Correlation between students' achievement and the combined indices of teachers' background, professional development and teaching practices:

The variables defining each of teachers' background, professional development and teaching practices were combined and correlated with students' achievement. Table 4.13 shows the Pearson product-moment correlation coefficient of combined variables and students' achievement. The table shows that teachers' background (qualifications, subject majors and teaching experience) has a positive significant relationship with students' achievement while professional development and teaching practice have positive but insignificant relationship with student achievement.

Table 4.13 Pearson product-moment correlation between students' achievement in mathematics and combined indices of teachers' background, professional development and teaching practices.

Variables	r
Teachers' background	0.552**
Professional development	0.209
Teaching practices	0.249

*significant at $p < 0.05$, ** significant at $p < 0.01$

To further confirm the results of the combined indices of teachers' background, professional development and teaching practices respectively, multiple regression analysis of the combined variables with students' achievement using SPSS was carried out. Table 4.14 shows the result of multiple regression analysis displaying the observed F-Statistic and probability (sig.) value of the combined effects of the indices of teachers' background, professional development and teaching practices. The probability value associated with the F statistics for teachers' background is less than 0.05 implying that there is statistically significant relationship between teachers'

background and students' achievement, but the probability values associated with the F statistics for professional development and teaching practices are respectively greater than 0.05 which means that there is no statistically significant relationship between professional development and students achievement and also between teaching practices and students achievement.

Table 4.14 Combined effects of the indices of teachers' background, professional development and teaching practices

		Sum of squares	df	Mean square	F	Sig.
Teachers' background	Regression	15.134	3	5.045	4.321	0.015
	Residual	26.853	23	1.168		
	Total	41.998	26			
Professional Dev.	Regression	9.657	5	1.931	1.209	0.341
	Residual	31.953	20	1.598		
	Total	41.609	25			
Teaching practices	Regression	3.072	3	1.024	0.620	0.609
	Residual	36.312	22	1.651		
	Total	39.383	25			

4.4 Results from regression analysis

Regression analysis was used to examine the contributions of each of the independent variables defining teachers' background to the dependent variable (students' achievement). It allows for the determination of the variance between the dependent variable and the independent variables. It also helped the researcher to determine the independent variables that are statistically significant predictors of students' achievement in mathematics. Table 4.15 shows the SPSS Regression analysis results involving students' achievement in mathematics as the criterion variable (dependent variable) and the three independent variables defining teachers' background namely qualifications, subject majors and years of teaching experience.

Table 4.15 Relationship between the criterion variable (achievement) and the three independent variables (Regression analysis) (N = 40).

Model summary					
R	R Square		F	p	
0.600	0.360		4.321	0.015	

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	p
Constant	0.450	1.070		0.420	0.678
Teaching experience	0.159	0.155	0.188	1.026	0.316
Qualifications	0.771	0.434	0.373	1.778	0.089
Subject Majors	0.348	0.417	0.176	0.835	0.412

The table indicates that the three statistically significant predictors accounted for 36 percent of the students' achievement in mathematics ($R^2 = 0.36$), $F(3,39) = 4.321$, $p < 0.05$. Teaching experience ($\beta = 0.16$, $p < 0.5$), teachers' qualifications ($\beta = 0.77$, $p < 0.5$) and subject majors ($\beta = 0.35$, $p < 0.5$) demonstrated significant effects on students' achievement in mathematics.

The coefficients of the model indicate that the three regressors can be ranked in order to quantify their influence on the dependent variable by starting with teachers' qualifications (0.77), subject major (0.35) and teaching experience (0.16). In other words, in the context of teachers' background, teachers' qualifications accounted for 77% variation in students' achievement in mathematics, while 35% and 16% can be attributed to teachers' subject majors and teaching experience respectively. It can therefore be concluded that if mathematics teachers are highly qualified (at least a degree) and are mathematics or mathematics education specialist they can go a long way in improving students' achievement in mathematics. That is not to say that the

benefit of teaching experience should be ignored as its effects on students' achievement in mathematics amount to 16%. The regression analysis highlights the importance of teachers' background in explaining how students' achievement in mathematics can be improved.

4.5 Testing of hypotheses

The results of the data analysis on Tables 4.7 and 4.8 were used to test the hypotheses advanced in this study. The hypotheses were tested one by one.

4.5.1 Hypothesis one

The first hypothesis stated that there is a statistically significant relationship between students' achievement in mathematics and teachers' qualifications. In testing this hypothesis, the data was analysed using correlation analysis while statistical inference was taken at 0.01 alpha levels. The result is displayed in Table 4.7. From the table the result ($r = 0.547$; $p < 0.01$) indicated that a statistically significant relationship existed between students' achievement in mathematics and teachers' qualifications. On the basis of the finding therefore, the hypothesis was accepted.

4.5.2 Hypothesis two

The second hypothesis stated that there is a statistically significant relationship between students' achievement in mathematics and teachers' subject majors. To test this hypothesis, the data was analysed using correlation analysis while statistical inference was taken at 0.05 alpha levels. The result is displayed in Table 4.7. From the table the result ($r = 0.467$; $p < 0.05$) indicated that a statistically significant

relationship existed between students' achievement in mathematics and teachers' subject majors in mathematics. On the basis of this finding therefore, the second hypothesis was accepted.

4.5.3 Hypothesis three

The third hypothesis stated that there is a statistically significant relationship between students' achievement in mathematics and teachers' years of experience. This hypothesis was also tested using correlation analysis while statistical inference was taken at 0.05 alpha levels. The result is shown in Table 4.7. From the table the result ($r = 0.393$; $p < 0.05$) indicated that a statistically significant relationship existed between students' achievement in mathematics and teachers' years of experience. Based on this finding therefore, the hypothesis was accepted.

4.5.4 Hypothesis four

The fourth hypothesis stated that there is a statistically significant relationship between students' achievement in mathematics and teachers' professional development. To test this hypothesis, the data was analysed using correlation analysis while statistical inference was taken at 0.05 alpha levels. The result is displayed in Table 4.13. From the table the result ($r = 0.209$; $p < 0.05$) indicated that there is no statistically significant relationship between students' achievement in mathematics and teachers' professional development. To confirm the finding further, another statistical method – multiple regression analysis using SPSS was used to analyse the data. The result of the combined significance of the variables of teachers' professional development is displayed in Table 4.14. The result shows that the probability value for combined teacher professional development indices is 0.341. This is greater than

0.05 implying that there is no statistically significant relationship found between teachers' professional development and student's achievement. Based on these findings therefore, the fourth hypothesis was rejected.

4.5.5 Hypothesis five

The fifth hypothesis stated that there is a statistically significant relationship between students' achievement in mathematics and teachers' teaching practices. The hypothesis was tested by using correlation analysis to analyse the data at 0.05 alpha levels. The result is displayed in Table 4.13. From the table the result ($r = 0.249$; $p < 0.05$) indicated that there is no statistically significant relationship between students' achievement in mathematics and teachers' teaching practices. To confirm the finding further, another statistical method – multiple regression analysis using SPSS was used to analyse the data. The result of the combined significance of the variables of teaching practices is displayed in Table 4.14. The result shows that the probability value for teaching practices is 0.609. This is greater than 0.05 implying that there is no statistically significant relationship found. On the basis of these findings the fifth hypothesis was rejected.

4.6 Conclusion

In this chapter, data collected from 40 Form C mathematics teachers and their students' achievements in JC mathematics examination indicated positive association between students' achievement in mathematics and teachers' background. Regression analysis revealed that teachers' qualifications, subject majors and years of experience are predictors of students' achievement in mathematics. Based on this finding, it was

concluded here that if the teachers' background are exploited students' achievement in mathematics would be greatly improved.

4.7 Projection for the next chapter

The next chapter discusses the findings and the implications of the analyses of the results. It also reviews the relevant literature to support or criticise the findings of the study. Finally, the researcher's recommendations and suggestions for further study are also presented.

CHAPTER 5

DISCUSSIONS, IMPLICATIONS OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a brief account of what was carried out in the study and discusses the findings in relation to the research hypotheses and some literature reviewed. It also presents the implications of the findings and lists some recommendations. Finally, it gives some suggestions for future study

5.2 Summary of the study

The purpose of the study was to gain insight into the influence of teachers' background (qualifications, subject majors and years of experience), professional development, and teaching practices on students' achievement in mathematics in Lesotho. Data was collected from mathematics teachers using a self-report instrument - MaTOS while students' achievement grades were collected from ECoL 2006 JC result list. The data was analysed first by frequencies of the variables on scales, the correlations of the variable with students' achievement was explored. Then, the variables that predicted students' achievement were further investigated using simple linear regression. The hypotheses were tested using the result of the correlation analysis and multiple linear regressions. The results showed that there was a statistically significant positive relationship between students' achievement in mathematics and the variables of teachers' background (namely teachers' qualifications, subject majors and years of experience). Teachers' professional

development and teaching practice were positively associated with students' achievement in mathematics but the associations were statistically insignificant. Regression analysis showed that students' achievement in mathematics is predicted by the variables of teachers' background (qualifications, subject majors and years of experience).

5.3 Discussions of the Findings

The findings are discussed here in a hypothesis-by-hypothesis order.

5.3.1 Hypothesis one

The first hypothesis tested in this study stated that there is a statistically significant relationship between students' achievement in mathematics and teachers' qualifications. The findings of the study as shown by the results of correlation analysis in Tables 4.7 supported this hypothesis. In other words, students whose teachers have higher qualifications would likely perform better in mathematics than students whose teachers have lower qualifications. This finding confirmed the findings of Greenwald, Hedges, and Laine (1996); Goldhaber and Brewer (1996); Betts, Zau, & Rice (2003) and Rice (2003). In addition, the regression analysis results (Table 4.15) showed that teachers' qualification is the greatest predictor of students' achievement in mathematics in Lesotho. However, the result of descriptive statistics on Table 4.1 shows that 20 percent of the teachers have not got a degree. The presence of this high percentage of not-well qualified mathematics teachers may not be unconnected to the high rate of students' poor achievement in mathematics in Lesotho. After all, research tells us that the influence of teachers is the single-most important factor in determining students' achievement (Sanders & Rivers, 1996;

Collias, Pajak, & Rigden, 2000). This is simply due to the fact that it is the teacher who sets and determines the pace of teaching, what to teach, how and when to impact subject contents. The teacher is also able to change and vary the curriculum and little wonder therefore as the trend in research outcome portends.

5.3.2 Hypothesis two

The second hypothesis stated that there is a statistically significant relationship between students' achievement in mathematics and teachers' subject majors. The results of the correlation in Tables 4.7 supported this hypothesis. Therefore, teachers having majors in mathematics or mathematics education correlates with students' higher achievement in mathematics. This further supports the earlier findings of Goldhaber & Brewer (1996), Wenglinsky (2002), Wilson & Floden (2003) and Greenberg, et al. (2004). The results of descriptive statistics in Table 4.1 indicated that 47.5 percent of the mathematics teachers do not have any major in mathematics or mathematics education. Having seen the influence of teachers' subject majors on students' achievement, this high percentage of mathematics teachers not majoring in mathematics or mathematics education could be very inimical to students' achievement. It is very unlikely that a teacher that did not major in mathematics or mathematics education will have enough content knowledge of mathematics to understand the intricacies that underlie mathematics and its learning to be able to manoeuvre his/her way and enable the students construct the relevant knowledge.

5.3.3 Hypothesis three

The third hypothesis stated that there is a statistically significant relationship between students' achievement in mathematics and teachers' years of experience. This was

supported by the findings of the study according to the correlation analysis results in Tables 4.7. This finding is parallel to the findings of Greenwald, Hedges, & Laine (1996); Hawkins, Stancavage, & Dossey (1998); and Rivkin, Hanushek, & Kain (2005). The table shows that the correlation between students' achievement and teachers' years of experience is significant (though not very strong). In fact, regression analysis (Tables 4.15) indicated that 10 percent of students' achievement can be attributed to teachers' years of experience. It was further revealed in Table 4.8 that a stronger correlation exists between students' achievement and teachers' years of experience from six years of teaching. The descriptive statistics (Table 4.1) showed that 80 percent of the teachers had taught for at least six years. Therefore, in the absence of any form of attrition of these experienced teachers the country will reap the benefits of their experience.

5.3.4 Hypothesis four

The fourth hypothesis stated that there is a statistically significant relationship between students' achievement in mathematics and teachers' professional development. This was not supported by the findings of the study. In other words there was no statistically significant relationship between students' achievement in mathematics and teachers' professional development. This agrees with earlier findings by Little & McLaughlin (1993) and Ball, Lubienski, & Mewborn (2001) that professional development for teachers was ineffective. However, looking at the results of the descriptive statistics in Tables 4.2 and 4.3 the bulk of the teachers were not engaged in substantial professional development programmes and activities. Thus, the statistically insignificant relationship between students' achievement in mathematics and teacher professional development could be as a result of the fact that these

teachers did not have enough exposure to professional development programmes and activities that could enhance their teaching and aid students' achievement subsequently.

5.3.5 Hypothesis five

The fifth hypothesis stated that there is a statistically significant relationship between students' achievement in mathematics and teachers' teaching practices. The findings of this study did not support this hypothesis. In Table 4.13, students' achievement in mathematics was found to positively correlate to teachers' teaching practices but the relationship was found to be statistically insignificant. This was further confirmed by the results of analysis shown in Table 4.14. This finding is contrary to expectation and some findings in the past (e.g. Stigler & Hiebert, 1999; Grouws & Cebulla, 2000; Wenglinsky, 2002; Entwistle & Entwistle, 2003). This implies that it is not just a teacher's report of using a practice that matters but the effectiveness of the teacher behind the practice as was also found by TIMMS video study (Stigler & Heibert, 1997). It could be that it is the knowledge and the experience of the teacher that makes teaching practice help students to be successful learners. In other words, teaching practices is like a tool which when handled by a skilful and experienced person will produce good results but in the hands of an unskilful person becomes ineffective. To teach mathematics effectively, the teacher must not only use practices that enhance students time on task but more importantly must also have good mastery of the substantive and syntactic structures of mathematics. Further analysis (Table 4.12) revealed that among the indices of teaching practices, teachers presentation was found to have a very low insignificant-negative correlation with students' achievement ($r = - 0.015$). This could be caused by the inability of the teachers to

carry the students along in their presentations. For example, when a teacher fails to relate their teaching to the students' environment, this makes it impossible for the teacher to effectively help the students to construct knowledge. In such a classroom the students might feel left out and perhaps develop a negative attitude towards the subject.

The use of whole class discussions and group work both had modest positive correlations with students' achievement although the relationships were statistically insignificant (Table 4.12). Perhaps, these practices have the potentials of engaging the students actively in the classroom, making them active members of the learning community. In such a classroom environment, it is likely that the inputs of the students would help others; also being part of the class or group discussion would instil confidence in the students that would likely make them have a positive attitude towards the subject.

The correlation between students' achievement and use of homework – a practice widely used by the mathematics teachers in Lesotho, was found to be very low (0.072). It may be that students didn't really have enough time to do their homework thoroughly because they return home late after the schools close at 4pm or that they didn't have relevant textbooks to consult to enable them to do their homework. It is also possible that parents were not concerned about their children's homework to make sure that the children completed their homework each day. On the other hand, a situation where parents do the homework for their children will also hamper the benefits of using homework. It is also possible that students copy from more able

peers when given homework. This would make the teacher to receive the wrong feedback about the students learning and thus would not be able to help them better.

5.4 Implications of findings

The findings from this study have a lot of implications for mathematics teaching. It was discovered from this study that teachers' qualifications correlated positively and significantly with students' achievement in mathematics. In other words, students whose teachers have higher qualifications in mathematics will likely achieve better than those whose teachers have lower qualifications. This implies that if all mathematics teachers were highly qualified (at least a first degree) it is likely that the students' achievement will begin to rise. The study also found that teachers' subject majors in mathematics or mathematics education correlated positively and significantly with students' achievement. This implies that if only teachers that majored in mathematics or mathematics education are employed to teach mathematics the students will likely have better achievement in mathematics than they had over the past years.

In addition, the study discovered that teachers' years of teaching experience correlated positively and significantly with students' achievement in mathematics. The correlation is stronger after five years of teaching mathematics and levels off after ten years of teaching experience. This implies that every effort should be made to keep the more experienced teachers in the service while the less experienced teachers are also encouraged to learn from the wisdom of practice of the veteran teachers.

It was found that teachers' professional development does not have a significant correlation with students' achievement in mathematics, but workshops or seminars on mathematics content and understanding students thinking in mathematics will likely help the teachers to perform better in their teaching. Furthermore, teaching practices that would engage students in communication with peers and with teachers would likely help the students perform better in mathematics.

5.5 Recommendations

The following recommendations are made based on the findings of this study:

5.5.1 Recommendations regarding teachers' background (qualifications, subject majors and teaching experience)

The study showed that teachers' qualifications, subject majors in mathematics or mathematics education and teaching experience are associated with students' achievement. It is therefore extremely important that the teaching service department and the management of schools have to step up recruitment efforts. They have to hire candidates who have high academic qualifications (at least a bachelor's degree) and that are specialised in mathematics or mathematics education to teach mathematics in the secondary schools. Also, they should consider teachers with more than five years of teaching experience where possible. Every effort should be made (for instance, putting in place contract signing bonus) to attract highly qualified teachers into the teaching profession. Also, certain incentives can be put in place to retain veteran teachers. In addition, mathematics teachers should be encouraged and motivated to further their studies in mathematics or mathematics education. Teachers with higher degrees and that are specialised in mathematics or mathematics education are likely to

have more content knowledge of mathematics which will make them more capable to impart the knowledge to the students with greater success. Such teachers can draw from their wealth of mathematics knowledge to make more positive impact in their classroom than other teachers. Also, teachers with more years of experience are likely to have acquired additional knowledge of students thinking and misconceptions in mathematics which would enable them to tailor their teaching in more beneficial ways to the students.

5.5.2 Recommendations regarding teachers' professional development

Teachers should be encouraged to regularly attend workshops or seminars related to deepening teachers' mathematics content knowledge, understanding students thinking in mathematics and on how to assess students learning in mathematics. Professional development activities should be coherent and not loose standing. Also, training on how to efficiently use different teaching strategies can be included in the professional development activities. This will enable the teachers to be efficient in using these strategies in their classes.

5.6 Suggestion for future research

To enhance future research on the teaching and learning of mathematics in Lesotho, researchers must

1. Explore the effects of students' socio-economic backgrounds on their achievement in mathematics.
2. Explore the effects of school factors like leadership support for teachers and school resources on students' achievement in mathematics. This is important because workplace conditions can exert a powerful influence over the quality

of teaching in two main ways: by helping to attract and retain quality people into teaching; and by energising teachers and reward their accomplishments (Darling-Hammond, 2000).

3. Explore the influence of system factors like class size and time allocated to mathematics on students' achievement.

5.7 Limitations of the study

One limitation of the present study, in retrospect, is that data about teachers and their teaching was collected using a questionnaire only. This was not adequate. A more balanced technique would have been to use both in-depth interviews with the teachers and classroom observations of their teaching. In-depth interviews as well as classroom observations would have given the researcher a clearer insight into the teachers teaching practices. Observer's report of the classroom practices would have been more accurate than teachers self report.

Another limitation is that students' achievement was measured by their success (grade obtained) in the JC examination; this should not be uncritically accepted as there are other goals of education than passing examination. The analysis represents one instrument of evaluation among many; bearing in mind that not everything which is desirable in education is measurable and vice-versa (Jones; Tanner; & Treadaway, 2000). However achievement in mathematics in JC examination is one significant goal for the secondary education and the result should be read in that context.

Also, the qualities of the variables (teachers' qualifications, subject majors, years of experience, professional development and teaching practices) used in the study are not

measurable. A teacher having four years of teaching experience for instance may have a more qualitative teaching experience than a teacher having ten years of teaching experience. Moreover, some teachers might have felt that their deficiencies would be exposed to the government and therefore might have provided false responses to some questions. Some might have provided biased responses because they considered they had to respond to the questions in an 'acceptable' or 'socially desirable' way as observed by Mayer (1999). Nevertheless, this limitation was reduced by explaining in the covering letter of the questionnaire that the study was for educational purposes only and their responses would be treated as confidential.

5.8 Conclusions

The present study that investigated the influence of teachers' background (qualifications, subject majors and years of experience), professional development, and teaching practices on students' achievement in mathematics in Lesotho has not been carried out before. Thus the findings add to the available body of knowledge. Some findings are consistent with findings reported in literature. The present study also established positive relationships between students' achievement in mathematics and teachers' background (qualifications, subject majors and years of experience). Teachers' professional development and the teaching practices were found to be positively related to students' achievement but the relationships were statistically insignificant. Furthermore, the study found that in terms of years of experience, teachers seem to perform at their peak from six years of experience. Generally, the study indicated that teachers' qualifications, subject majors in mathematics or mathematics education and years of experience are positively and significantly related to students' achievement in mathematics in Lesotho.

Final thought: The key to the technological development and economic empowerment of Lesotho lie in the hands of the nation's mathematics teachers. With well qualified, experienced and dedicated mathematics teachers the country will be put on the map of the world's economic and technological powers.

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Appendix A

JC Grading system

Symbol	Percentage Mark Scored	Point Equivalent used in the study
A	70 - 100	8
B	60 - 69	7
C	50 - 59	6
D	40 - 49	5
E	30 - 39	4
F	20 - 29	3
G	10 - 19	2
H	0 - 09	1

Appendix B

Control No.	
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Mathematics Teaching Opinionate Scale (MaTOS)

Form C Teacher Opinion

Dear Form C Mathematics teacher,

I am Mr. U. I. Ogbonnaya, I am a student in the Department of Mathematics, Science and Technology education, University of South Africa. I am interest in determining the influence of teachers' background, professional Development and teaching practices on students' achievement in Mathematics in Lesotho.

The enclosed questionnaire is designed to obtain information about you and your Mathematics teaching in Form C this academic year. Your response will be anonymous and the information gathered will help us improve the teaching of Mathematics and also help our students to perform better in Mathematics.

I would appreciate your completion of the questionnaire. I realise that your schedule is very busy. However, I hope that the 25 minutes it will take you will help us understand how to improve the teaching of Mathematics in Lesotho.

Thank you in advance for your participation. If you have questions about the study or any items in the questionnaire, call me at 62733644, your money will be refunded when am collecting back the questionnaire.

Yours truly,

Ugorji Ogbonnaya

Directions

1. This questionnaire asks you to describe your Form C Mathematics teaching this session (2006). There are no right or wrong answers.
2. From page 2 to page 5 you will find 55 questions. For each question "Mark" (✓) on what applies, if you make a mistake cross out and Mark another opinion
3. Now turn to the pages that follow and please give an answer for every question.

A. Demographic Information

1. Indicate your sex: [1] Male [2] Female

2. How many years have you taught? [1] 0 – 5 years, [2] 6 – 10 years, [3] 11 –15 years

[4] 16 –20 years, [5] Over 20 years

B. Teacher Education

3. Do you have each of the following degrees?

[1] Certificate [2] Diploma [3] Bachelors [4] Masters [5] Doctorate

Please indicate the subject(s) for each of your degrees.

		certificate	Diploma	Bachelors	Masters	Doctorate
4	Mathematics	1	2	3	4	5
5	Computer Science	1	2	3	4	5
6	Mathematics Education	1	2	3	4	5
7	Science/Science Education	1	2	3	4	5
8	Secondary Education	1	2	3	4	5
9	Other Education (e.g., Special Education)	1	2	3	4	5
10	Others, please specify _____	1	2	3	4	5

C. Teacher Professional Development

11. What is the **total** amount of time you have spent on professional development in mathematics or the teaching of mathematics in the last 3 years? (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] None [2] Less than 6 hours [3] 6-15 hours [4] 16-35 hours [5] More than 35 hours

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

		Yes	No
12	Taken a formal college/university mathematics course. (Please do not include courses taken as part of your undergraduate degree.)		
13	Taken a formal college/university course in the teaching of mathematics. (Please do not include courses taken as part of your undergraduate degree.)		
14	Observed other teachers teaching mathematics as part of your own professional development (formal or informal).		
15	Met with a local group of teachers to study/discuss mathematics teaching issues on a regular basis.		
16	Collaborated on mathematics teaching issues with a group of teachers at a distance using telecommunications.		
17	Served as a mentor and/or peer coach in mathematics teaching, as part of a formal arrangement that is recognized or supported by the school or district. (Please do not include supervision of student teachers.)		
18	Attended a workshop on mathematics teaching.		
19	Attended a mathematics teacher association meeting.		

Questions 20-25 ask about your professional development in the last 3 years. If you have been teaching for fewer than 3 years, please answer for the time that you have been teaching.

Considering all the professional development you have participated in **during the last 3 years**, how much was each of the following emphasized?

		Not at all	Slightly	Moderately	Largely	To a great extent
20	Deepening my own mathematics content knowledge	1	2	3	4	5
21	Understanding student thinking in mathematics	1	2	3	4	5
22	Learning how to use inquiry/investigation-oriented teaching strategies	1	2	3	4	5
23	Learning how to use technology in mathematics instruction	1	2	3	4	5
24	Learning how to assess student learning in mathematics	1	2	3	4	5
25	Learning how to teach mathematics in a class that includes students with special needs	1	2	3	4	5

D. Mathematics Instruction

For 26-36, about how often do **you** do each of the following in your mathematics instruction?

		Never	Rarely (e.g. a few times a year)	Sometimes (e.g. once or twice a month)	Often (e.g. once or twice a week)	All or almost all mathematics lessons
26	Introduce content through formal presentations (teacher presentation)	1	2	3	4	5
27	Pose open-ended questions	1	2	3	4	5
28	Use whole class discussions	1	2	3	4	5
29	Require students to explain their reasoning when giving an answer	1	2	3	4	5
30	Ask students to explain concepts to one another	1	2	3	4	5
31	Ask students to consider alternative methods for solutions	1	2	3	4	5
32	Ask students to use multiple representations (e.g., numeric, graphic, geometric, etc.)	1	2	3	4	5
33	Allow students to work at their own pace	1	2	3	4	5
34	Help students see connections between mathematics and other disciplines	1	2	3	4	5
35	Assign mathematics homework	1	2	3	4	5
36	Read and comment on the reflections students have written, e.g., in journals	1	2	3	4	5

For 37-54, about how often do students in this **mathematics** class take part in the following types of activities?

		Never	Rarely (e.g. a few times a year)	Sometimes (e.g. once or twice a month)	Often (e.g. once or twice a week)	All or almost all mathematics lessons
37	Listen and take notes during presentation by teacher	1	2	3	4	5
38	Work in groups	1	2	3	4	5
39	Read from a mathematics textbook in class	1	2	3	4	5
40	Read other (non-textbook) mathematics-related materials in class	1	2	3	4	5
41	Engage in mathematical activities using concrete materials	1	2	3	4	5
42	Practice routine computations/algorithms	1	2	3	4	5
43	Review homework/worksheet assignments	1	2	3	4	5
44	Follow specific instructions in an activity or investigation	1	2	3	4	5
45	Design their <i>own</i> activity or investigation	1	2	3	4	5
46	Use mathematical concepts to interpret and solve applied problems	1	2	3	4	5
47	Answer textbook or worksheet questions	1	2	3	4	5
48	Record, represent, and/or analyze data	1	2	3	4	5
49	Write reflections (e.g., in a journal)	1	2	3	4	5
50	Make formal presentations to the rest of the class	1	2	3	4	5
51	Work on extended mathematics investigations or projects (a week or more in duration)	1	2	3	4	5
52	Use calculators or computers for learning or practicing skills	1	2	3	4	5
53	Use calculators or computers to develop conceptual understanding	1	2	3	4	5
54	Use calculators or computers as a tool (e.g., spreadsheets, data)	1	2	3	4	5

55. How much mathematics homework do you assign to this mathematics class in a typical week?

[1] 0-30 min [2] 31-60 min [3] 1-2 hours [4] 2-3 hours [5] More than 3 hours

Thank you very much. Your participation is greatly appreciated.