CLASSROOM LEVEL FACTORS AFFECTING MATHEMATICS ACHIEVEMENT: A COMPARATIVE STUDY BETWEEN SOUTH AFRICA AND AUSTRALIA USING TIMSS 2003

by

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STATEMENT OF ORIGINALITY

I hereby declare that this dissertation is my own work and that it has not been submitted for a degree at any other University. In addition, all literature that has been used or referred to have been included in a complete list of the reference.

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APPROVAL

This research work has been examined and approved as meeting the standards of scholarship for partial fulfilment of the requirements for the degree of Master of Education at the University of Pretoria

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ABSTRACT

The purpose of the study was to explore and compare key classroom level factors affecting mathematics learner achievement for South Africa and Australia. The study focused in the classroom where teaching and learning takes place. This is a secondary analysis of classroom level factors influencing Grade 8 mathematics learner achievement using the Trends in International Mathematics and Science Study (TIMSS) 2003. TIMSS 2003 was chosen because it was the latest international study available to measure trends in mathematics learner achievement, where South Africa had participated.

Quantitative research approach was employed and a survey research method was used which seeks, among others, to explore relationships and patterns. Survey research method was suitable to provide data that responded to the research questions. The data collection in South Africa and Australia was conducted in October-December 2002 as both countries are located in the Southern Hemisphere. The sample for South Africa consisted of 255 schools with 100% coverage and stratification done by a total of nine provinces, and language. This resulted in 8952 learners tested across the provinces (Joncas, 2004, p. 212). For Australia, the sample consisted of 207 schools with 100% coverage and stratification done by a total of 8 States and Territories and school type. This resulted in 4791 learners participating in the study. The sample included teachers of learners who were selected to participate in the TIMSS 2003 study for South Africa and Australia. The intended target was teachers of all learners at the end of their eight year of schooling. For each participating school, a single mathematics class was sampled and the mathematics teacher of the selected class was asked to complete a mathematics questionnaire. Mathematics teachers of sampled learners responded to questions about teaching emphasis on the topics in the curriculum frameworks, instructional practices, professional training and education and their views on mathematics. The mathematics teacher questionnaire was designed to take about 45 minutes to complete

The main question for this study was "What are the key classroom factors that influence learner performance in mathematics?" The three sub questions for the study were: What key variables on classroom level are related to learner achievement in mathematics for South Africa? What key variables on classroom level are related to learner achievement in mathematics for Australia? How do the classroom level factors in mathematics performance of South Africa compare with classroom level factors in Australia?

The conceptual framework for the study stressed classroom level factors including instructional quality, which includes teacher background factors, classroom climate, teaching requirements and mathematics curriculum. The framework describes the factors related to classroom interactions within the comprehensive education system, with regard to inputs – process – outputs – outcomes. The selection of variables for the inclusion in the models was guided by the conceptual framework and extensive preliminary analyses. Preliminary statistical analyses included exploring descriptive statistics, Varimax factor analysis, reliability, correlation analysis and stepwise multiple regression analysis.

The results of the study indicate that several specific classroom level factors were associated with the higher levels of mathematics achievement of South Africa and Australia. The results for the final South African model were: age of teacher; years been teaching; outside school day grading tests; outside school day other; and computer shortage were identified to predict learner achievement. For Australia ten classroom factors, namely, teacher perception of school climate; teacher perception of school safety; teacher emphasis on mathematics homework; teacher repeat mathematics limiting factors; homework contribute towards learning; work conditions; unhappy learners; shortage of instructional equipment; geometric shapes; and algebraic functions were identified to predict learner achievement. South Africa has factors like teacher background and outside school activities by the teacher. Australia has factors like classroom climate, work conditions and curriculum quality.

In the light of schools effectiveness research and school improvement research, a comparative study like this one would require more than one level (classroom level),

two or three levels would have been ideal to draw other variables and enrich the analysis, especially the learner level and school level. School effectiveness places an emphasis on the ability and social background of the learners as factors that shape academic performance

Keywords

Secondary analysis, classroom factors, school effectiveness, learner achievement, curriculum, quality, education, survey, mathematics, statistics, reliability, validity, construct, correlation, variance, and teacher

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LIST OF ACRONYMS

ABET – Adult Basic Education and Training

ANA – Annual National Assessment

ANC – African National Congress

C 2005 – Curriculum 2005

CAPS – Curriculum and Assessment Policy Statement

CEM – Council of Education Ministry

DBE – Department of Basic Education

DEST – Department of Education, Science and Training

DET – Department of Education and Training

DoE – Department of Education

FET – Further Education and Training

FIMS – First International Mathematics Study

GDE – Gauteng Department of Education

GET – General Education and Training

GDP – Gross Domestic Product

HE – Higher Education

HoA – House of Assembly

HoD – House of Delegates

HoR – House of Representatives

HSRC – Human Sciences Research Council

ICT – Information Communication Technology

IEA – International Association for the Evaluation of Educational Achievement

IIEP – International Institute for Educational Planning

IQMS – Integrated Quality Management System

IRT – Item Response Theory

KMO – Kaiser-Meyer-Olkin

MIP – Mathematics Improvement Program

MLA – Monitoring Learning Achievement

NAEP – Nation Assessment of Education Program

NCS – National Curriculum Statement

NCTE – National Council of Teachers of English

NNSSF – National Norms and Standards for School Funding

NQF – National Qualification Frameworks

NRC - National Research Coordinator

OBE – Outcomes – Based Education

OECD – Organisation for Economic Cooperation and Development

PIRLS – Progress in International Reading Literacy Study

PISA - Programme for International Student Assessment

PEQIP – Primary Education Quality Improvement Project

PPS – Probability – proportionality – to - size

RNCS – Revised National Curriculum Statement

RSA – Republic of South Africa

SACMEQ – Southern and Eastern Africa Consortium for Monitoring Educational Quality

SAQA – South African Qualifications Authority

SRN – School Register of Needs

SD – Standard Deviation

SE – Standard Error

SER – School Effectiveness Research

SIMS – Second International Mathematics Study

SIR – School Improvement Research

SPSS – Statistical Package for the Social Sciences

TAFE – Technical and Further Education system

TIMSS – Trend in International Mathematics and Science Study

UNESCO – United Nations Educational, Scientific, and Cultural Organisation

UNICEF – United Nations Children's Fund

VET – Vocational Education and Training

WSE – Whole School Evaluation

CHAPTER 1

INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

The aim of this study was to explore and compare the key classroom level factors affecting mathematics achievement between South Africa and Australia. The study was a secondary data analysis of the achievement of South African and Australian learners, secondary data is existing data already collected and stored in archives, which can be used for reanalysis to answer other research questions which were not necessarily the intention of the main study. The dataset used in this study forms part of the Trend in International Mathematics and Science Study (TIMSS) 2003 data collected under the auspices of the International Association for the Evaluation of Educational Achievement (IEA). The data was stored in TIMSS databases and is accessible via the internet. The focus of the study was on Grade 8 mathematics. TIMSS 2003 was chosen because it was the latest international study available to measure trends in learner mathematics achievement which met the criteria of both South Africa and Australia participating in the study so that the results could be compared.

The following depicts the organisation of the sections of this chapter. In Section 1.1, a brief discussion of the problem statement and in 1.2, the rationale for the study is discussed. In 1.3, the objectives of this study are outlined. In Section 1.4, the research questions are stated and briefly discussed. In 1.5, the context of the study, the South African and Australian education systems, is discussed. In Section 1.6, a brief background of TIMSS 2003 is given, while in Section 1.7, an overview of the study is outlined and lastly, in 1.8, the key points of the chapter are summarised in the conclusion.

1.2 PROBLEM STATEMENT

Although the South African Education system has achieved a significant level of learners of school-going age in terms of access and participation, the quality of learning in schools has not kept apace (DoE, 2009, p. 2). Research has shown that South African learners do not have a solid foundation in numeracy and reading literacy in the early primary school years of learners (CEM, 2009; DoE, 2009; Riddell, 2008) which affects the throughput of learners in the secondary and tertiary phases of education. As a result, the country has a serious shortage of engineers, doctors, technicians, scientists, managers, teachers and artists. Thus, the lack of quality education impedes creative solutions for development, the creation of jobs and economic growth (CEM, 2009). The challenge then is to provide quality learning output for its multi-cultural society of about 48 million people, which means to cognitively develop the young generation to compete mathematically, scientifically, and technologically with the rest of the world (DoE, 2001; 2004; Taylor, Muller, & Vinjevold, 2003). .

However, an analysis of 2008 Grade 12 results has shown some interesting trends, particularly highlighting the relationship between poverty and performance. This is important particularly in developing countries to highlight some trends and functionality of the education system in order to understand learner achievement. One of the interventions implemented in 2006 by the Department of Education to address such issues and to determine the funding of each school, is quintile ranking. Each school, based on the poverty level of the community in which it is located, is assigned a quintile rank (Quintile 1 to Quintile 5). Assigning a quintile rank is in accordance with the National Norms and Standards for School Funding (NNSSF), which requires the allocation of funds to schools according to their poverty score. The quintile system determines the amount of funding that an individual school receives and was an initiative of the government in post-apartheid South Africa to redress and redistribute resources in education (Chutgar & Kanjee, 2009).

Schools in Quintile 1 and 2 are mostly found in previously disadvantaged communities whilst schools in Quintile 4 and 5 are situated in well resourced communities. Column A, in Table 1.1, shows national percentages per quintile, and Column B lists per learner funding (Sayed & Motala, 2009, p. 3). The fourth column in this table gives an analysis of schools in terms of performance in different quintiles shows the following trends.

Table 1.1: National table of targets for the school allocation (2009) and performance

Quintile		2010	Pass	Number of schools
	A %	B	%	under 60%
Quintile 1 (poorest)	30.0	R855	50	1.029
Quintile 2	27.5	R784	53	590
Quintile 3	22.5	R641	59	752
Quintile 4	15.0	R428	67	290
Quintile 5 (least poor)	5.0	R147	84	168
No fee threshold		**R605**		
TOTAL			**62%**	**3,070**

Source: DoE (2009)

As the quintile poverty index decreases (that is, a move from Q1 to Q5), the pass percentage rate increases (50% pass rate for schools in Q1 to 84% pass rate for schools in Q5) whilst the number of schools in the quintile decreases (1 029 schools in Q1 and only 168 schools in Q5). This means that there are more schools with low pass percentage rates in Quintile 1, 2 and 3 whilst there are fewer schools with high pass percentage rates in Q4 and 5. The government has increased the subsidy of the schools in Q1, 2 and 3 in an attempt to redress and redistribute resources (HSRC, 2009) as compared to schools in Quintile 4 and 5. However, the results have not shown a return on investment and it has become apparent that increasing funding for disadvantaged schools does not necessarily solve the problem (HSRC, 2009). The HSRC reports that schools in Q5 are better off than schools in Q1 who are worse off in terms of school resources (HSRC, 2009). It also seems that the factors influencing educational quality and effectiveness were not adequately explored by the relevant stakeholders to provide solutions (Riddell, 2008) which could influence and increase learner performance.

A study conducted by the HSRC has found serious flaws in the government's ranking system for schools funding (2009). The quintile ranking system used by the government to determine how much funding each school receives, has led to many schools catering for poor children without the much needed funds even though their needs are as great as or greater than those schools receiving the funding. In conclusion, it seems that increased funding does not imply sufficient funding or improved quality learner performance.

Learner performance in international comparative studies has revealed that South African learners perform poorly in reading literacy and mathematics in comparison to other participating countries (Howie, 2001; Reddy, 2006). South Africa has participated in the following international studies: Monitoring Learning Achievement (MLA), Southern Africa Consortium for Monitoring Educational Quality (SACMEQ II), and Trends in International Mathematics and Science Study (TIMSS1995, 1999, 2003). MLA and SACMEQ II focused on primary level and TIMSS focused on both primary and secondary level (Chinapah, 2003; Howie, 2002; Moloi, 2005; Reddy, 2006).

The Monitoring Learning Achievement (MLA) Project was conducted in 1999, and measured the competencies of Grade 4 and 5 learners in numeracy, literacy and life skills, and Grade 8 focused on Mathematics and Science. The MLA is a joint project of UNESCO and UNICEF Education for All (EFA) Campaign began in 1992 and aimed to examine the effectiveness of the basic education provision in terms of learning attainment (Chinapah, 2003; Chinapah, H'ddgui, Kanjee, Falajayo, Fomba, Hamissou, Rafalimanana & Byamugisha, 1999; DoE, 2009). South Africa did not perform well in all three areas of assessment and did not fare well when compared to other participating countries. Some lower-income countries outperformed South Africa, even though South Africa is a middle-income country (DoE, 2009, p. 2). The South African Government refused permission for the South African data to be included in the African report which could have allowed the South African learner performance to be compared with other African learners (Howie, 2002, p. 30). A separate "confidential report" revealed that South African learner performance was far below that of their counterparts (DoE, 2009; Howie, 2002).

SACMEQ is a consortium of education ministries, policy-makers and researchers who, in conjunction with UNESCO's International Institute for Educational Planning, aims to improve the research capacity and technical skills of educational planners (Moloi & Strauss, 2005, p. 12). SACMEQ generate information through survey which enables decision makers to monitor general education conditions of schooling and the quality of basic education. The first two SACMEQ projects, SACMEQ I (1995-1998) and SACMEQ II (1998-2004) focused on an assessment of the conditions of schooling and the quality of education and included achievement data on reading literacy. SACMEQ II assessed the reading (literacy) and Mathematics (numeracy) competencies of Grade 6 in 14 countries. South Africa only participated in SACMEQ II (Howie, 2002; Hungi, Makuwa, Ross, Saito, Dolata, Cappelle, Paviot & Vellien, 2010; Moloi, 2005). Around 80% of South African learners in the study reached the lower half of eight levels of competence in both reading and mathematics on the SACMEQ continuum (DoE, 2009; Moloi, 2005). The study conducted by Moloi (2005) revealed that among the South African learners, the lowest levels of competence were observed among learners in rural schools. However, these were schools in which the lowest levels of resources were reported and infrastructure was also inadequate (Howie, 2002; Moloi, 2005).

The SACMEQ III project, conducted between 2005 and 2007, provided knowledge levels of learners and their teachers in matters related to HIV and AIDS and also reading and mathematics achievements of Grade 6 learners. The Grade 6 overall mathematics achievement for South African learners in SACMEQ III was 494.8 with only 30.9% of learners achieving between Level 4-8. The SACMEQ III overall result was 512.0, therefore the performance was below the international average (Hungi et al., 2010, p. 22). The study revealed that South Africa has more qualified teachers, lower learner to teacher ratios and better access to resources than most SACMEQ participating countries. Such a finding would expect that South African learners would perform at the top of the regional distribution but this is not the case. However, the findings revealed that South Africa ranks 8th out of 15 for the learner mathematics performance (Hungi et al., 2010, Makuwa, 2010).

Ever since South Africa has participated in the Trends in International Mathematics and Science Studies (TIMSS 95, TIMSS 99 and TIMSS 2003), the overall South

African results have been very low in comparison to other countries; in fact, they have consistently been the lowest of all participating countries (Howie, 2002; Martin & Mullis, 2004). Yet South Africa shares some similarities in terms of its education system and schooling conditions with countries whose learners performed well, such as an outcome based approach to education, language diversity, multicultural classrooms and diverse socio-economic conditions.

In 2001, 2007 and 2004, the South African Department of Education conducted national learner achievement assessments at Grades 3 and 6 levels. In 2001 and 2007, a systemic evaluation at the end of the Foundation Phase of schooling was conducted by assessing approximately 54 000 randomly selected Grade 3 learners in the areas of literacy, numeracy and life skills. In 2004, a systemic evaluation of the Intermediate Phase of schooling was conducted with approximately 34 000 Grade 6 learners assessed in the language of learning and teaching, Natural Science and Mathematics. The results from all three systemic evaluations were poor as the performance of South African learners was not satisfactory, and did not meet the expectations of the Department of Education (DoE, 2009, p. 77).

Thus, poor performance in internal systemic evaluation studies and international assessments (MLA, SACMEQ and previous TIMSS studies) has led to the researcher's interest to explore classroom level factors affecting mathematics achievement in South Africa, as a developing country and then compare these factors with those identified in Australia, a developed country. Therefore, this study identified key classroom level factors influencing mathematics achievement which are similar and/or different in both South Africa and Australia.

1.3 RATIONALE

South Africa has participated in several international studies and has conducted national and international assessment studies as discussed in the problem statement above. In many of these studies, low achievement scores in mathematics have been recorded, a situation causing considerable concern. The available literature and reports tend to be more descriptive without further analysing the results to uncover the explanations and solutions. The Department of Education has initiated intervention programmes, such as the National Strategy for Mathematics, Science and Technology Education, known as Dinaledi School Project (DoE, 2001; 2004) in an attempt to address the situation. The primary objective of the Dinaledi School Project is to ensure that selected schools are supported to significantly increase the participation and performance of learners, especially African and girl learners in mathematics and physical science.

The situation in the international performance has not, however, changed with consistently low scores being recorded in TIMSS 1995, 1999 and 2003. Although South Africa did not participate in TIMSS 2007, it is important to draw a comparison between the low results achieved in South Africa with better performing countries like Australia, exploring classroom factors which influence classroom practice in an attempt to learn from high performing countries' best practices (Reddy, 2006, p. 4).

South Africa is a developing country whilst Australia is classified as a developed country. There are similarities and differences between South Africa and Australia which make conditions for comparison possible. For example, both countries implemented outcomes based education (OBE). In Australia, OBE began with competency based training in industry, which moved into vocational training and then into the schools (Kilfoil, 1999) where education is based on key competences (rather than critical outcomes). In South Africa, competency based training was first advocated by the labour movement (Jansen, 1998) which developed into OBE within the education and training network. Australia, like South Africa is a multicultural society and experiences ethnic and cultural diversity, multicultural classrooms, different Indigenous languages and English as the official language (Anderson, Ingvarson, Jackson, Kleinhenz, McKenzie, Mulford & Thornton, 2007, p. 13). The socio-economic conditions of the different states in Australia are diverse, being more rural and less urban and vice versa, just like the various provinces in South Africa. Yet, Australia is reported to be doing well in international comparative studies. Based on the comparability of education systems and similarities, it is for this reason that the researcher chose to explore and compare classroom factors thought to influence mathematics achievement in South Africa to Australia using the results of TIMSS 2003.

Participation in TIMSS has given South Africa an opportunity to benchmark their learners' performance against other countries, and to provide comparative information relevant to the design and development of strategies for raising mathematics standards (Reddy, 2006, p. 4). The data and the national report provide information that may be of use to national policy makers and practitioners. However, further analysis of factors which impact on and affect mathematics achievement is required and as such, school effectiveness research could be used as a framework for such an investigation.

School effectiveness research in developing countries indicates that resource input factors have a larger impact than in industrialised countries (Lockheed & Levin, 1993; Scheerens, 2001b). Reports indicated that learners from impoverished populations are provided with education of poor quality, attend school which are under-resourced and where teaching and learning is also poorly monitored, a situation reported with schools in Quintiles 1, 2 and 3 (HSRC, 2009). Learners from these schools are characterised by high dropout rates and repetition as they tend to lack proficiency in reading, writing and computational skills. They are also reported to lack the skill to apply what they have learned to new situations. It seems that more underperforming learners are generally found in rural areas than in urban areas. Learners from families of wealth and power living in more affluent communities attend schools in Quintiles 4 and 5 (HSRC, 2009) or are sent to private schools both of which provide quality education which is well resourced and managed (Lockheed & Levin, 1993; HSRC, 2009).

In school effectiveness research, there are few studies that have focused on instructional or classroom level processes (Scheerens, 2001b, p. 360). Reynolds (1998, p. 1279) claims that classroom level factors have “maybe two or three times the influence on learner achievement than the school level does”. This claim is also supported by Scheerens (1998) in the extensive review of literature on school effectiveness, which factors at classroom level correlate generally more highly with achievement than those at school level. This study investigates classroom factors in South Africa, a developing country and compares it with the classroom factors of Australia, a developed country. This type of research is of particular importance as school effectiveness research in developing countries highlights the relevance of culture and contextual conditions in learner performance and achievement (Scheerens, 2001b, p. 360).

Drawing from a range of research, there are many factors that influence learner achievement, Howie (2002) found that there are seven classroom factors that have a direct effect on learner achievement in mathematics. These factors include class size, the attitude of the teacher, teachers' belief about mathematics, dedication towards lesson preparation, resources and gender. These factors could manifest itself in both developing and developed countries.

The factors, class size and teacher qualifications, have recently received considerable attention and earlier research reviews generally have indicated low negligible effects in developed countries (Hanushek, 1997; Scheerens, 2001b). Greenwald, Hedges and Laine (1996) concluded that school inputs lead to positive learner outcome, and that the magnitude of the effects are sufficient to suggest that a moderate increase in spending may be associated with significant increases in achievement. Literature reviewed on the process output studies in the field of research on teaching concentrated on classroom management factors, teacher-learner interaction and instructional strategies (Scheerens, 2001b, p. 360).

Scheerens (2000) points out three major conclusions from empirical school effectiveness studies. There is

1. considerably larger school variation in developing countries as compared to industrialised countries;
2. a more consistent and stronger effect on material and human resource input factors in developing countries; and
3. inconclusive and weak evidence on the effect of instructional or classroom level factors that have received empirical support in industrialised and developing countries.

Because of Scheerens's last conclusion, this study explored classroom level factors which affect learner achievement in a developing country and then compared the factors with those of a developed country. It is also interesting to note the point made by Howie (2002) that school level factors such as resources (human and physical) are the determining factors for learner achievement in developing countries as well as out of school factors like parental influence whereas in developed countries these factors are no longer the determining factors. However, this study focussed on the classroom level factors in developing and developed country.

A range of studies has examined different effects of classrooms and school level factors as well as learner background, but no study has been conducted comparing Republic of South Africa and Australia using TIMSS. This research uses the TIMSS 2003 data to explore the classroom level factors that affect mathematics achievement in South Africa and in Australia. However, a key issue is to explore whether teacher quality and classroom effectiveness account for classroom level variation in mathematics achievement or whether there are other factors that are of more importance.

The following Figure1.1 is a representation of Grade 8 mathematics performance of the two countries: South Africa and Australia.

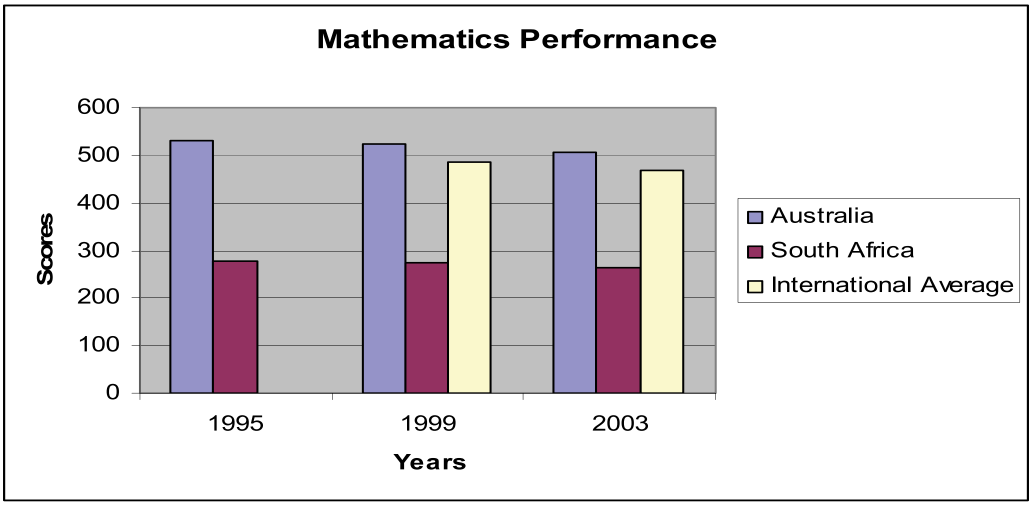

Figure 1.1 Representation of mathematics performance – Grade 8 (South Africa and Australia)

In Australia, learner performance is significantly higher than the international average at eighth grade. Learners acquitted themselves moderately well in mathematics. There was no significant change in the average scale score at eighth grade level for

Australia from TIMSS 1995 to 2003. Furthermore, there was no significant gender difference in overall mathematics achievement in Australia.

In TIMSS 2003, the South African learner performance was significantly below that of all 46 participating countries, including developing countries such as Tunisia, Chile, Morocco, Indonesia, and the Philippines (Reddy, 2006). This was also the case in 1995 and 1999 where South Africa performed below all 40 and 37 countries in the study. This is an inspiration to explore the classroom factors that had an effect on the South African learner performance in mathematics.

1.4 OBJECTIVES OF THE STUDY

The aim of the study was both exploratory and analytical in nature. It focused on the secondary analysis of the TIMSS 2003 data related to mathematics achievement of Grade 8 learners. The data was explored to identify and investigate the classroom level factors affecting learner performance. The factors identified were then explored and similarities and differences between the two countries were compared. The exploratory part of the study was to determine the factors that influence mathematics achievement for both South African and Australian learners.

To reiterate, the aims of the study were:

- To explore classroom factors affecting learner achievement in mathematics;
- To analyse key background variables on classroom level related to South African learner achievement;
- To analyse key background variables on classroom level related to Australian learner achievement; and
- To compare key classroom level factors in mathematics achievement of South Africa learners with classroom level factors of Australian learners.

1.5 RESEARCH QUESTIONS

The main question for this study is:

- What are the key classroom factors that influence learner performance in mathematics?

Sub questions for the study are:

- What key variables on classroom level are related to learner achievement in mathematics for South Africa?
  This question identifies the classroom level factors based on the literature reviewed and further investigates which of these classroom factors are key for the learner achievement in South Africa. It takes into cognisance the context of South Africa because the factors as found in the literature may not be relevant to South African context. According to School effectiveness, factors like human and physical resources play a determining role in a developing country like South Africa.

- What key variables on classroom level are related to learner achievement in mathematics for Australia?
  Similarly, the second question identifies classroom factors as identified by the literature, and investigate which are the key factors for Australia, when taking context is taken into consideration. Australia is a developed country, so factors like parental influence are a determining factor in learner achievement. Contrary, in developed country like Australia, factors like human and physical resources are not important.

- How do the classroom level factors in mathematics performance of South Africa compare with classroom level factors in Australia?
  The third question is a comparison of the identified classroom factors taking into consideration the context of South Africa and Austria. The comparison will reveal the similarities and the differences in classroom factors between the two countries.

1.6 THE CONTEXT OF THE RESEARCH

The National Qualification Frameworks (NQF) has been used to transform education and training in a number of countries in the world, especially the United Kingdom, Australia, New Zealand and South Africa (Coetzee, 2002, p. 5). The NQF has played an important role in developing policies and the education systems in both South Africa and Australia. However, when the TIMSS instruments were administered in 2002, South African education was undergoing a period of curriculum change and restructuring. Teachers were referred to different curricula to determine what was taught in their classrooms – NATED 550, C2005, and the RNCS and the philosophy of underpinning the restructured curriculum was that of outcomes based education.

A brief background and context of the education systems of South Africa and Australia are discussed in 1.5.1 and 1.5.2 respectively. Both countries used the national qualification framework, standards, and outcomes based system to transform their respective education systems.

1.6.1 The South African Education System

Since 1994, the Department of Education (DoE, 1996; 1997a; 2002) has laid a clear policy foundation to define the kind of education system envisaged in the Constitution of the Republic of South Africa (RSA) (1996) – a vision of society ”based on democratic values, social justice and fundamental human rights” (p.7). Education is not only pivotal to economic prosperity but also plays a crucial role in enabling South Africans to improve the quality of their lives and contribute to a peaceful, productive and democratic nation (DoE, 1996; 1997b).

South Africa has a single national education system that is organised and managed by the national Department of Education and the nine provincial departments (Eastern Cape, Free State, Gauteng, KwaZulu Natal, Limpopo, Mpumalanga, North West, Northern Cape and Western Cape). Formal education in South Africa is categorised according to three levels. The General Education and Training (GET) band consists of the Reception Year (Grade R) and learners up to Grade 9, as well as an equivalent adult basic education and training (ABET) qualification. The Further Education and Training (FET) band consists of all education and training from the National Qualification Framework (NQF) level two to four (equivalent to Grade 10 – 12 in schools) and the National Technical Certificate one to three in FET colleges. The Higher Education (HE) band consists of a range of degrees, diplomas and certificates up to, and including, post-doctoral degrees. These levels are integrated within the NQF provided by the South African Qualifications Authority (SAQA) Act, 1995 (Act 58 of 1995), (DoE, 1997a; 1997b).

The rich diversity of South African society is reflected by the large number of official languages of the country. English is the language of business and government although it is spoken as a first language by less than 10% of the population (DoE, 2001; 2004). The language used in the classroom at the time of the study was English and Afrikaans. These were the official languages of teaching and learning in schools. Code switching is very common in South African classrooms (Setati, 1999, Department of Basic Education, 2010). South Africa adapted full sets of instruments (TIMSS 2003 Grade 8 Mathematics Background questionnaires: School, Teacher, Curriculum and Learners) from the international English and translated into Afrikaans versions (Chrostowski & Malak, 2004, p. 94). Therefore, the language of testing was both English and Afrikaans.

The school year runs from mid-January to December and is divided into four terms, two per semester. There are approximately 10 weeks in each term followed by holidays. School is held Monday to Friday from 8h00 to 15h00 in most schools (DoE, 1996).

The implementation of Curriculum 2005, a new curriculum for a transformed education system, took place in an environment characterised by enormous infrastructural backlogs, resource limitations, inadequate supply of quality learning support materials and absence of a common national standards for learning and assessment. In addition, there was an enormous shortage of qualified teachers, more especially in Mathematics and Science (DoE, 1997a).

Outcomes based education (OBE), which focuses on the outcomes of educational process, was introduced in South Africa as one of the measures to improve the quality of education in post-apartheid South Africa and in addition, it was introduced to address the demands for an increasingly skilled work force (DoE, 1997b). The curriculum was aimed at activating the minds of young people so that they are better able to take part in economic and social life. Within the OBE curriculum and as opposed to the old, outcomes do not depend on the content, as outcomes are the results of learning, and can be measured and assessed (DoE, 1997b; 2002).

A challenge faced by the South African Department of Education is providing quality mathematics education for its multi-cultural society of 48 million people. There is disagreement about the causes of poor provision of mathematics education but this could be due to a legacy of poor resourcing, poor teacher preparation, and a curriculum that is not explicit about the performance standards expected (Taylor, Muller, & Vinjevold, 2003). However, under Apartheid, education was administered separately and unequally within the different racial groups. The different ex-departments of education were the House of Assembly (HoA), the House of Delegates (HoD), the House of Representatives (HoR), and the Department of Education and Training (DET). Schools operated under different conditions such as infrastructure, management and governance, educational culture, resources base, socio-economic status of learners, (Reddy, 2007, p.117). Black schools were the most disadvantaged with white schools being the most advantaged. Black schools were located in areas where the Black population predominantly lives and these areas tend to be characterised by high levels of poverty and underemployment. HoA schools, previously for white learners, exist in better socio-economic conditions (Reddy, 2007, p.117).

The table below provides an indication of how the different school types would have fared in the international comparison and against a selection of African countries (Reddy, 2006, p. 51).

Table 1.2 Distributions of Mathematics Achievement by ex-racial departments of schools, Year 8 learners

Year 8 Departments	1999 Mean scale score (SE)	2003 Mean scale score (SE)
Australia		505 (4.9)
Ex-HoA	**442 (18.0)**	**468 (20.3)**
International mean		467 (0.5)
Tunisia		410 (2.2)
Egypt		406 (3.5)
Morocco		387 (2.5)
Ex-HoD	**406 (14.3)**	**366 (24.9)**
Botswana		366 (2.6)
Ex - HoR	**348 (16.1)**	**314 (8.6)**
Ghana		276 (4.7)
South Africa	**264 (5.5)**	**264 (5.5)**
Ex-DET	**238 (4.9)**	**227 (2.9)**

Source: Reddy (2006, p. 49)

There is a difference in the performance of learners attending different school types. Learners who attended ex-HoA schools achieved a score close to the international average whilst the average mathematics scale score (and SE) for schools of the ex-racial departments were: ex-DET schools 227 (2.9), Ex-HoR 314 (8.6); ex-HoD 366 (24.9); and ex-HoA 468 (20.3). However of concern is that there was a decrease in the average score in the ex-DET, ex-HoR, and ex-HoD schools in the period 1999 to 2003 which is significant in the ex-DET schools. In contrast, there was an increase in the ex-HoA schools over the period 1999 to 2003.

In 2009 the Minister of Basic Education, set up a Task Team for the Review of the Implementation of the National Curriculum Statement Grades R to 12. The brief of the Task Team was to identify the challenges and pressure points that impacted negatively on the quality of teaching in schools and propose mechanism to address these. The report found that teachers were confused, overloaded, stressed and demotivated and as a result were underperforming. The following were a few recommendations for addressing and improving the situation: produce one clear and accessible policy document; write a more streamlined curriculum; go back to subjects and essential subject knowledge; ensure there is progression and continuity across grades; and standardise assessment. In brief, the report centred around three important ideas, that is simplification, improvement and clarification. The plan was to use what was good from the existing RNCS and replace what appeared not to be working. As a result, a new Curriculum and Assessment Policy Statement (CAPS) has been gazetted and is about to become an education policy. The Department of Basic Education is committed to ensuring that the education system is properly prepared at all levels and grades for the introduction of the CAPS. Educators at all levels of the system are prepared to ensure a common understanding, starting with the Foundation Phase and Grade 10 in 2012. Training and training toolkits are prepared at provincial and district level. The training toolkit focuses on the following: the structure and content of the CAPS in the Foundation Phase; the role and the use of the workbooks in Grades R-3; and the Annual National Assessment (ANA) as a baseline assessment in Grade 2 and 3 and the implication for classroom practice (DBE, 2011, p.14).

The Department of Basic Education has introduced the Annual National Assessments (ANA) into the system to improve quality of learner attainment. The focus areas are literacy and numeracy for all learners in Grades 1 to 6. The purpose is to provide each school with an objective picture of their learners' competency levels using nationally benchmarked tests that are aligned to the curriculum. Targets for improving learning outcomes have been set in *Action Plan to 2014: Towards the Realization of Schooling 2025* (DBE, 2011, p. 20)

1.6.2 The Australian Education System

Australia is one of the developed countries in the world, ranking second on the United Nations Human Development Index. Rates for infant and maternal mortality, educational enrolment, life expectancy, adult literacy rates, and Gross Domestic Product (GDP) per capita are among the best of any highly developed nations. Australia, however, is home to an indigenous population (the Aboriginal and Torres

Strait Islander people) and they have not shared in the high state of development of other Australians. Indigenous Australians experience higher infant and maternal mortality rates, lower levels of education, higher rates of substance abuse and imprisonment. Improving educational experiences and outcomes for such a disadvantaged group is critical to improving all outcomes for the group (Thomson, 2007).

Australia is a highly diverse and economically dynamic society, and continues to flourish in this direction. Schools need to contribute to social and economic development by meeting the needs of an increasingly diverse range of young people with varying socio-economic, language and family backgrounds (Anderson et al., 2007). Australia adapted the full set of instruments in international English version. The language of testing was English (Chrostowski & Malak, 2004, p.94). The Australian community is more informed, involved and supportive of education, but also more critical and challenging. More responsibilities have been given to schools and accountability demands have increased. School leadership is widely recognised as an important but challenging role.

Education in Australia is constitutionally a responsibility of the eight state and territory governments (New South Wales, Victoria, Queensland, Western Australia, South Australia, Tasmania, the Australian Capital Territory and Northern Territory). These states determine staffing policies, school resources and management, and curriculum development (Lokan & Greenwood, 2000; Thomson, 2007). There is also a Common Wealth Department of Education which has some influence on national education directions through financial support of special programmes and initiatives. The various systems are made aware of what each are doing through joint meetings of key personnel, twice a year (Lokan & Greenwood, 2000; Thomson, 2007).

As Australia does not have a single school system, under the federal political structure, education is the responsibility of the eight states and territories. This means that each state provide funds and regulation for their schools. The curriculum taught in each state or school may vary but the learning areas are the same in all. Almost all school learners study a curriculum that includes English, mathematics, science, social studies, humanities, the creative and performing arts, technology, physical education, and a language other than English. Each state has a Vocational Education and Training (VET) or Technical and Further Education (TAFE) system. VET prepares people for work in a career that does not need a university degree. VET is transferable between the states. The National government provides funding for universities in all the states.

Outcomes-based education has been adopted in significant ways in the United States, Australia, South Africa, Hong Kong, and other countries. The proponents believe that all learners can learn, regardless of ability, race, ethnicity, socio-economic status, and gender. Yet, the critics claim that the existing tests do not adequately measure learner mastery of the stated objectives. The OBE model for Australia is performance based unlike South Africa which is outcomes based (Alderson & Martin, 2007; Kilfoil, 1999).

Schooling in Australia starts with primary school (Pre-Year 1) to Year 7, and finishes with secondary school (Year 8 to Year 12). The school year runs from late January to December and is divided into four terms, two per semester. There are approximately 10 weeks in each term followed by holidays. School hours are 09h00 to 15h30 Monday to Friday in most schools (Anderson et al., 2007).

Australia‘s population is mainly of European origin and recent immigration from Asia has added to the ethnic and cultural diversity. This means that Australia has a multicultural society but English is the official language. At least 15% of the population speak a language other than English at home, with Italian, Greek, Cantonese and Arabic being the most common but there is also a large number of different indigenous languages (Kilfoil, 1999).

The performance of Australia’s non-indigenous learners in TIMSS 2003 compared well internationally and was significantly above the international mean for Year 8 mathematics. The performance level was comparable to the performance of developed countries such as United States, England, New Zealand and Scotland. The average age of Australian learners was lower than the averages for each of these countries. However, the performance of Australia’s indigenous learners was significantly lower than the performance of non-indigenous Australian learners and significantly lower than the international mean. Their performance was similar to the performance of learners in less-developed countries such as Egypt, Tunisia, South Africa and Indonesia (Thomson, 2007).

Table 1.3 Distribution of Mathematics Achievement across selected countries, Year 8 learners

Year 8 TIMSS 2002/3 Countries	Mean scale score (SE)	Average age
Singapore	605 (3.6)	14.3
Non-Indigenous Australian learners	508 (4.5)	13.9
Australia	505 (4.9)	13.9
United States	504 (3.3)	14.2
Scotland	498 (3.7)	13.7
England	498 (4.7)	14.3
New Zealand	494 (5.3)	14.1
International mean	467 (0.5)	14.5
Indigenous Australian learners	429 (7.6)	14.0
South Africa	264 (5.5)	15.1

Source: Thomson, 2007, p.218

The performance level between indigenous and non-indigenous learners in TIMSS 95 and 2003 remained statistically about the same, although the level of performance of indigenous learners declined slightly. The gap between the performance level of non-indigenous and indigenous learners was also static (Thomson, 2007). Australian indigenous learners have less access to resources at home such as books, desks, than do their non-Indigenous counterparts, and they are more likely to live in areas of Australia that are classified as remote.

1.7 BACKGROUND TO TIMSS 2003

The International Association for the Evaluation of Educational Achievement (IEA), based in the Netherlands, was responsible for initiating TIMSS and other earlier international comparative studies (Martin & Mullis, 2004; 2006). The IEA has conducted a number of studies of learner achievement in the curricular areas of mathematics, science and reading, but in this study, the research focuses on the performance of learners in mathematics. The First and Second International Mathematics Studies (FIMS and SIMS) were conducted in 1964 and 1980/1982 respectively. The Third International Mathematics and Science Study (TIMSS) in 1994 – 1995 was the largest and most complex IEA study ever conducted, including both mathematics and science at third and fourth grades, seventh and eighth grades and the final year of secondary school (Martin & Mullis, 2004, p. 4).

1.7.1 Goals of TIMSS 2003

The IEA recognizes two main goals of the achievement studies (Mullis et al., 2004; Martin & Mullis, 2006):

- To provide policy makers and educational practitioners with information about the quality of their education system. This goal asks primarily for international comparisons of test scores at a descriptive level on international achievement tests. It also includes a comparison between countries of contextual indicators referring to educational processes at different levels (learner, class/teacher, school and country level) (Bos & Meelissen, 2006, p. 195).

- To assist in understanding the reasons for observed differences between education systems. This goal refers to seeking explanations for the described differences in achievement within and more importantly across nations and can be approached by analysing the possible relationships of the context indicators with achievement in an international comparative context. Studies of effectiveness of education showed that the identification of factors on different levels (learner, teacher, class and school level), influencing learners' achievement within a country is complicated enough as it is (Scheerens & Bosker, 1997). Finding explanations for differences in achievement between nations, means that an extra level is added to an already very complex model (Bos & Meelissen, 2006).

This study focused on the second goal of the IEA's studies: understanding the reasons for the differences in learners' achievement between countries such as

South Africa, a developing country and Australia, as a developed country. In order to accomplish this, the TIMSS 2003 data from two countries was explored.

1.7.2 The Purpose of TIMSS 2003

TIMSS collects educational achievement data (curricula, instructional practices and classroom environment) in mathematics to provide information about trends in performance over time which can be used to improve the teaching and learning of mathematics for learners around the world (Mullis et al., 2004). TIMSS 2003 has a number of components: learners completed achievement tests in mathematics, and then answered questions pertaining to their home background and their attitudes towards mathematics. Mathematics teachers completed questionnaires on, inter alia, their teaching preparations, teaching styles, professional development, and attitudes towards mathematics and science. Principals completed questionnaires on school characteristics, parental involvement, Grade 8 teaching and teachers of mathematics, learner behaviour, resources and technology.

1.7.3 Mathematics Achievement

TIMSS is designed to assess learner achievement in mathematics in the context of the national curricula, instructional practices and the social environment of learners. One of the purposes of TIMSS was to allow researchers, practitioners and policy makers to analyse and relate performances in mathematics and to study these performances in relationship to background and context variables (Howie & Plomp, 2005; 2006).

Table 1.4 Trends in Mathematics achievements (Eighth Grade)

Country	**1995**		**1999**		**2003**	
	Score	**Ranking**	**Score**	**Ranking**	**Score**	**Ranking**
Australia	530	16	525	13	505	14
South Africa	278	41	275	38	264	50
International Average		N/A	**487**	N/A	**467**	N/A

Source: Mullis et al. (2004, p. 44)

1.7.4 Participants in TIMSS 2003

In South Africa, the Human Sciences Research Council (HSRC) coordinated and managed the South African part of the TIMSS 2003 study. TIMSS 2003 is the third TIMSS in which South Africa has participated, the others being in 1995 and 1999. For countries that participated in previous assessments, TIMSS 2003 provides three cycle trends at the eighth grade (1995, 1999 and 2003). This assessment trend could help policy makers and practitioners assess the country's comparative standing and gauge the rigor and effectiveness of the mathematics programmes. Table 1.1 illustrates the population and sample size for the eighth grade in Australia and South Africa.

Table 1.5 Population and Sample sizes – Grade 8

	Population		Sample			Mean Age of Learners Tested
	Schools	**Learners**	**Schools**	**Learners**	**Est. Pop**	
Australia	2 297	253 522	207	4 791	257 407	13.9
South Africa	8 926	1 009 215	255	8 952	783 951	15.1

Source: Martin et al. (2004, p.198)

The sample for Australia was designed in the following manner: There was explicit stratification by state and territories for a total of eight explicit strata. Participation was open to all schools in the eight states. There was implicit stratification by school type (Government, Catholic, Independent), for a total of 24 implicit strata. The criteria were embedded in the selection of schools. Schools were sampled with equal probabilities in the "Tasmania, Northern Territory and Australian Capital Territory" strata. Coverage was 100%. All schools were eligible to participate in the survey study. School level exclusion consisted of special education schools, hospital schools, schools with radically different curricula, remote schools in the Northern Territory, and very small schools (less than five eligible learners). However, these were the schools that were deliberately excluded from participation. Table 1.2 provides an overview of the total number of Australian schools per strata as described above.

Table 1.6 Allocation of school sample in Australia – Eighth Grade

Explicit Stratum	Total Sampled School	Ineligible School	Participating Schools			Non-Participating Schools
			Sampled	1st Replacement	2nd Replacement	
New South Wales	40	0	27	4	1	8
Victoria	35	0	31	2	1	1
Queensland	35	1	29	1	3	1
South Australia	30	0	25	2	0	3
Western Australia	30	1	23	2	1	3
Tasmania	30	1	25	1	0	3
Northern Territory	15	1	13	1	0	0
Australian Capital Territory	15	0	13	1	1	0
Total	**230**	**4**	**186**	**14**	**7**	**19**

Source: Martin et al. (2004, p. 348)

The sample for the Republic of South Africa was designed in the following manner. There was explicit stratification done by province, for a total of nine explicit strata. The School Register of Needs (SRN) database was used to select the sample of schools by province. It was open for all schools in the nine provinces. It included implicit stratification by language of teaching and learning (English, Afrikaans, mixed chosen by schools) for a total of 19 implicit strata. There was a language of teaching and learning which was contained or embedded in the criteria for selection. The coverage was 100% and all schools were equally eligible to participate in the survey. The school-level exclusions consisted of special education schools and very small schools (less than 12 eligible learners) which were the only schools excluded from participating in the study. Table 1.4 below provides an overview of the total number of South African schools per strata.

Table 1.7 Allocation of school sample in South Africa – Eighth Grade

Explicit Stream	Total Sampled Schools	Ineligible schools	Participating Schools			Non-Participating Schools
			Sampled	1st Replacement	2nd Replacement	
Eastern Cape	33	0	29	3	1	0
Free State	25	0	24	1	0	0
Gauteng	27	0	20	3	0	4
KwaZulu Natal	48	0	43	2	1	2
Mpumalanga	25	0	23	1	0	1
North West	25	0	25	0	0	0
Northern Cape	25	0	24	1	0	0
Limpopo	32	0	31	0	0	1
Western Cape	25	0	22	1	0	2
Total	**265**	**0**	**241**	**12**	**2**	**12**

Source: Martin et al. (2004, p. 402)

The total allocation of school sample for Australia (186) and South Africa (241) was similar in design which was explicit stratification by state/territories and provinces respectively.

1.7.5 South Africa in relation to other African Countries

The TIMSS 2003 study included six African countries. These countries were Botswana, Egypt, Ghana, Morocco, Tunisia and South Africa. Morocco, Tunisia and South Africa participated in TIMSS 1999, while the Botswana, Egypt and Ghana participated in TIMSS 2003. A comparison of South Africa with these countries is sensible because other variables, together with mathematics achievement scores, can provide a more contextualised perspective (Reddy, 2006: p 20). South Africa has the lowest average Mathematics score (264), first column of Table 1.8 if compared to other African countries. It is also evident from the Table 1.8 that all African countries participating in TIMSS 2003 had an average score below an international average. The study will benefit South Africa and other African countries.

Table 1.8 Scale scores and key indicators of African country participants in TIMSS 2003

	Average Math scale score (SE)	Population (millions)	Life expectancy (years)	Net enrolment (primary)	Net enrolment (secondary)	GNI per capita in US$
Tunisia	410 (2.2)	9.8	73	97	68	1 990
Egypt	406 (3.5)	66.4	69	90	78	1 470
Morocco	387 (2.5)	29.6	68	88	31	1 170
Botswana	366 (2.6)	1.7	38	81	55	3 010
Ghana	276 (4.7)	20.3	55	60	30	270
South Africa	264 (5.5)	45.3	46	90	62	2 500
Australia	505 (4.6)	19.7	79	96	88	19 530
International Average	467 (0.5)					

Sources: UNDP 2003, cited in Mullis et al. (2004)

1.7.6 TIMSS 2003 Questionnaire and Assessment

TIMSS 2003 used four types of background questionnaires at Grade eight to gather information at various levels of the education system. These are curriculum questionnaire, school questionnaire, teacher questionnaire and learner questionnaire (Chrostowski, 2004). The process of the development of the TIMSS Mathematics assessment was a collaborative process involving educators and development specialists from all over the world (Martin & Mullis, 2004). Central to this was the update and revision of the existing TIMSS framework to address changes in curricula and the way mathematics is taught.

Tables 1.6 and 1.7 depict the Content and Cognitive Domains of the Mathematics Frameworks for Mathematics TIMSS 2003 eighth grade:

Table 1.9 Distributions of Mathematics Items by Content Domain (Eighth Grade)

Content Domain	Percentage of Items	Total Number of Items	Number of Multiple Choice Items	Number of Constructed-Response Items	Number of Score Points
Number	30	57	43	14	60
Algebra	24	47	29	18	53
Measurement	16	31	19	12	34
Geometry	16	31	22	9	34
Data	14	28	15	13	34
Total	**100**	**194**	**128**	**66**	**215**

Source: Mullis et al. (2004, p. 342)

Table 1.10 Distributions of Mathematics Items by Cognitive Domain (Eighth Grade)

Cognitive Domain	Percentage of Items	Total No of Items	Multiple Choice Items	Constructed-response Items	Score Points
Knowing Facts and Procedures	23	45	35	10	45
Using Concepts	19	37	31	6	39
Solving Routine Problems	36	70	43	27	76
Reasoning	22	42	19	23	55
Total	**100**	**194**	**128**	**66**	**215**

Source: Mullis et al. (2004, p. 342)

TIMSS 2003, as in the 1995 and 1999 assessments, used a matrix-sampling technique that assigns each assessment item to one of a set of item blocks, and then assembles learner test booklets by combining the item blocks according to a balanced design (Martin & Mullis, 2004). Each learner was given a booklet containing both mathematics and science items. Thus, the same learners participated in both the mathematics and science testing.

In the TIMSS 2003 assessment design, the 194 eighth-grade items were divided among 28 blocks at each grade, 14 mathematics blocks labelled M01 through to M14. Each block contained either mathematics items or science items only. The assessment time for eighth grade was 90 minutes (six 15 minute blocks). The booklet was organised into Parts I and II. The 2003 assessment was the first TIMSS assessment in which calculators were allowed to be used (Martin & Mullis, 2004).

1.7.7 Translation and Verification

The TIMSS data collection instruments were prepared in English and translated into 34 languages. In addition to translation, it was sometimes necessary to modify the international versions for cultural reasons (Chrostowski & Malak, 2004, p. 98). Translation included a series of guidelines and statistical checks. This also included verification by the International Study Centre (ISC) that corrections were made (Chrostowski & Malak, 2004, p. 102).

1.7.8 Data Collection Processing

Each country was responsible for carrying out all aspects of the data collection, using standardised procedures developed for the study. Training manuals were created for school coordinators and test administrators that explained procedures for receipt and distribution of materials as well as for the activities related to the testing sessions (Mullis et al., 2003; Martin & Mullis, 2004). Each country was responsible for conducting quality control procedures and this is described in the National Research Coordinator’s report documenting procedures used in the study. International quality control monitors were trained to observe testing sessions and conduct interviews with the National Research Coordinators in each country, South Africa and Australia. The reasons for participation of quality control monitors are to quality assure the process of data collection (testing, interviews, and data capturing).

The data collection for TIMSS 2003 was conducted in October-December 2002 in the Southern Hemisphere and March-June 2003 in the Northern Hemisphere. The data collection in the TIMSS cycle of studies was administered at the eighth grade.

This helped to assess countries' comparative standing and gauge the effectiveness of the mathematics programmes (Mullis et al., 2004, p. 361).

1.7.9 Scoring the Constructed-Response Items

A large proportion of test time was devoted to constructed response-items. TIMSS 2003 developed procedures for reliably evaluating learners' responses within and across countries (Mullis et al., 2004, p. 361). Scoring used two digit codes identifying the correctness of the response given. The first digit designates the correctness level of the response. The second digit combined with the first, represents a diagnostic code identifying specific types of approaches, strategies or common errors and misconceptions.

Analyses of responses based on the second digit provide insight into ways to help learners better understand mathematical concepts and problem solving approaches (Mullis et al., 2004, p. 361). In ensuring reliable scoring procedures based on the TIMSS rubric, the International Study Centre prepared a detailed guide containing the rubrics and explanations of how to use them. Intensive training in scoring the constructed-response items was conducted to help representatives of national centres (Mullis et al., 2004, p. 366).

1.7.10 Data Processing

Throughout the process, the TIMSS 2003 data were checked and double-checked by the IEA Data Processing Centre, the International Study Centre, and the national centres (Mullis et al., 2004, p. 369). Multiple opportunities were given to national centres to review the data for their countries. The International Study Centre, in conjunction with the IEA Data Processing centre reviewed item statistics for each cognitive item in each country to identify poorly performing items.

1.8 CONCLUSION

This study investigated key classroom factors affecting mathematics achievement at Grade 8 using TIMSS 2003. This chapter focused on the introduction to the study, outlining the problem statement, rationale for conducting the study and the background of TIMSS 2003. The chapter revealed that the learners' performance in South Africa according to ex-racial departments of schools Ex-HoA (468) is just above the international mean (467) and all other African countries but still below the performance of Australia (505). The other ex-racial departments are far below Australia, the international mean and all other African countries. The non-indigenous learners' performance (508) is just above the Australian average (505). The average age for Australia is 13.9 compared to 15.1 for South Africa. South Africa faces challenge of providing quality education to its multi-cultural society. There is clear difference in performance based on racial lines. The same could be said about Australia, where non-indigenous learners perform far better than indigenous learners.

1.9 OUTLINE OF THE DISSERTATION

This study is divided into five chapters. Chapter 1 introduces the study, outlining the problem statement, the rationale for conducting the study and the background of TIMSS 2003, as well as the educational contexts of South Africa, a developing country and Australia, a developed or industrialised country. Chapter 2 presents a review of the literature concerned with the key classroom level factors affecting mathematics achievement. It will further explore the school and classroom effectiveness and improvement and the conceptual framework adapted for the purpose of this study will be discussed. Chapter 3 describes the design and methodology followed in conducting this study while Chapter 4 reports on the research findings with regard to the key classroom level factors affecting mathematics achievement. Chapter 5 presents the conclusions and recommendations, as well as the implications for further study and the limitations of this study.

CHAPTER 2

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 INTRODUCTION

In South Africa, providing quality education is a must for institutions and a constitutional right of the citizens, such that this right is entrenched in the constitutional documents. The Bill of Rights in the Constitution of South Africa (RSA, 1996) stipulates that everyone has the right to “a basic education, including adult basic education, and further education, which the State, through reasonable measures, must make progressively available and accessible”(Republic of South Africa, 1996; Department of Basic Education, 2010). Access to education of high quality and equitable distribution of human as well as material resources have been identified as key transformational goals of the government. Quality of education is characterised by three inter-related and inter-dependent strands: i) efficiency in meeting the goals; ii) relevance to human and environmental conditions and needs; and iii) exploration of new ideas, the pursuit of excellence and the encouragement of creativity (Haves & Stephens, 1990, p. 19). Urwich and Junaidu (1991) distinguish two contrasting orientations towards quality, technical efficiency and pedagogic:

> “The technical efficiency orientation focuses on the provision of school basic inputs (teachers, material and learning time), their effect on academic achievement and the consequent priorities for investment. The orientation is characterised by positivist assumptions and by attempts to measure production functions through large-scale surveys. The pedagogic orientation towards the quality of education does not give much emphasis either to physical inputs or to their effects, but rather sees teaching skills, patterns of school organization and curricular content as the essential components of quality” p. 20.

In South Africa, the quality of public education has come under the spotlight over the past few years, despite the increased access and financial resources invested in the system (Chisholm, 2004; DoE, 2009; Taylor, Muller & Vinjevold, 2003; Van der Berg, 2008). The quality of education is linked to the teachers, texts and values promoted in schools through the official and hidden curriculum (Chisholm, 2004, p.14). In the Global Monitoring Report, UNESCO (2005) identified five dimensions of quality that influence the core processes of teaching and learning. The dimensions are, *firstly*, learner characteristics, context, enabling inputs, teaching and learning and learning outcomes. Learner characteristics include aptitude, perseverance, school readiness, prior knowledge and barriers to learning. *Secondly*, context, this includes globalisation, economic and labour-market conditions, socio-cultural and religious factors, parental support, peer pressure, public resources that are available for education, competitiveness of the teaching profession in the labour market, national governance and management strategies, time available of schooling and homework, and national standards. *Thirdly*, enabling inputs refers to teaching and learning materials, physical infrastructure and facilities, school governance and human resources (teachers, principals, inspectors, supervisors and administrators). *Fourthly*, teaching and includes learning time, this dimension includes learning time, teaching methods, assessment, feedback, incentives and class size. *Lastly*, learning outcomes, that is numeracy, life skills, creative and emotional skills, values and social benefits. These five dimensions of quality of education outcomes are interrelated and influence each other (UNESCO, 2005). It is a challenge to monitor and measure the effects of these dimensions of quality in education.

In monitoring the quality of education, it is important that the views of teachers are taken into consideration (Moloi & Strauss, 2005, p. 96). Monitoring involves visiting classrooms, observing teachers at work and providing constructive feedback to the teachers (Moloi & Strauss, 2005; Southworth, 2004). Whole School Evaluation results have revealed that there is a strong link between good monitoring and good teaching (GDE, 2010). Classroom observation is mandatory for South Africa's Integrated Quality Management System (IQMS), but not all schools observe this important duty (DoE, 2001a; 2001b; GDE, 2008). A study conducted by Soudien and Gilmour (2008) revealed that historically black schools have not translated the resources into learning outcomes despite a number of reform initiatives by the government; and a study conducted by Taylor (2007) concluded that interventions in poorly performing schools, which constitutes around 80% have realised some impact but proved to have poor performance returns. Crouch and Vinjevold (2006, p.12) argue that South Africa is undergoing a period of imbalance between access and quality, and this is not new, for example whites in South Africa had dealt with the tradeoffs successfully. South Africa as country is doing well in terms of access but not in terms of quality. The breakdown given by Table 1.2 (p. 15) brings some interesting facts in terms of performance, ex-HoA performance in TIMSS 1999 and TIMSS 2003 is slightly above the international average and above all African countries. The reconciliation of access and quality is a matter of conscious purposive policy changes and implementation.

South Africa has put in place various strategies to improve the quality of secondary education immediately post-apartheid (DoE, 2001a; 2002). The *first* was the Culture of Learning, Teaching and Service (COLTS), which was aimed to address the erosion of time and disruption of teaching and learning during the period of struggle against apartheid. The *second* was the campaign to address high failure rates in schools. This campaign set national targets for pass rates and target time management and teaching and learning in poorly performing schools, especially schools with under 20% pass rate. Provincial departments had to develop interventions which included pace setters, common examinations in Grades 10, 11 and 12, and additional classes and training for teachers. The *third* strategy, was improving the access of Africans to the quality or gateway subjects, mathematics, Science and Technology Education Strategy. It aimed to increase participation and success rates. The cabinet-approved the strategy and the selection of 102 schools to drive the goals of the Strategy (DoE, 2000; 2001c; 2004). The strategy was expanded and greater focus in the mathematics, Science and Technology Education Strategy to 400 schools in 2006 (DoE, 2001c; 2004; 2009). *Fourthly*, the introduction of the new curriculum from 2006 to raise the cognitive demand of the subjects was introduced into Grades 10, 11 and 12 in 2006, 2007 and 2008 respectively. In the new curriculum, the 29 curriculum subjects were all offered at same grade, with no differentiation of the curriculum (standard or higher grade). The Ministry has put in place a number of interventions strategies to improve the quality of education, and a review of the curriculum implementation was conducted by the Ministerial Team. The above information clearly reveals that there are no interventions from national level which are at a senior phase level (Grades 7, 8 and 9). Most focus is at FET (Grades

10, 11 and 12). Learners and teachers at GET level do not receive the necessary support and attention they deserve.

A Ministerial Task Team was set to review the implementation of the National Curriculum Statement Grades R to 12. The Department of Basic Education is committed to ensuring that the education system is properly prepared at all levels and grades for the introduction of the new Curriculum and Assessment Policy Statement (CAPS). Educators at all levels of the system are prepared to ensure a common understanding, starting with the Foundation Phase and Grade 10 in 2012. Training and training toolkits are prepared at provincial and district level. The training toolkit focuses on the following: the structure and content of the CAPS in the Foundation Phase; the role and the use of the workbooks in Grades R-3; and the Annual National Assessment (ANA) as a baseline assessment in Grade 2 and 3 and the implication for classroom practice (DBE, 2011, p.14).

Apart from curriculum reforms a study conducted by Motala (2008) on equity and school finance describes the pattern and topography of inequalities in post-apartheid education in South Africa. Motala (2008) argues that while significant progress has been made in the redistribution of resources through finance and mechanism, the level of redress has not been sufficient to address past inequalities and historical backlogs in a meaningful way. She further argues that the redistribution of resources and the level of redistribution have occurred based on the assumption that there would be greater effectiveness and efficiency of spending. She states that:

> “The location of redress within macro-economic and fiscal goals highlights the tension between fiscal stabilization policies and meeting the demands of social development and democracy. Also that certain policies, such as private inputs into public education and the notion of devolution and self managing schools, require critical review if there is to be greater democratic transformation with the system” (p. 301)

In addition to resources, mathematics achievement is affected by several classroom-level factors which appear to be interrelated. This means that each factor, to a certain degree, has an influence on the behaviour of another factor so it may not be one factor alone affecting mathematics achievement (Howie, 2006; Howie & Plomp, 2006; Park & Park, 2006). School effectiveness research will assist to understand the interrelated nature of these factors in school and classroom.

In this chapter, the literature on classroom-level factors affecting mathematics achievement is reviewed. In Section 2.2, classroom and school effectiveness and improvement are discussed while in Section 2.3 classroom factors affecting learner achievement in mathematics are described. Previous research has identified these factors that influence performance in mathematics. An outline of eight selected classroom factors is briefly discussed, such as 2.3.1 teacher characteristics; 2.3.2 instructional strategies; 2.3.3 time on task (time spent on mathematics); 2.3.4 homework; 2.3.5 positive reinforcement and feedback; 2.3.6 monitoring learner performance; 2.3.7 classroom-learning environment; and 2.3.8 class size. The conceptual framework (Classroom factors related to mathematics achievement), adapted from Shavelson, McDonnell and Oakes (1987) and linking elements of the education system is discussed in Section 2.4.

2.2 SCHOOL AND CLASSROOM EFFECTIVENESS

The origins of the Effective Schools Movement dates back to the late 1960s and can be located in a group of studies that attempted to examine whether school resources were associated with student outcomes. This research was described as input/output equity studies. Most notable among these is Coleman study (Coleman, Campbell, Hobson, McPartland, Mood, Weinfield, & York, 1966). Lezotte (1986) has identified four critical periods that mark the epochs of the Movement's evolution, which is 1966 – 1976; 1976 – 1980; 1980 – 1983, and 1983 – present. In terms of general concerns with school effectiveness; however, it took a particular form in the 1970s (Lockheed, & Levin, 1993, p. 4). The history of school effectiveness research in developed countries could be traced back to influential studies by Edmonds (1979) in the United States of America (USA) and Rutter, Maugham, Mortimore and Ouston (1979) in the United Kingdom (UK) in the 1970s and in some continental European countries, especially in the Netherlands. In the mid 1960s there were earlier studies but these were not influential (Townsend, 2001; Yu, 2007). The three distinct but interrelated branches of school effectiveness research were, firstly, school effects research (scientific properties), secondly, effective school research (process oriented study of characteristics), thirdly, school improvement research (focusing and limiting its test of specific models of effective schools), (Yu, 2007, p.3). These studies were trying to address or respond to the view that schools did not make much difference to young people's life chances, summed up by Coleman, Campbell, Hobson, McPartland, Mood, Weinfield and York (1966) as:

> "Schools bring little influence to bear on a child's achievement that is independent of his background and general social context; and that this very lack of an independent effect means that the inequality imposed on children by their home, neighbourhood, and peer environment are carried along to become the inequalities with which they confront adult life at the end of school" (Coleman, 1966, p. 325).

Furthermore, various systemic reviews of literature in school effectiveness research have been conducted since the publication of the Coleman Report in 1966. Jencks (1972) analysed many of the variables in the Coleman Report and verified Coleman's findings, Stephens (1967) carried a similar analysis, comparing reviews of research on the relative effectiveness of different factors, methods and procedures; to mention a few. School effectiveness has many critics who claim that school effectiveness had created more problems than it had generated solutions. Reynolds and Teddlie (2001) were two researchers who were actively involved in the development of the school effectiveness traditions. They responded to the claims of the critics and reflected on the criticism and beyond (Reynolds & Teddlie, 2001; Teddlie & Reynolds, 2001). They published papers about school effectiveness and school improvement as a means to expand the debate. Scheerens (2001b) concluded that multilevel school effectiveness studies, which integrate conditions at school and classroom levels, could handle many of the cultural contingencies. His contribution also contains reviews of the main substantive outcome of the effectiveness in developing countries as compared to industrialised countries. The Primary Education Quality Improvement Project (PEQIP) included activities that were divided into four main components: 1) teacher development, 2) educational management, 3) books and learning materials and 4) community participation.

Multilevel analyses were used to determine the impact of student level background variables in addition to school and classroom level conditions. Creemers and Reezigt (1996) developed an integrated model of school effectiveness to evaluate and research the activities and substantive conclusions were reached. School effectiveness and improvement is relevant to this study as it is possible to identify and study the classroom level factors that affect learner performance in a developing country like South Africa.

A number of characteristics for effective schools were provided by scholars of primary studies such as strong administrative leadership, high expectation for learners' achievement, an emphasis on basic skills instructions, a safe and orderly climate conducive to learning, and frequent evaluation of learner progress. Apart from this list of characteristics of effective schools by scholars of primary studies reviewers of school effectiveness research studies of developed countries also came up with many similar recipes (Yu, 2007, p. 4). Reviews of school effectiveness research had traditionally focussed in developed countries; it started in the late 1970s in the developing countries driven by the concept of educational production function and cost effectiveness. It began with a specific factor of school effectiveness in developing countries and resulted in two generations of school effectiveness; firstly, in the 1970s, studies were modelled on the methodologies of the Coleman Report and secondly, in the 1980s, studies used more sophisticated statistical techniques.

However, these studies were exclusively financed by the World Bank to identify which school factors were stronger determinants of academic achievement and better cost-effective investments in developing countries (World Bank, 2005). School effectiveness research in developing countries was driven by the concept of production function research (econometric notion of cost-effectiveness) which looks at the relationship between student academic achievement and school spending. Fuller and Clarke (1994) reviewed school effectiveness research studies and concluded that three major areas consistent with school effect emerged; firstly, the availability of textbooks, secondly, supplementary reading materials and teacher quality; and thirdly, instructional time. Hanushek (1995) suggests that "there is no clear and systematic relationship between key inputs and student performance". The third wave applied multilevel analysis to questions of school effectiveness in the late 1980s. Literature reviewed by scholars in developing countries showed significant positive associations between academic achievement and school input as well as process variables. However, class size and teacher salaries had inconsistent or no effect on learner achievement (Fuller, 1987; Lockheed & Hanushek, 1988; Lockheed & Verspoor, 1991).

It is important that school effectiveness and school improvement are adequately delineated. Firstly, school effectiveness as defined by Scheerens (1999) is the degree to which schools achieve their goals. The education model commonly used is "input – process – output - outcome" (see Fig. 2.1 below). Effectiveness is referred to as the transition of inputs by means of processes into desired outputs and outcomes (Reynolds, 1998; Scheerens, 1992; Scheerens & Bosker, 1997). On one hand, school effectiveness strongly focuses on learner outcomes and the characteristics of schools and classrooms that are associated with these outcomes without, as a matter of course, looking at the processes that are needed to bring changes.

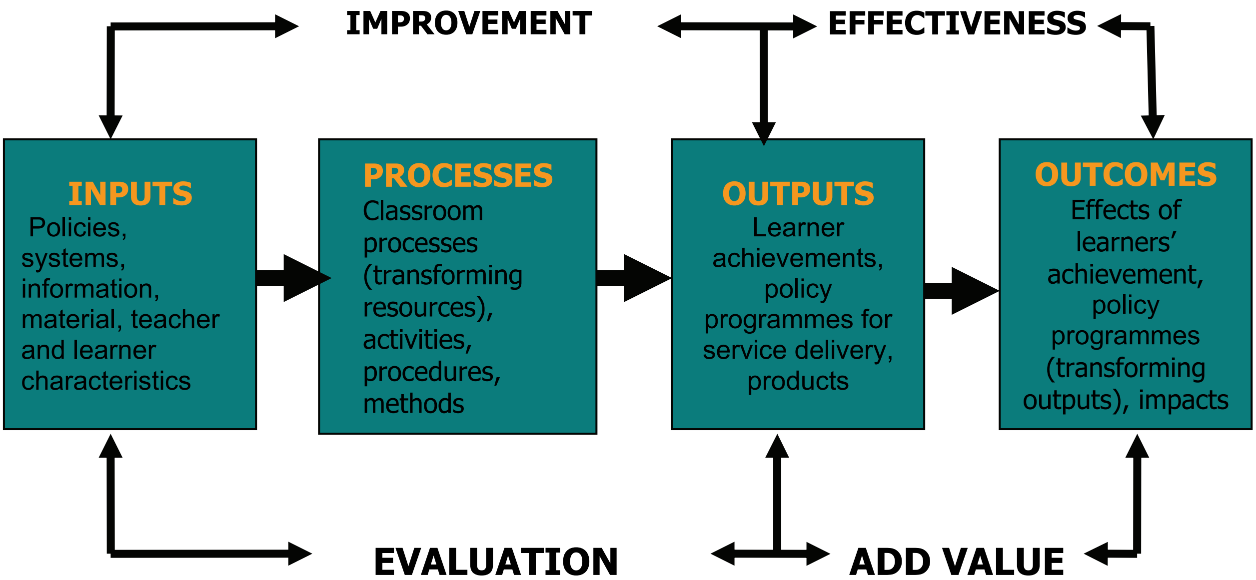

Figure 2.1 Components of an educational system adapted from literature

On the other hand, school improvement is mainly concerned with changing the quality of teachers and schools without necessarily looking at the consequences for learner outcomes. In short, school effectiveness is trying to explore what is to be changed in schools in order to become more effective, while school improvement is trying to find out how schools can change in order to improve (Hill & Rowe, 1994; Creemers, 1999b). There is a strong debate on the concept of school effectiveness as some consider school effectiveness as the degree to which a school adds value to the achievement of learners over and above the progress or improvement. The most effective schools are those where learner outcomes exceed expectations.

The expectations of school communities are diverse, not only from school to school but also from region to region. It shows that in a predominantly middle class area, many parents, teachers and learners feel that the major role of the school is academic (to prepare people for further education), whereas in a more working class region parents, teachers and learners are more supportive of the vocational role of the school and its preparation of people for work (Townsend, 1994, p. 48). Future definitions of an effective school should therefore incorporate both systemic and local concerns.

An effective school is one that develops and maintains a high quality educational programme designed to achieve both system-wide and locally identified goals. All learners, regardless of their family or social background, experience both improvements across their school career and ultimate success in the achievement of those goals, based on appropriate external and school-based measuring techniques (Townsend, 1994, p. 48).

School effectiveness places an emphasis on the ability and social background of the learners as factors that shape academic performance, and suggests that schools have little direct effect on learner achievement (Lamb & Fullarton, 2002). In addition, in their original study, Coleman et al. (1966) found that resources had a surprisingly small impact on achievement. These findings raised considerable attention, and acceptance by some individuals, in the academic, legal and public policy arenas. Hanushek (1981; 1986; 1989; 1991) in his studies concluded that the data he assembled did not provide evidence of a strong and consistent relation between resources and learner achievement. Yet, the re-analysis of Hedges, Laine, and Greenwald, (1994) found that the typical relationship between input and outcome in the data considered was positive and large enough to have important implications for educational policy.

Furthermore, as discussed above, an investigation conducted by Coleman et al. (1966, p. 325) on the relationship between the equality of educational outcomes and pupil socio-economic background, and concluded that schools bring little influence to bear on a child's achievement that is independent of his background and general social context. Thus, the lack of an independent effect means that the inequalities imposed on learners by their home, neighbourhood and peer environment are carried along to become the inequalities with which learners confront adult life at the end of school. Equality of educational opportunity therefore must strengthen the effect of school so that it is independent of the child's immediate environment (Coleman et al., 1966). Also, Scheerens (1993) argues that several studies have concluded that classrooms as well as schools are important and that teacher and classroom variables account for more variance than school variables. Yet recent work on the effect of classroom and school has suggested that teacher effectiveness accounts for a large part of variation in mathematics achievement (Lamb & Fullarton, 2002; Naker, 2007).

Perhaps it is because effective teachers are able to organise and manage classrooms as effective environments in which academic activities run smoothly, transitions are brief and little time is spent getting organised or dealing with resistance (Muijs & Reynolds, 2000; Werry, 1998). The same researchers found that the classroom environment is significant in the sense that it should be relaxed and supportive for learners to be able to succeed (Muijs & Reynolds, 2000). It is for this reason that the current study intends to explore and investigate classroom factors affecting mathematics achievement by South African learners in comparison with Australian learners.

Hill and Rowe (1996) maintain that teacher effectiveness is the key to improve educational outcomes and that a given school is likely to be as effective as the quality of classroom teaching within the school. Their study reinforces the notion that teacher and classroom variables account for more of the variance in learner achievement than school variables. The explanation is that learning takes place in classrooms through the interactions of learners and their teachers. In addition, Fuller and Clarke (1994) argue for the consideration of contextual conditions and complex interactions in school effectiveness studies in developing countries, taking into account classroom processes and teachers' subject knowledge.

Teachers' subject knowledge is seen as an important factor influencing subject outcomes. It has been found that high staff turnover and severe staff shortages in specialist areas can act as barriers to effectiveness. Effective schools manage this by encouraging teachers to embark on professional development in their teaching area or by establishing a mentoring system to provide advice and give direction (Hill& Rowe. 1996).The quality of teaching is foremost in effective schooling and there are a number of elements to this quality. Successful teachers tend to be efficient and well organised, they are clear about the purpose of their lessons and they structure their lessons. Although these factors are associated with effectiveness, it has also been shown that learner learning is enhanced when teachers are aware of differences in learners' learning styles and can use appropriate strategies.

Joyce and Showers (1988) as well as Creemers (1994) conclude in their summaries of school effectiveness research that effective teachers present information and skills clearly and enthusiastically; keep the lessons task-oriented; have expectations for learners to achieve; relate comfortably to the learners and are not judgemental; consistently provide positive feedback; have good lesson structure through emphasising key points; are constantly checking for pupil understanding to establish the appropriateness of instruction; use high quality questioning techniques; and motivate the learners through probing and elaborating on their answers.

2.3 CLASSROOM-LEVEL FACTORS

Effectiveness focuses on value-added in that effective schools are those schools whose learners' progress more than is expected in comparison with schools having similar learner intake levels (Creemers & Reezigt, 1996; Mortimore, 1991). Similarly, effective teachers are those whose learners' progress more than normally expected. School effectiveness is on three levels, that is school, classroom and learner level.

The teacher effectiveness is on classroom level (Creemers, 1994; Stringfield & Teddlie, 1991).

Classrooms can be defined as complex social settings, with many variables interacting in a way that affects how much learning actually takes place, not only the physical structure (Clarke, 2001; Froyen, 1988; Papanastasiou, 2000). Mathematics classrooms, as social settings, are determined by all the actors both present and absent, who are searching for common understanding (Edwards & Mercer, 1987). The term 'absent' represents those who are part of making the setting such as textbook writers, school administrators, parents, and others but who are not physically present in the classroom. The term 'present' represents those who are physically present and make the setting such as learners, teachers, learning and teaching resource material, and the infrastructure (Lerman, 2001, p. 56).

The classroom environment is also related to the broader school environment. Classrooms exist within the context of schools, which are characterised by a school environment that often permeates classrooms. A teacher's interest and enthusiasm for teaching, as well as his or her effectiveness in meeting learners' learning needs, is often related to the quality of his or her professional and social relationship with principals, colleagues, and staff (Lambert & McCombs, 1998, p. 61).This interaction in the classroom is characterised by a number of factors.

At classroom level, performance in mathematics is affected by factors which include the teaching and learning environment, teacher quality, teacher competence, time on task, disruptions in class, teacher confidence, teacher attitude towards mathematics, teacher qualifications, class size, content coverage, assessment, learner attitude towards mathematics, teacher personality, instructional material, language of instruction, teaching load, opportunity to learn and academic orientation, (Bos & Kuiper, 1999; Howie, 2001; 2003; 2005; Lokan & Greenwood, 2000; Mac Iver, 1987; Muijs & Reynolds, 2000). In a review conducted by Greenwald, Hedges and Laine (1996) a number of studies found that class size has a minor effect on achievement. However, factors such as textbooks, teacher quality and time on task were identified as being key factors emerging from school instructional effectiveness research (Creemers, 1996a; Riddell, 1997).

Work on the effect of classroom factors suggests that the effect of teacher characteristics accounts for a large part of variation in mathematics achievement. Several Australian studies have also pointed to teachers having a major effect on learner achievement. In a three-year longitudinal study of educational effectiveness, known as the Victorian Quality Schools Project, Hill and Rowe (1994,1996) examined learner, class, teacher and school differences in mathematics achievement. Using multilevel modelling procedures to study the interrelationships between different factors at each level (learner, classroom and school), the authors found that at the primary level, 46% of the variation in mathematics was due to differences between classrooms, whereas at secondary level, the rate was almost 39% (Lamb & Fullarton, 2002).

It was also important to conduct further analysis of the study which showed that between-class differences were also important in examining learner growth in mathematics achievement and that difference in achievement progress located at the classroom level, ranged from 45 - 57% (Hill, Rowe & Holmes-Smith, 1995; Hill & Rowe, 1998). In explaining the large classroom level differences in learner achievement in mathematics, Hill et al. (1995) highlighted the role of teacher quality and teacher effectiveness. They contend that although not fully confirmed, they had “evidence of substantial differences between teachers and between schools on teacher attitudes to their work and in particular their morale” and this supported the view that “it is primarily through the quality of teaching that effective schools make a difference” (Hill & Rowe, 1994).

In South Africa, however, a number of factors have emerged which seem to have an effect on the poor performance of learners. These include inadequate subject knowledge of teachers; inadequate ability of pupils in the language of instruction; lack of instructional materials; difficulties experienced by teachers to manage activities in classrooms; the lack of professional leadership; pressure to complete examination driven syllabi; heavy workloads, overcrowded classrooms; poor communication between policy-makers and practitioners and lack of support due to shortage of professional staff in the ministries of education (Adler, 1998; Arnott & Kubeka, 1997; Kahn, 1993; Monyana, 1996; Setati & Adler, 2000; Taylor & Vinjevold, 1999).

Below is a brief discussion of some of the classroom-level factors, which include 2.3.1 teacher characteristics, 2.3.2 instructional strategies, 2.3.3 time on task, 2.3.4 Homework, 2.3.5 monitoring learner performance, 3.3.6 positive reinforcement and feedback, 2.3.7 classroom-learner environment, and 3.3.8 class size, affecting mathematics achievements for both Australia and South Africa countries whose achievement in TIMSS 2003 is being examined in this study.

2.3.1 Teacher Characteristics

The concept of teacher characteristics is synonymous to teacher quality in the literature and is sometimes used interchangeably. By the term characteristics it refers to those typical or distinguishing features of the teacher. On the other hand quality is synonymous with excellence. The distribution and allocation of mathematics specialists in the classroom has been a challenge for school principals, project managers as well as intervention organisers. The shortage of mathematics specialists has been there for decades, however, no solution or strategy has been successful in attracting good learners to the teaching profession. The distribution and allocation of mathematics specialists does not yield a positive relationship with the intention of improving teaching performance inside the classroom (Schmidt & Kifer, 1998, p. 229). The commitment and experience of teachers is identified as one factor that supports learner achievement (Bush, Joubert, Kiggundu, & van Rooyen, 2009; Howie & Plomp, 2005). However, commitment alone is inadequate if not matched by a willingness to innovate with a well developed content knowledge framework.

Quality teachers take into account the curriculum (intended, implemented and attained), and as such they decide what to teach, when to teach, how to teach and what practice exercises to assign. They also assess efficiently and provide learners with feedback on their performance. In short, teachers manage and monitor learner performance and progress. This aspect of teaching can be challenging and often overwhelming (Spicuzza, 2001, p. 522), particularly to teachers who are either novice teachers or under-prepared. It seems that when quality teachers work with disadvantaged learners, there is a substantial effect on learner achievement. Nye, Konstantopolous and Hedges (2004) report that disadvantaged learners seem to benefit more from being taught by teachers of quality than advantaged learners. Teacher quality has influenced differences in learner performance more than race, class or school of the learner.

The teacher's role in the classroom is not only to actively engage learners in doing mathematics and to select and appropriately set up worthwhile mathematics tasks, but also proactively and consistently to support learners' cognitive activity without reducing the complexity and cognitive demands of the task (Henningsen & Stein, 1997, p. 546). Teachers should use their subject content knowledge and experience to provide support to developing learners' cognitive knowledge, thus enhancing learners' engagement and performance in the classroom.

Teachers illustrating the following four characteristics of teacher quality, content knowledge, teaching experience, teacher training and certification and general cognitive skills, consistently generate higher learner achievement. Content knowledge means that effective teachers have a solid background in the subject they teach. Secondly, teaching experience plays a major role as typically five years or more experience produces higher learner results. Teacher training and certification results tend to result in more effective teachers than uncertified ones. Finally, teachers with stronger academic skills perform better (Center for Public Education, 2005). Each of these four characteristics shows a positive relationship to learner performance.

Teachers' knowledge of the content they teach is a consistently strong predictor of learner performance, even though studies differ in how strong its effects are. The study conducted by Darling-Hammond (1999) found that although other factors had a stronger association with achievement, the presence of a teacher who did not have at least a minor (College) degree in the subject matter that he or she teaches, accounts for around 20% of the variation in National Assessment of Educational Progress (NAEP) scores. Goldhaber and Brewer (1996) found that the presence of a teacher with at least a major in the subject area was the most reliable predictor of learner achievement scores in mathematics and Science. They also found that an advanced degree that was specific to the subject area that a teacher taught was associated with higher achievement (Goldhaber & Brewer, 1996).

There is a consistency in finding a positive correlation between years of teaching experience and higher learner achievement (Center for Public Education, 2005; Rice, 2003).Teachers with more than five years experience in the classroom seem to be the most effective. Conversely, inexperience is shown to have a negative effect on learner performance. Learners taught by newly hired uncertified teachers do not perform well as learners taught by certified teachers (Darling-Hammond, 1999; Fetler, 2001; Lackzko-Kerr & Berliner, 2002; Rice 2003). It could be argued that teachers who have developed greater cognitive abilities tend to have better learner performance. Therefore, an overall positive relationship appears to exist between the teacher's teaching experience and learner performance (Ferguson & Ladd, 1996; Greenwald, Hedges, & Laine, 1996; Rice, 2003).

2.3.2 Instructional Strategies

A variety of instructional strategies that teachers use when teaching mathematics reflects different didactic attitudes to the teaching and learning of the subject. It is not surprising that these strategies produce different learner results (Antonijevic, 2007). Effective teachers emphasise academic instruction as their main classroom goal and have academic direction, creating an environment which is both business-like and task-oriented. They spend classroom time on academic activities illustrating that effective teaching is not just active, but interactive as well (Muijs & Reynolds, 2000).

Bruner (1986) observes that learning in most settings is a communal activity. In the education context, learning in the classroom is a shared and social experience with peer-based learning demonstrating that learners have a powerful influence upon one another's intellectual development (Copeland, 1984; Damon, 1984).

> "Most of us have an intuitive feeling for the cognitive benefits of discussion. We recognise in our own discussions that the process of clarifying ideas as we communicate them to others. It seems, then, reasonable to assume that the same process may occur when children talk to each other. As well as our own intuitive beliefs about discussion there exist a number of theoretical traditions which underpin this

> assumption that children benefit from talking to one another. Piaget and Vygotsky, two quite distinct and often opposing theorists, are in agreement on this issue, albeit for different reasons" (Thomas, 1994, p. 1).

Cognitive-developmental psychologists in the tradition of Piaget have taken the view that learner - learner interaction facilitates development by posing cognitive conflicts. In Piagetian theory, learner - learner interaction works as a stimulus for change but it does not provide substance of the change (Copeland, 1984; Damon, 1984). Psychologists in the tradition of Vygotsky, in contrast, value the thought processes generated by learner - learner communication with Vygotsky focusing closely upon "talk as a medium for sharing knowledge and potentially transforming understanding" (Mecer, 1994, p. 95).

A number of studies concluded that learners' learning is enhanced by their active interaction. For example, Webb (1989) found that the giving of elaborate explanations by learners was positively related to their individual achievement. On the other hand, receiving of elaborate explanations had few significant positive relationships with achievement**.** Russell and Kelly (1991) found that requiring learners to explain aspects of their work led to the increased understanding of their work.

Interestingly, Damon (1984) suggests that there are a number of reasons why learner peers act as an effective source of cognitive development. *First,* learners speak to one another using a vocabulary that they both understand. This has also been noted in Holton, Anderson and Thomas (1997, p. 45) where it is observed that learners sometimes understand other learners' explanations better than they understand a teacher's explanation. *Secondly*, learners tend to take the feedback of another child seriously and are motivated to reconcile contradictions although this appears to depend on the confidence with which the opposing viewpoints are held (Tudge, 1990). *Thirdly*, learners tend to speak directly and openly to one another. *Finally*, informational communications with other learners are often less emotionally threatening than corrective feedback from an adult.

In addition, learning involves the integration of new information into existing knowledge (Lambert & McCombs, 1998; State of Victoria, 2005). Generating explanations seems to facilitate that integration process and with the growth of instructional technology, learners have access to efficient information retrieval through electronic bulletins and networks. Educational technology also gives learners exposure to expertise outside of the traditional classroom setting and as a result, learners are able to complement their studies with videotapes, CD-ROM programming, cable television, telephone conference calls, and satellite broadcasts (Lambert & McCombs, 1998, p. 64).

Furthermore, Christenson, Ysseldyke & Thurlow (1998) argue that specific instructional strategies and tactics, if used in combination, are most likely to increase learner success. Some of these instructional strategies include allocation of sufficient time to academic activities, efficient classroom management as well as direct and frequent measurement of learner progress. When teachers actively monitor their learners' understanding during class work, by moving from desk to desk, they guide those with difficulties and select appropriate learner work for whole-class review and discussion (Kaur, 2009). During such lessons, teachers reinforce their learners' understanding of knowledge expounded during whole-class demonstration by a detailed review of learner work done in class or as homework. A complex array of factors is involved in orchestrating classroom activity and balancing classroom management needs with academic demands (Henningsen & Stein, 1997; State of Victoria, 2005). Failure of poor learners is due to a lack of opportunities to participate in meaningful and challenging learning experiences, positive feedback, review and discussion rather than to a lack of abilities or potential (Henningsen & Stein, 1997; State of Victoria, 2005).

2.3.3 Time on Task (Time Spent on Subject)

Time on task is defined as the period of time during which a learner is actively engaged in a learning activity. It is strongly influenced by a teacher's classroom management (Muijs & Reynolds, 2000). Effective teachers organise and manage classrooms as teaching environments in which academic activities run smoothly, transmissions are brief and little time is spent getting organised. Learners learn more effectively when they are supervised by their teachers than when learning on their own and this is confirmed in a meta-analysis study (Glass & Smith, 1979; Glass, McGaw & Smith, 1981), where it was evident that well controlled studies yielded better learner achievements than poorly controlled studies.

Learners who fall behind their classmates academically fall further behind each year they remain in school. Not acquiring the mathematical knowledge possessed by other learners or skills needed to succeed in technologically advanced society increases as the years progress. (Good & Beckerman, 1978; Griffin, Case, & Ziegler, 1994).The correlation analyses conducted reveals that there is a statistically significant relationship between improvement in mathematics performance and the amount of time spent on the activity (Louw, Muller, & Tredoux, 2008; Sciarra & Seirup, 2008). Within the school environment, importance of time on task for teaching and learning has been reiterated by the President of South Africa, "Teachers should be in school, in class, on time, teaching, with no neglect of duty and no abuse of pupils. The learners should be in class, on time, learning, be respectful of their teachers and each other, and do their homework" (Zuma, 2009).

Time on task is an academic engagement which allows learners to be actively involved, committed, and attentive to the classroom activity. Doing homework, coming prepared for classes, regular attendance and not missing classes reflect learner engagement and motivation. Motivation, attitudes, interest and academic engagement are critical constructs related to learning (Nardi & Steward, 2003; Peterson & Swing, 1982; Singh, Granville & Dika, 2002). Learners at individual level are able learn and master material, when they engage in it and react to it, read, and make a response (Dalton, 2008; Killen, 2006).

Stimulus information such as that encountered during classroom learning is selectively attended to, analysed, compared, synthesised, rehearsed, encoded, and elaborated while it is being learned or used in intellectual tasks. The processing operation itself is directed by mental control processes, which perform such functions as identifying and characterising the problem at hand, planning and scheduling appropriate problem solving strategies and monitoring and evaluating the effectiveness of the process (Hamzah & Abdullah, 2009; Peterson & Swing, 1982). The performance of intellectual tasks involves complex mental processes and behavioural measures, but observations on task behaviour convey limited information about classroom learning. Although behaviourally the learners may appear to be engaged in a task, cognitively they may not be on task. Cognitive learning is defined as the acquisition of knowledge and skill by mental or cognitive processes that are listening, watching, touching or experiencing and creating mental representations of physical objects and events.

It is argued that differences in the quality and appropriateness of learners' thinking produce differences in learners' academic achievement (Hamzah & Abdullah, 2009; Peterson & Swing, 1982). Learners' thought processes may be better predictors of learner achievement than observations of learner behaviour (Hamzah & Abdullah, 2009; Peterson & Swing, 1982). Learners who tend to use cognitive strategies do better on the academic tasks which means that certain cognitive strategies are important for learner learning. More research is needed on procedures for training learners to use cognitive strategies and to investigate the effects of such training on learners' academic performance (Hamzah & Abdullah, 2009; Peterson & Swing, 1982).

2.3.4 Homework

The general aim of homework is to improve the quality of teaching which allows learners to exercise and reinforce the previously developed abilities and skills, and so to advance in some areas of mathematical learning (Antonijevic, 2007; Mikk, 2007). Homework thus serves a twofold purpose. Firstly, it is a formative assessment tool that provides teachers with feedback that allows them to adjust their instruction and provide learners with a means of improving their learning. Secondly, homework is a type of summative assessment tool that is used for learner grading but teachers also use homework to maximise learner learning (Lan & Lin, 2007; Mikk, 2007).

Homework is defined as tasks assigned by teachers to be carried out by learners during a non-school period (Cooper, 1989; Cooper, Robinson & Patall, 2006; Monyana, 1996) on their own without the supervision of the teacher. The assigned task not only helps the learners to master what they have learnt in class, but also gives learners an extended opportunity to learn and practise the concepts. Homework practices as discussed in the literature, considers four dimensions: the frequency of homework, the amount of homework provided, the focus of homework, and the strategies teachers use for homework (Cooper, Lindsay, Nye, & Greathouse, 1998; Lan & Li,2007). Below is a short discussion of the four dimensions. The frequency of the homework assigned is determined by the number of exercises given to learners per week (Lan & Li, 2007; Monyana 1996; Wagemaker & Knight, 1989) but the amount of time spent on mathematics homework varies considerably from system to system.

The assignment of homework, like many educational practices can be beneficial, depending upon the nature and context of the homework tasks. The use of homework assignments bears a significant and positive relationship to achievement when the homework is carefully monitored, as well as serving the function of increasing learners' learning time. Homework yields the most beneficial results when closely tied to the mathematical subject matter currently being studied in the classroom; given frequently as a means of extending learner practice time with new material and quickly checked and returned to learners. However, a study conducted by Van der Berg (2008, p.149) found that homework frequency did not significantly improve performance.

The research also indicates that homework which meets these criteria is positively related to learner attitudes. Learners may not like homework but those who are assigned regular homework have a more positive attitude towards school and the subject than learners who have little or no homework (Cotton, 1988; Taylor & Vinjevold, 1999). Thus, the effective use of homework is important as it promotes learner learning and forms a vital part of classroom instruction (Cotton, 1988; Lan & Li, 2007). Therefore, it is of paramount importance that the teacher monitors the learner's work to see if s/he has understood the previous work dealt with in the classroom. This gives immediate feedback to the teacher and the learner.

The planning and implementation of homework as a learner evaluation strategy is valuable, as there is a likelihood that learners will benefit. In a constructive evaluation environment, all stakeholders can benefit from information about the learners' strengths and weaknesses. Information about both these areas, reported in a constructive manner enables learners to direct their energies effectively, provides parents/guardians with information they can use to assist their learners, and helps teachers plan and implement appropriate opportunities to learn (Gullickson, 2003, p. 67).

3.3.5 Monitoring Learner Performance

Monitoring learner performance is an activity conducted inside and outside the classroom by teachers, principals, parents and curriculum administrators. For the purpose of this study, the researcher focused on the teacher. Monitoring learner performance means activities pursued by teachers to keep track of learner learning for the purpose of making instructional quality decisions and providing immediate feedback to learners on their progress (Cotton, 1988, Taylor & Vinjevold, 1999). The generally accepted teacher practices are to question learners during classroom concept discussions to check their understanding of the material being taught; move around the classroom during class work and engaging in one-on-one contacts with learners about their work; assigning, collecting, and correcting homework and class work; recording completion and grades; conducting periodic reviews with learners to confirm their grasp of the concepts and identifying gaps in their knowledge and understanding. Below is a brief discussion of the common elements of monitoring methods.

Cotton (1988, p.5) briefly discussed the common elements across monitoring methods for learners' learning (several attributes of effective monitoring practice includes: setting high standards; holding learners accountable; frequency and regularity; clarity; collecting, scoring and positively related to achievement; and feedback). *Firstly*, when learners' work is monitored I n relation to high standards, their effort and achievement increase. Standards must not be so high that learners perceive them as unachievable, because their effort and achievement will decrease. Learners must be able to experience a high degree of success (on assignment, during classroom questioning, discussion) while continually being challenged with new and more interesting complex material.

Secondly, hold learners accountable for their work by establishing expectations and guidelines for their' class work, homework, and other functions and following through with rewards/sanctions that facilitates learning and enhances achievement. *Thirdly,* frequency and regularity in monitoring of class work, administration of tests, checking homework, or conducting reviews are a major reason for effectiveness. *Fourthly*, clarity about expectations, formats, and other aspects of direction-giving bears a positive relationship to the achievement of the learners doing the homework; participating in the classroom questioning session.

Fifthly, collecting, scoring and recording results of class work, homework, tests and so on, these activities are positively related to achievement, because they produce useful information to teachers and learners. These activities communicate to learners that those teachers are serious about effort and completion of assignments. *Finally*, providing immediate feedback to learners assist learners to know how they are doing and helps them to correct errors of understanding and fill in gaps in knowledge. When feedback is provided, learners who are having learning difficulties require support, encouragement and attention paid to their success.

There is a strong connection between teachers' monitoring of learners' learning progress and learners' academic performance. It is ideal that teachers receive thorough training in monitoring and become highly skilled in classroom monitoring practices. Classroom level monitoring and assessment reveals that standardised achievement test results are the main focus of assessment and evaluation efforts, as nearly all important decisions about learner placement, instructional pacing and so on are made on the basis of teachers' ongoing classroom monitoring (Cotton, 1988, p. 5).

Monitoring also involves principals visiting classrooms, observing teachers at work and providing them with feedback (Southworth, 2004; DoE, 2002). A report by the GDE (2008) found that there was a strong link between very good monitoring and good teaching, although this cannot be confirmed as it needs further research. Southworth (2004, p. 80) adds that monitoring classrooms is now an accepted part of leadership. He concludes that monitoring is a role that includes principals, deputies, heads of department and subject facilitators. However, many teachers are expected to assign homework frequently; record marks for assignments on completion, monitor class work and check on learners' progress, or conduct the kind of questioning that helps to monitor learning. Monitoring learner performance should identify, consider, and acknowledge the learners' background, learning experiences, and temporary or extraordinary occurrences beyond the learners' control that may influence performance. The results and information obtained from assessment should help to understand the variables that may have influenced the learner's performance. In addition, the learners' parents/guardians should be helped to understand the results from assessment (Gullickson, 2003, p. 143).

Effective classrooms tend to have well-established mechanisms for monitoring learners' progress in their subjects, for evaluating the class's performance as a whole and to have improvement programmes for learners and teachers in place (Department of Education, Science and Training (DEST), 2004; State of Victoria, 2005). Effective schools and classrooms guard against the over-use of assessment procedures which could lead to a shift of focus away from the teaching and learning processes. Testing by itself is not teaching. To maximise the learning effect of assessment, teachers in effective schools provide clear and informative feedback to learners (DEST, 2004; State of Victoria, 2005). Furthermore, teachers avoid the use of negative public criticism of learners whose performance in an assessment is poor. It seems that teachers do not receive adequate pre-service training in conducting formal or informal assessments. As a result, many teachers are aware that their monitoring skills are inadequate and desire training to expand their capabilities;

many others are unaware of the importance of close monitoring of learner progress and of their own need for skill development in this area (Cotton, 1988, p. 6).

3.3.6 Positive Reinforcement and Feedback

Effective teachers are skilled not only on instructional methods, but also in evaluating and assessment practices that allow them to gauge individual learner learning and adapt activities according to learner needs. The process includes both performance assessment and assessment of factual knowledge (Colby, 2000; State of Victoria, 2005). The learners' knowledge gained in the class is reinforced through homework, assessment and class work exercises. The outcome will indicate whether learners have reached a certain level of mastery (Lloret, Garcia, Bri & Coll, 2009; State of Victoria, 2005)). When learners achieve better scores or do what is considered right, effective schools will reinforce that pattern to increase the probability that the behaviour will increase in the future. Feedback provided to learners has proved to be the single most powerful factor that enhances learning achievement (Todd & Mason, 2005; Schelfhout, Van Landeghem, Van den Broeck, & Van Damme, 2007). This applies not only to learners' behaviour in class or around the school, but in academic pursuits. Feedback on their academic progress has a positive effect and if the feedback takes the form of public praise with awards and prizes, it can have a positive effect on other learners too (DEST, 2004). Furthermore, Leahy et al. (2005, p. 23) argue that effective feedback causes thinking in learners. Grades, scores and comments like 'Good job' do not do that. What does cause thinking is a comment that addresses what the learner needs to do to improve, linked to rubrics where appropriate. In short, the teacher must provide feedback that moves learners forward. Feedback has a powerful influence (Monti, McCrady & Barlow, 2006; Zakaria & Iksan, 2007).

When teachers are positive in their interactions with learners, the stage is set for increased academic achievement and improved learner conduct. Reinforcement should be delivered immediately, frequently and intensely when learners are learning new and difficult skills (Kameenui & Darch, 1995). Feedback ought to be analytical, to be suggestive, and to come at a time when learners are interested in it. And then there must be time for learners to reflect on the feedback they receive, to make adjustments and to try again. Feedback should focus on learning content as well as on providing learners with the support necessary to build self-regulated learning processes. (Schelfhout et. al., 2007). However, when reinforcing and giving learners' positive feedback about their performance, it is important to know learners' prior experiences, knowledge and interest. It assists to address knowledge gap and misconceptions on concepts that exist in learners.

2.3.7 Classroom-Learning Environment

The classroom learning environment stimulates or inhibits the interest of learners or teachers to perform their work inside the classroom. This environment has both psychological and physical (organisational) influences on the learners. The physical environment provides space and motivation for teaching and learning to take place at any time while the psychological environment enhances performance and allows teaching and learning to take place with ease (GDE, 2008, p. 23).

Learner learning should take place openly and spontaneously without hindrances or psychological barriers. Thus, the classroom learning environment should enable learners to learn freely without any disturbances, psychological intimidations or threats. Effective classrooms are more likely to be calm places rather than chaotic, to be task oriented and have an orderly climate. However, classrooms do not necessarily become more effective just because they have an orderly environment, but rather this type of environment is a precursor for effective learning and teaching to occur (DEST, 2004; Scheerens, 2001a).

A positive learning environment depends on the creation of positive communication and interaction between learners and teachers as well as among learners themselves. Teachers have high expectations of learners to perform better in the mathematics classroom. In order to do that, teachers should know the needs of learners (their interests, their prior knowledge and their learning strategies). Their communication signifies that both learners and teachers interact to fulfil each other's expectations. The teacher expects the learner to have learned what is expected to be learned as the achievement is indicative of learning success and in addition, the learner should understand and value the achievement. All these behaviours are associated with cognitive and affective learning (Anderson, 2003; Anderson, Ryan, & Shapiro, 1989; Diamond, Randolph & Spillace, 2004; Fan, & Chen, 2001; Schelfhout, Van Landeghem, Van den Broeck & Van Damme, 2007), which takes place within the organisation of the classroom and adds to the classroom learning environment.

The physical environment of the classroom can affect the learners' attitudes and behaviour, which in turn can influence levels of achievement. For example, a classroom which has teaching aids such as wall charts, pictures, learner assignments displayed on the wall will stimulate positive thinking about learning (Anderson et al., 1989; GDE, 2008; Scheerens, 2001). Learners want to identify themselves with the class as it enhances the learner sense of belonging as well as classroom cohesiveness (Anderson, 2003, p.119). Learners in one way or another come to believe that they are welcomed, respected or valued by others in the classroom. If, however, the learners feel different, they are mostly likely to withdraw from participation in classroom activities.

In addition to the learning environment, Bahrenberg (2001) and Vally (2002) argue that predominantly low-income schools are more likely to experience an enormous degree of learner disorder which inhibits education. Learners begin to feel alienated and anonymous. Conflicts are more likely to arise between the learner and others. Absenteeism increases and achievements decline (Anderson, 2003; Froyen, 1988, Thomson, 2007). Problem behaviours such as violence, vandalism, bullying, truancy, and lateness create an unsafe learning environment which undermines instruction and pose a threat to the school population (Luiselli, Putnam, Handler & Feinberg, 2005; Thomson, 2007). Learners assess the environment and opportunities provided by the classroom environment and are able to react accordingly. When the reaction of learners is positive to the classroom environment, learners are able to accept and adapt to the culture and behaviour of the classroom. However, a negative reaction result in rejection and learners are passive. Learner achievement is determined by the reaction to the classroom reception.

The learners' achievement must also be associated with the learner's classroom behaviour. The behaviour of the learner with his classmates, whether he is accepted or rejected by them, his attitude and relationship with his teachers, is a matter of importance in his achievement. A learner must be free from different types of anxieties because his anxieties and maladjustments may affect his achievement adversely. A learner may not achieve the expected result if he fails to adjust or behave properly in the classroom environment (Deka, 1993, p. 23).

Classroom learning environment research emphasises the learner cognition paradigm that maintains that how learners perceive and react to their learning tasks and classroom instruction may be more important in influencing learner outcomes than the observed quality of teaching behaviours (Knight & Waxman, 1991; Winne & Marx, 1977; 1982; Wittrock, 1986). Learner perceptions of the learning environment are essential for understanding the opportunities for learning that are provided to each learner in class (Fraser, 1990). In other words, this paradigm assumes that better understanding and improvement of teaching and learning can emerge by examining the way that classroom instruction and the learning environment are viewed or interpreted by the learners, because learners ultimately react using their perceptions of what is important (Chavez, 1984; Schultz, 1979).

Teachers' working conditions affect their ability to provide quality education. This includes aspects of school life and educational policy which go into teachers' perception of their employment, such as teacher salaries which have drastically declined in recent years (Postlewaite, 1998). The condition of infrastructure, availability of textbooks, learning materials and class sizes all influence teachers' experience as an educator. Low and late remuneration lead to teachers taking other jobs and this is not good for learners. Effective teachers who are committed and care about their learners need supportive working conditions to maintain these positive attitudes (Willms, 2000).

Teacher's belief that all learners can learn is an important factor that relates to school priorities and expectations. This is evident the way time is used to provide quality education with an understanding that learners are at the centre of the learning process. Learner achievement is the school's number one priority. Teachers believe in the school's ability to help all learners. Research has shown that low expectation for learner achievement permeates educational systems (UNICEF, 2000, p. 16). Schools committed to learners learning communicate expectations clearly and give frequent and challenging assignments, monitor performance regularly and give learners an opportunity to participate and take responsibility of their learning (Cotton, 1988; Craig, Kraft, & du Plessis, 1998)

The study conducted by Zuzovsky (2004) found that the relationship between professional development opportunities and the achievement of learners often differs owing to the learners' academic aspirations. Learners who are highly motivated usually are less sensitive to teachers' input as they tend to manage on their own. But, learners who have low academic aspirations usually require more focus on the content that teachers teach and cannot readily be replaced by instructional strategies. Also, there is a positive relationship between content-focused professional development activities and learner achievement. Thus for mathematics teachers, this argument supports policy interventions aimed at providing more opportunities.

2.3.8 Class Size

Literature on class size has been widely debated and a good deal of research has appeared but controversies have also arisen about the research findings (Betts, 1996; Biddle & Berliner, 2002, Howie, 2006). There is contradiction or confusion in the literature about the concepts 'class size' and 'pupil teacher ratio'. The confusion is that they are used to mean the same thing, yet they have a different meaning. Michel and Rothstein (2002) have tried to differentiate the meaning between the two concepts.

Class size refers to the specific number of learners enrolled in a particular teacher's classroom. Pupil-teacher ratio refers to the total number of learners enrolled in a school divided by all of the teachers in the school. A school's librarian, the vice principal and principal, and teachers who provide support outside a classroom for learners facing challenges also count as teachers for the purpose of determining the pupil-teacher ratio of a school. This means that there is a great difference between the number of learners a teacher instructs each day (class size) and the total number of learners in a school divided by the total number of teachers working in the school (Michel & Rothstein, 2002).

Researchers, (The National Council of Teachers of English, (NCTE), 1999; Cohen, Manion & Morrison, 2000; 2007; Finn, Gerber & Boyd-Zaharias, 2004), argue that learner achievement increases significantly in classes of fewer than 20. Smaller classes, complemented by diverse teaching methods, create better learner performance, a more positive attitude, and fewer discipline problems. Furthermore, the NCTE (1999) recommends that by reducing the class size and workload, hiring qualified professional teachers and providing strong professional development will assist in increasing learner achievement in mathematics. However, Schmidt and Kifer (1989), Jansen (1998) and Walberg (1984) argue that making classes smaller to produce better instruction for learners, who have not done well, does not necessarily have the desired effects. Learners in such classes still lag behind.

As the number of learners in a classroom increases, the potential of problems associated with discipline grows exponentially. When there are only two learners in a classroom, there are only two interpersonal transactions possible. When one additional learner is added, there are six transactions possible. As the number of transactions or interactions increases, classroom instruction and management functions become more complex and demanding. Teachers become more restrictive, inducting learners into routines that minimise management problems and then gradually relinquishing control as learners demonstrate responsible behaviour, and progressively build pride and self-confidence in learners as they achieve greater self-discipline (Antonijevic, 2007; Froyen, 1988; Thomson, 2007).

Class size and class space are inseparable issues when discussing the practical level of the classroom. Classrooms that were actually built for 20 to 25 or 30 to 35 learners now have more learners assigned to this space, and teachers find their creativity curtailed because so many non-traditional instructional formats require more space. Co-operative learning activities, such as team projects, simulated games, learning centres, and role-playing all require configurations of space that are difficult to create as class size increases. Furthermore, with not only the class sizes increasing and the space per pupil decreasing, teachers also have to contend with greater differences among learners. Increased racial and cultural diversity in the classroom, coupled with the mainstreaming of handicapped learners has increased the demands for effective classroom management (Froyen, 1988; Schelfhout et. al., 2007; Thomson, 2007).

Class size has an influence on the effectiveness of the teacher-learner interactions that take place during the classroom activities. Furthermore, small class sizes are advantageous to maximizing the effective implementation of the intended curriculum (Antonijevic, 2007; Werry, 1989;Pate-Bain, Fulton, & Boyd-Zaharias, 1999).A survey conducted by UNICEF/UNESCO in 1995 in 14 least developed countries found that class size ranged from fewer than 30 learners in rural and urban areas but in developing countries there is evidence of large class sizes which range at 73 or 118 learners (Postlewaite, 1998; Werry, 1998).Many studies have a relationship that class size has not consistently been linked to learner achievement (Odden, 1990;Pate-Bain et al., 1999; Rutter, 1979; Werry, 1998; Wilms, 2000).

2.4 CONCEPTUAL FRAMEWORK

The aim of this study is to explore and compare the key classroom level factors affecting mathematics achievement between South African learners and Australian learners using TIMSS. The study used the model by Travers, & Westbury (1989), Figure 2.2, which was integrated with the model of the comprehensive education system by Shavelson, McDonnell, & Oakes (1987, p. 14), Figure 2.3, which describes the teacher and learner interactions and finally present the adapted model for this study, Figure 2.4. The reason for using these two models is that it will be relevant to the context and components of the education system for both South Africa and Australia. The adapted model will be able to respond to the research questions. The two models describe the factors related to school interactions within the comprehensive education system with regard to inputs – process– outputs - outcome.

2.4.1 IEA'S RESEARCH STUDY MODEL (TRAVERS, GARDEN & ROSIER, 1989)

The first model is the summary of the generic IEA conceptual framework; see Figure 2.1. The curriculum at each level is influenced by the context in which it occurs and the contexts are determined by the number of antecedent conditions and factors (Travers, Garden & Rosier, 1989). The arrows depict in a general way, the direction of expected effects. It is recognised that in a causal model the networks of relationships would be more complex.

In this model, the curricular are examined at the system level (intended curricula), school/classroom level (implemented curricula) and on the individual learner level (attained curricula). Curricular antecedents (such as background characteristics and school and home resources) can be investigated in relation to curricular contexts to predict curricula content outcomes.

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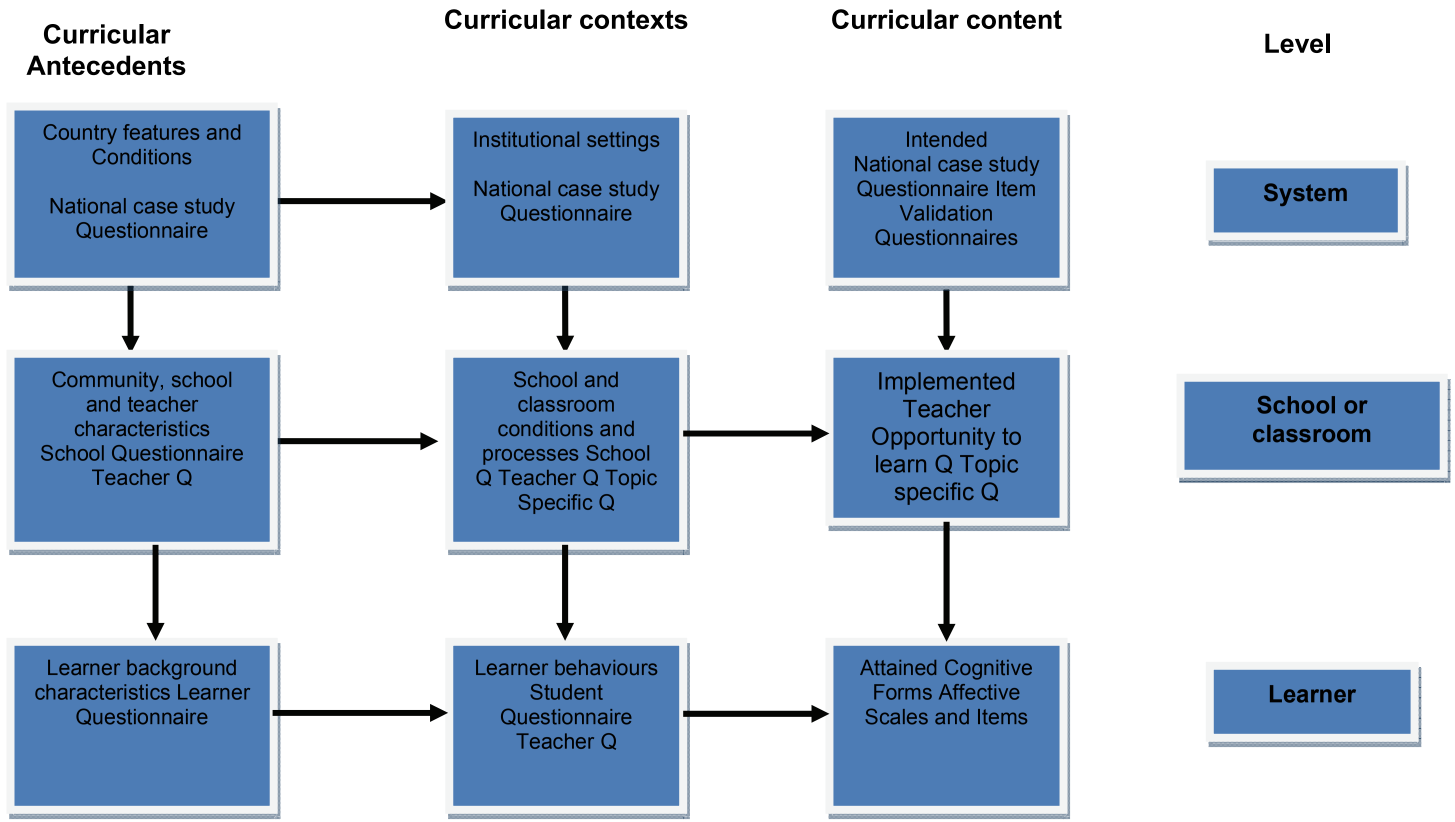

Figure 2.2 Model of an IEA Research Study (Travers, Garden & Rosier, 1989, p. 5)

2.4.2 ELEMENTS OF THE EDUCATION SYSTEM MODEL (SHAVELSON, MCDONNELL AND OAKES, 1987)

Figure 2.2 depicts the second model derived by Shavelson, McDonnell and Oakes (1987). This model is developed to illustrate the linkages of the different elements of the education system and relate to social indicators.

The model's *inputs* are the human and financial resources available to education; the *processes* are what is taught and how it is taught; and the *outputs* are the consequences of schooling for learners from different backgrounds Shavelson et al., 1987). The multilevel nested depiction of schooling places the teacher and learner classroom interaction at the centre. It is only what happens at the teacher – learner level is directly related to learner learning. Furthermore, McPartland and Becker (1985) argue that what happens at teacher - learner level is influenced by what happens at all other levels of the system.

The model identifies major domains and suggests how these elements are likely to be logically or empirically related. The following are the major domains of the educational system: fiscal and other resources, teacher quality, learner background, school quality, curriculum quality, teaching quality, instructional quality, achievement, participation and attitudes and aspiration (Shavelson et al., 1987, p 17).

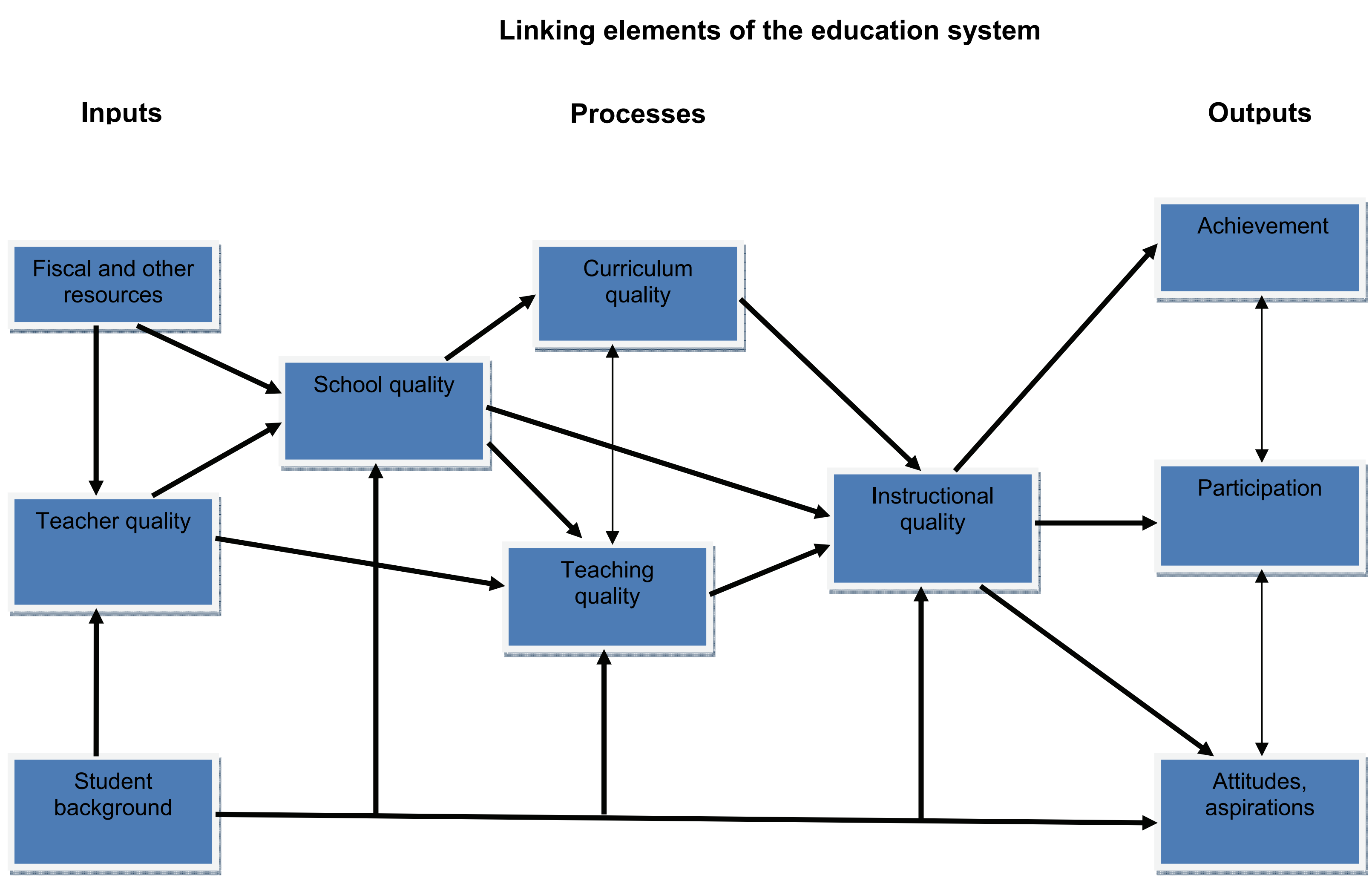

Figure 2.3 A comprehensive model of the educational system (Shavelson et al., 1987, p. 14)

2.4.3 ADAPTED MODEL FOR THE STUDY

The adapted model in Figure 2.4 has identified a possible relationship between the elements of the education system and a number of elements have been added and adapted in the original model of Shavelson et al., (1987). The adapted model presents the education system in terms of inputs, processes and outputs. In the adapted model, the *inputs* are depicted in terms of policy as well as *antecedents*.

Among the studies conducted to date, few secondary analysis studies have been conducted to uncover the factors which influence mathematics achievement even though large scale data is available for this purpose. In addition, there is no comparative study conducted using TIMSS data. The study conducted by Howie (2002) focused on all three levels, school, classroom and learner. In addition, the studies done by Howie (2002); Moloi & Strauss (2005); Shavelson et al., (1987); Reddy (2006) did not focus on classroom factors but on broader issues or factors (school, teacher, home, learners, etc.) affecting mathematics achievements. This study is different from other studies in that its focus is specifically on the teacher in the classroom.

There are many important variables influencing the learner achievement in the classroom, but the focus of this study will be to explore and investigate the main classroom factors influencing achievement in mathematics. Therefore the framework only covers classroom variables in terms of input (intended curriculum), process (implemented curriculum) and output (attained curriculum), (Howie, 2002; Shavelson et al., 1987; Travers et al., 1989. Travers & Westbury, 1989).

The following depicts the elements of educational system for the adapted conceptual framework for the study.

Table 2.1 Elements of education system for the adapted conceptual framework

Elements	Description
National, Provincial, local context, education policies & system	This refers to the education policy documents on national, provincial and local level that has an impact on what learners are supposed to learn, that is in the intended curricula

Learner characteristics	**Learner Characteristics** refers to age, gender, race/ ethnicity, attitudes, experience, beliefs, hours at school the textbooks and the materials that learners select and use (Howie, 2002,Schmidt & Kifer, 1989)
Intended curriculum	**Intended curricula** refer to curricular documents and how these give prescriptions for distribution of emphasis across Mathematics as a subject and cognitive domains (Howie, 2002; Martin & Mullis, 2006; Travers, Garden, & Rosier, 1989).
Teacher characteristics	**Teacher Characteristics** refers to age, gender, race/ ethnicity, attitudes, experience, beliefs, teacher education (qualifications, school graduation), training, bachelors or higher, hours worked per week (Howie, 2002,Schmidt & Kifer, 1989)
Classroom quality	**Classroom process** refers to maintenance of discipline, organizing learning, character building, conflict resolution, counselling etc; teacher establishes and maintains conditions that enable learners to learn efficiently, share the experiences with learners' discoveries, strategies to improve the teaching-learning processes, real life problems (Howie, 2002).
Teaching requirements	***Teaching requirements*** refers mainly to teaching load, class size, demands on time, and teachers' perceptions of working conditions, autonomy and collegiality (Howie, 2002)
Implemented curriculum	***Implemented curriculum*** refers to what is actually taught by teachers in practice in the classroom and the emphasis is given to the different aspects, as opposed to what is supposed to be taught as laid down by policy. It is a result of a number of components (Howie, 2002; Martin & Mullis, 2006; Travers et al., 1989)
Curriculum quality	***Curriculum quality*** refers to the "what" of Mathematics education. This element covers not only the contents, topics, processes and skills that learners learn, but also the breadth and depth of the contents of that is taught, the way the teachers organise, sequence and present it (lesson planning), time on task, and the textbooks and the materials that teachers select and use (Howie, 2002).
Instructional quality	***Instructional quality*** refers to the "how" of Mathematics education and is supposed to be determined by all other factors at this level. It consists of policies, practices and social climate in the Mathematics classes. It also refers to the interaction of teachers and learners within the classroom, language of learning, group work, opportunity to learn, assessment, homework, etc. (Howie, 2002).
Learner achievement	Learner achievement refers to learner's performance in a subject area, in this case the achievement in mathematics (Howie, 2002; Martin & Mullis, 2006; Travers et al., 1989). .

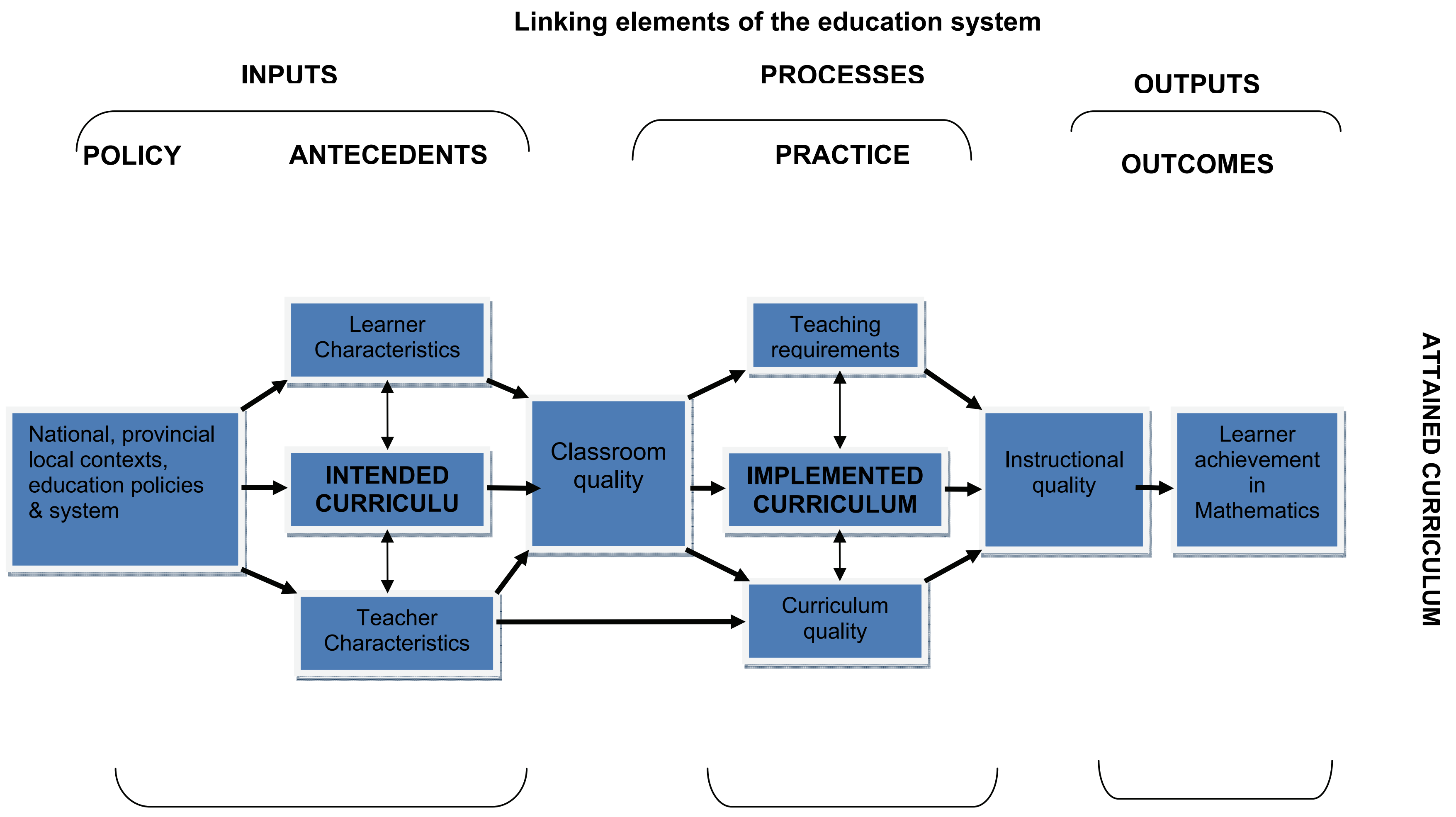

Figure 2.4: Classroom factors related to Mathematics achievement (Adapted from Shavelson et al., 1987, p. 14)

2.5 CONCLUSION

School Effectiveness Movement started in the developed countries in the 1960s with the Coleman Report (Coleman et al., 1966) especially in the United State and United Kingdom. There are three distinct but related branches of school effectiveness research, namely, school effects, effective school research, and school improvement research. Both reviewers and researchers in school effectiveness research come up with lists of factors affecting school effectiveness as well as lists for implementing school improvement initiatives. Similarly in developing countries school effectiveness date back to 1970s modelled on the methodologies of the Coleman Report (Coleman et al., 1966). In 1980s empirical studies were exclusively financed by the World Bank to identify which school factors were stronger determinants of academic achievement and better cost-effective investments. School effectiveness in developing countries was driven by the concept of production function research which looks at the relationship between student academic achievement and school spending. Fuller and Clarke (1994) concluded that three major areas consistent with school effect emerged, firstly availability of textbooks, secondly supplementary reading materials; and teacher qualities, and thirdly, instructional time. Hanushek (1995) suggested that “there are no clear and systematic relationship between key inputs and student performance”. School effectiveness assists the study with regard to identifying classroom level factors affecting learner achievement in mathematics.

The literature on classroom level factors indicates that some of the selected factors could be directly related to the learner achievements in mathematics. These factors include teacher quality, time on task, and instructional strategies. Other factors could not be directly linked to the learner achievement. These factors include class size, homework, learning environment, monitoring strategies, et cetera. The conceptual framework for this study is adapted from the two models of Shavelson et al., 1987 and Travers and Westbury (1998). The conceptual framework covers classroom level variables in terms of inputs (intended curriculum), processes (implemented curriculum) and outputs and outcomes (attained curriculum). The following chapter describes the research design and the methodology adopted in order to answer the research questions.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

The research approach used for this study is a quantitative approach. Quantitative research is defined as a formal, objective, systematic process in which numerical data are used to obtain information about the world (Cohen, Manion & Morrison, 2000, 2007; Pietersen & Maree, 2010; Trochim, 2001) and this research approach is used to describe variables and examine relationships among variables. This study is a secondary analysis of the TIMSS 2003 data for South Africa and Australia using both descriptive and inferential statistics. Descriptive statistics is a collective name for a number of statistical methods which are used to describe, organise and summarise data in a more meaningful way. This included frequency tables, histogram, describing trends, comparing and relating variables (Cohen, Manion & Morrison, 2007; Creswell, 2005; Maree & Pietersen, 2007). Inferential statistics goes beyond describing the characteristics of data and the examination of correlations between variables. It produces predictions through inferences, based on data analysed and it also tests statistically based hypotheses (Walliman, 2005, p. 305). For the purpose of this study, analysis was performed using the Statistical Package for Social Sciences (SPSS) software which applies statistical formulae and carries out computations (Cohen et al., 2007; Field, 2009; Maree & Pietersen, 2007; Weinberg & Abramowitz, 2008).

The main research question addressed in this study is "*What are the key classroom level factors that influence learner performance in mathematics?"*

This question examines the classroom level factors that influence learner performance in mathematics between the two countries, South Africa and Australia. It takes into account the classroom processes and the teacher characteristics as the main contributing factors to learner performance. Based on this research question, a number of sub-questions were identified namely:

- *What key variables on classroom level are related to learner achievement in mathematics for South Africa?*
- *What key variables on classroom level are related to learner achievement in mathematics for Australia?*

The first and the second questions refer to the attained curriculum which is defined as the outcomes of schooling in mathematics and which factors need to be considered when interpreting achievement as identified from literature. What learners have learned inside the classroom is influenced by what mathematics learners are expected to learn and study (the intended curriculum) and by the opportunities that were made available to them (the implemented curriculum).

- *How does the classroom level factors in mathematics performance of South Africa compare with classroom level factors in Australia?*

The third question compares the results from South Africa and Australia to see if there are any common factors as well as which factors differ. This looked at the results of multiple regression and literature taking into consideration the contextual factors for each country.

After introducing the research design, the rationale for the research design is presented in Section 3.2. In Section 3.3 the methodology used in the study is explored; 3.4 briefly discuss the data collection methods; and Section 3.5 discusses the data analysis methods. The procedure followed to conduct the study is discussed in Section 3.6, and in Section 3.7 methodological norms are explored. In Section 3.8 ethical considerations in relation to this study are discussed. Finally, in Section 3.9, limitations of the study are stated. 3.10 provides a short conclusion of the chapter.

3.2 RESEARCH DESIGN

Research design is an overall plan that the research uses in conducting the study, the design is constituted by several components (Stone-Romero, 2009, p.303).

3.2.1 Research paradigm

The post-positivist research paradigm focuses on establishing and searching for evidence that is valid and reliable in terms of existence of phenomena rather than generalisation (Nieuwenhuis, 2007, p. 47). The post-positivist paradigm addresses the shortcomings of positivist paradigm; it situates itself between the positivist (naïve realism that reality is both real and apprehendable) and constructivist (maintains that meaning is generated by individuals and groups) ontologies which are irreconcilable (Cupchik 2001; Lincoln & Guba, 2005). Table 3.1 illustrates the essential characteristics of positivist, post-positivist and constructivism paradigms.

Table 3.1 Essential characteristics of positivist, post-positivist and constructivism paradigms

Paradigm	Epistemology	Ontology	Methodology	Nature of knowledge
Positivist	*Dualism* Takes an outsider position/objectivist Researcher can be objective	Single Reality exists and can be predicted	Deductive, mostly experimental manipulative methods verification of hypotheses quantitative	Verified hypotheses established as facts or laws
Post- Positivist	*Modified Dualism* Takes an outsider position/objectivist	Multiple realities, Critical realism	Deductive, modified experimental, manipulative, critical multiplism, falsification of hypotheses	Non-falsified hypotheses that are probable facts or laws
Constructivis t	*Relativism* Takes an insider position/subjectivis t	Multiple constructe d realities	Hermeneutic/Dialecti c	Individual/ collective reconstruction s

Source: Guba & Lincoln (2005, p. 193); Cohen et al. (2007, p. 9)

The difference between the positivist and post-positivism paradigms is that the positivist is satisfied that there is a reality to be studied, captured, and understood whereas the post-positivist argues that reality can never be fully apprehended, only approximated (Guba, 1990, p. 22). Post-positivism relies on multiple methods as a way of capturing realities. It emphasises the discovery and verification of theories (Denzin & Lincoln, 2008, p.14). In this study, multiple methods of data analysis were used to understand the key factors related to South African learner performance. The reality of factors affecting learner performance cannot be fully apprehended but approximated. These factors are interdependent with each other in one way or another. In addition, the post-positivism paradigm allows the use of methodologies which are purely quantitative and decontextualised (Coryn, 2004; Guba & Lincoln, 1994; 2005; Mertens, 2003).

3.2.2 Research Method

Survey research design is a very valuable tool for assessing attitudes, opinions and trends especially as these are phenomenon that cannot be directly observed. Survey research is a powerful research method and is very often associated with large scale research (Cohen et al., 2007, p. 501). Survey research falls within a post-positivism paradigm which contributes to and defines the true nature of the world which means that the inquiry has predictable patterns and formulas.

TIMSS 2003 data were collected using survey research, which is a research method associated with post-positivism. Survey research is a method used to collect information from a sample of individuals in a systematic way. Survey research is always based on a sample of the population and the success of the research is dependent on the representativeness of the population. Survey research has three distinguishing characteristics; firstly, a survey is used to quantitatively describe specific aspects of a given population. This involves examining relationships among variables. Secondly, the data required for survey research are collected from people and are subjective in nature. Thirdly, survey research uses a selected portion of the population from which the findings can later be generalised to the broader population (Glasow, 2005, p.1). Survey research is used to describe and explain the status of the phenomena, to trace, change and to draw comparisons (McMillan & Schumaker, 2001; Pinsonneault & Kraemer, 1993). The typical characteristics of survey research include the following: firstly, samples are usually big to allow for inferential statistics to be applied; secondly, many variables are measured and multiple hypotheses are tested (Maree & Pietersen, 2007, p. 155).

There are two basic types of survey: cross-sectional and longitudinal surveys (Babbie, 1973; Maree & Pietersen, 2007). Cross-sectional surveys are used to gather information on a population at a single point in time. Longitudinal surveys gather data over a period of time. The researcher then analyses changes in the population to describe or explain the changes. There are three main methods of longitudinal surveys which are trend and focus on a particular population sampled and studied more than once; however, cohort studies have a different focus. Lastly, panel studies allow the researcher to find out why changes in the population are occurring, since the researcher uses the same sample of people every time (Babbie, 1973; De Vaus, 2002; McArt & McDougal, 1985).

Survey research involves the following techniques for data collection namely structured or semi-structured interviews, questionnaires, telephone interviews, internet surveys, standardised tests of attainment or performance, and attitudes scales. Survey research proceeds through well defined stages with four main considerations in its planning. Firstly, problem definition: deciding what kind of answers are required, what variables to explore. Secondly, sample selection: what is the target population, how can access be assured, what other samples will need to be drawn for the purpose of comparison. Thirdly, design measurements: what will be measured, and how will reliability and validity be assured, and fourthly, concern for participants, ensure confidentiality and anonymity (De Vaus, 2002; Krosnick, 1999; McArt & McDougal, 1985).

The following are some of the advantages of survey research, firstly it is relatively inexpensive (especially self-administered surveys), secondly, it can be administered quickly and faster from remote locations using mail, email or telephone, thirdly, very large samples are feasible, fourthly, make results statistically significant even when analysing multiple variables, and fifthly, standardized questions make measurement more precise by enforcing uniform definitions upon the participants as well as ensuring that similar data can be collected from groups then interpreted comparatively. The main weakness of a survey is that it is inflexible in the sense that survey requires the initial study design of the tool and administration remain unchanged throughout the data collection (McArt & McDougal, 1985; De Vaus, 2002).

3.2.3 Secondary Analysis

Secondary analysis of the survey data, organised in a numeric form, allows for new findings to be generated from the old data such as comparing the classroom level factors (multiple realities) from both South Africa and Australia. Secondary analysis is when the researcher analyses data which was collected by another researcher that is analysing existing data. In this case, the TIMSS data collected by researchers in Australia and South Africa was used. By using secondary analysis, the researcher explores areas of interest without having to go through the process of collecting data in the field (Babbie & Mouton, 2001; De Vaus, 2002; McCaston, 1998; McArt & McDougal, 1985). According to Glass (1976), secondary analysis is the re-analysis of data for the purpose of answering the original research questions with better statistical techniques or answering new questions with old data. In this study, with conducting a secondary analysis, the researcher was able to address new research questions using the existing data.

Secondary analysis has several advantages. For example, it is extremely difficult to obtain samples that are sufficiently large and representative for analysis. It is also difficult to find good data for the whole nation which has been collected over a period of time from different countries (Mouton, 2001; De Vaus, 2002). The purpose of this secondary data analysis study is to improve and deepen understanding of the classroom level factors affecting mathematics achievement particularly in South Africa and Australia. The approach used in the study is the comparison of two countries as a sub-sample of the larger group (original research TIMSS 2003). The two countries selected are South Africa and Australia (as discussed in Chapter 1), a developing and a developed country respectively. The reason to compare South Africa and Australia is that Australia has been consistent in achieving good results that are above the international average in mathematics and has done so over a number of years, 1995, 1999 and 2003 but South Africa performed poorly, yet the conditions between the two countries are almost similar as elaborated on in Chapter 1. Furthermore, South Africa and Australia experience similar socio-economic conditions regarding population and language diversity in addition to employing similar education philosophies.

There are some advantages for conducting secondary data analysis; firstly, it is that secondary data offers the researcher an opportunity to access good quality data in relatively less cost and time (McArt & McDougal, 1985; De Vaus, 2002). Secondly, secondary data is preferred due to its convenience and reliability. Thirdly, it also provides an opportunity to conduct sub-group analysis from large sample data. Re-analysis of data offers new interpretations as it is more focussed and allows more time for data analysis (Bryman, 2004, p. 200).

3.3 RESEARCH METHODOLOGY

In this quantitative research study, the TIMSS 2003 data was collected by the IEA which used a survey research method which seeks, among others, to explore relationships and patterns through factors, reliability, correlation, multiple regression (Cohen, 2007, p. 207). The study used a longitudinal survey which collected the data over time that is in 1995, 1999, 2003 and 2007. This allowed for studies of trend which focused on a particular population which is Grade 8 learners. This study is a comparative study between South Africa and Australia as both countries participated in the TIMSS 2003 Grade 8 mathematics study.

McMillan and Schumacher (2001, p. 602) define survey research as “the assessment of the current status, opinions, beliefs and attitudes for a known population”, whereas Cohen (2001, p. 169) assert that surveys “set out to describe and to interpret what is”. Although surveys are usually conducted by means of questionnaires, information can be obtained in a number of ways including interviews, telephone calls and observations.

3.3.1 Population and sampling

The sample includes teachers of learners who were selected to participate in the TIMSS 2003 study for South Africa and Australia. The intended target population is teachers of all learners at the end of their eight year of formal schooling in South Africa and Australia. This is the grade that contains the largest proportion of the 13 year old learners at the time of testing.

Table 3.2 School Participation & Sample Sizes for Grade 8 mathematics

Country	Schools in Original Sample	Eligible schools in original Sample	Schools in Original Sample that Participated	Replacement Schools that Participated	Total no of schools that Participated
South Africa	265	265	241	14	255
Australia	230	226	186	21	207

Source: Joncas (2004, p.212)

Coverage and exclusion: Coverage for South Africa was 100%, and school-level exclusion consisted of special education schools and very small schools (less than 12 eligible learners**).** Stratification was done by a total of nine provinces, and languages (English, Afrikaans, mixed). For Australia, the coverage was 100%, and school-level exclusions consisted of special education schools, hospital schools, schools with radically different curricula, remote schools in the Northern Territory, and very small schools (less than five eligible learners). Stratification occurred with a total of eight States and Territories and school type (Government, Catholic, and Independent).

Table 3.3 Learner Participation Rates & Sample Sizes, mathematics Grade 8

Countries	Within – School Learner Participation (Weighted %)	Sampled learners	Learners withdrawn from class/ school	Learners excluded	Eligible learners	Learners absent	Learners assessed
South Africa	92%	9905	320	0	9585	633	8952
Australia	93%	5286	60	16	5210	419	4791

Source: Joncas (2004, p.198)

Tables 3.2 and 3.3 summarise the number of schools and learners in South Africa and Australia, the target populations, as well as the number of sampled schools and learners that participated in the study. The estimated size closely matched the actual population size from the sampling frame as shown in the tables (Joncas, 2004, p.198).

The international sample design for TIMSS 2003 is a two stage stratified cluster sample design. Stratification is the grouping of sampling units (schools) in the sampling frame according to some attributes or variables (states, provinces, school type, and rural or urban) prior to drawing the sample (Babbie & Mouton, 2001; Foy & Joncas, 2004). Stratification is generally used for the following reasons:

- To improve the efficiency of the sample design, making survey more reliable.
- To apply different sample designs or disproportionate sample size allocations to specific groups of schools.
- To ensure adequate representation in the sample of specific groups from the target population.

The first stage consists of a sample of schools, which is stratified and the second stage consists of a sample of one or more classrooms from the target grade in sampled schools. TIMSS 2003 prefers to sample intact classrooms because that allows the simplest link between learners and teachers (Babbie & Mouton, 2001; Foy & Joncas, 2004).

The first sampling stage

The sample selection method used for the first sampling stage in TIMSS makes use of a systematic probability – proportional-to-size (PPS) technique. Schools are sampled according to the number of learners in the school in the target grade. The benefits of this selection method are that it is easy to implement and that it is easy to verify that it was implemented properly (Babbie & Mouton, 2001; Foy & Joncas, 2004).

The second sampling stage

The second sampling stage in the TIMSS international design consisted of selecting classrooms in sampled schools. As a rule, one classroom per school was sampled, although some participants opted to sample two classrooms in order to meet the minimum requirement of 4 000 sampled learners. Classrooms were selected with equal probabilities. The minimum cluster size was set at 30 learners; any classroom with fewer than 15 learners was combined with another. The resulting pseudo-classroom then constituted a sampling unit.

TIMSS 2003 used a sample design and procedure that ensured effective and efficient sampling of the learner populations in each participating country. To be acceptable for TIMSS 2003, national sample designs had to result in probability samples that gave accurate weighted estimates of population parameters, such as means and percentages. The design was simple and easy to implement while yielding accurate and efficient samples of school and learners (Foy & Joncas, 2004, p. 109). The international project team provided software, manuals and expert advice to assist the National Research Coordinator (NRC) to adapt the TIMSS sample design to the national system.

All schools and learners in the desired population not included in the defined population were excluded population. Exclusion from the international desired population was clearly documented. Exclusion took place at national coverage, school level and within schools. Schools were excluded from the sampling frame based on the following reasons: geographic remote region; extremely small size; curriculum different from the main stream education system; and instruction only to learners in the categories defined as within school exclusion (Foy & Joncas, 2004; Gonzalez et al., 2004). The final sample that the researcher worked with in this study for South Africa was 255 schools and 8952 learners, and for Australia was 207 schools and 4791 learners (Joncas, 2004, p.198).

3.3.2 Instruments

3.3.2.1 Assessment Instruments

South Africa and Australia, as participating countries in the TIMSS 2003 study, were responsible for carrying out all aspects of the data collection, using standardised procedures developed for the study. The data collection instruments were developed and prepared in English by TIMSS with contributions from the National Research Coordinators (NRCs) of participating countries (Chrostowski & Malak, 2004, p. 93). The assessment instruments were translated by the participating countries into their local languages of instruction. The translation process was to ensure that the national language and cultural context is taken into consideration, so that the instrument would be standardised across countries. The translated instruments went through a vigorous process of translation verification and review to ensure accuracy and international comparability. Translated instruments for each country were checked by independent verifiers against the TIMSS 2003 international version. Australia adapted the full set of instruments from the international English version whilst South Africa specifications was to adapt full sets of instruments from the international English and translated into Afrikaans versions (Chrostowski & Malak, 2004, p. 94).

The process of the development of the TIMSS mathematics assessment was a collaborative process involving educators and development specialists from all over the world (Martin & Mullis, 2004). Central to this was the update and revision of the existing TIMSS framework to address changes in curricula and the way mathematics is taught. Tables 3.4 and 3.5 depict the Content and Cognitive Domains of the Mathematics Frameworks for Mathematics TIMSS 2003 eighth grade:

Table 3.4 Distributions of mathematics Items by Content Domain (Eighth Grade)

Content Domain	Percentage of Items	Total Number of Items	Number of Multiple Choice Items	Number of Constructed-Response Items	Number of Score Points
Number	30	57	43	14	60
Algebra	24	47	29	18	53
Measurement	16	31	19	12	34
Geometry	16	31	22	9	34
Data	14	28	15	13	34
Total	**100**	**194**	**128**	**66**	**215**

Source: Mullis et al., (2004, p. 342)

Table 3.5 Distributions of mathematics Items by Cognitive Domain (Eighth Grade)

Cognitive Domain	Percentage of Items	Total No of Items	Multiple Choice Items	Constructed-response Items	Score Points
Knowing Facts and Procedures	23	45	35	10	45
Using Concepts	19	37	31	6	39
Solving Routine Problems	36	70	43	27	76
Reasoning	22	42	19	23	55
Total	**100**	**194**	**128**	**66**	**215**

Source: Mullis et al., (2004, p. 342)

TIMSS 2003, as in the 1995 and 1999 assessments, used a matrix-sampling technique that assigns each assessment item to one of a set of item blocks, and then assembles learner test booklets by combining the item blocks according to a balanced design (Martin & Mullis, 2004). Each learner was given a booklet containing both mathematics and science items. Thus, the same learners participated in both the mathematics and science testing.

In the TIMSS 2003 assessment design, the 194 eighth-grade items were divided among 28 blocks at each grade, 14 mathematics blocks labelled M01 through to M14. Each block contained either mathematics items or science items only. The assessment time for eighth grade was 90 minutes (six 15 minute blocks). The booklet was organised into Parts I and II. The 2003 assessment was the first TIMSS assessment in which calculators were allowed to be used (Martin & Mullis, 2004).

3.3.2.2 Background questionnaires

It is important to know the context in which learners learn in order to understand the factors affecting learner performance in mathematics. Background questionnaires were based on the contextual assessment framework and specification of TIMSS 2003. Four types of background questionnaires were used in TIMSS 2003 to collect information at different levels of the education system, and included the school questionnaire, the teacher questionnaire, the learner questionnaire and the curriculum questionnaire. The questionnaires are briefly discussed below:

The school principal of each school sampled for the study completed **the school questionnaire**. It was designed to collect information about the school contexts for the teaching and learning of mathematics. This information concerns some major factors that influence learner achievement in mathematics. It was designed to be completed in 30 minutes.

The learner questionnaire collected information about learners' home background, resources for learning and their experiences, attitudes in learning mathematics. The questionnaire was designed to gather information on some of the major factors thought to influence learner achievement in mathematics. It was designed to take about 30 minutes to complete.

The curriculum questionnaire addressed issues related to the intended national curriculum in mathematics. This questionnaire was addressed to National Research Coordinators, who were asked to supply information about their nations' mathematics curricula in Grade 8. The curriculum questionnaire was designed to collect basic information about organisation and support for the intended mathematics curriculum.

The teacher questionnaire is the focus of the study and is thus discussed in more detail and asked teachers information related to preparation and professional development, pedagogical activities and the implementation of the curriculum. For each sampled school, a single mathematics class was sampled for the TIMSS 2003 assessment. The mathematics teacher of that class was asked to complete a mathematics teacher questionnaire. The teacher questionnaire was designed to take about 45 minutes to complete.

For the purpose of this study, the teacher questionnaire was explored in detail. The teacher questionnaire was designed to gather information about the classroom contexts for the teaching and learning of mathematics. For each participating school, a single mathematics class was sampled for the TIMSS 2003 assessment. The mathematics teacher of the selected class was asked to complete a mathematics questionnaire. These collected information about the teachers' preparation and professional development, their pedagogical activities, and the implemented curriculum (Martin et al., 2004, p. 12).

Some of the primary questions addressed in the teacher questionnaire were:

- What is teachers' educational background, and do they have a teaching licence or certificate?
- How many years of pre-service teacher training did teachers have, and how many years have they been teaching?
- How ready do teachers feel they are to teach various topics at the target grade?
- In what types of professional development have teachers participated?
- What is the teaching load of teachers, and how do they spend their time both during and outside the formal school day?
- What are teachers' attitudes towards teaching the subject matter, and their perceptions regarding school climate and school safety?

The teacher questionnaire was designed to take about 45 minutes to complete. Most school co-ordinators reported that teachers completed their questionnaires during the testing session. Almost half of the school co-ordinators indicated that the estimate of 60 minutes to complete the questionnaire was accurate. Eleven percent reported that the questionnaire took longer and about 26% took less time to complete.

The assignment of teacher questionnaires was based on participating learners; teacher responses do not necessarily represent all of the teachers of the Grade 8 in South Africa or in Australia. However, they represent teachers of the representative samples of learners assessed. The teacher questionnaire was divided into two sections: Section A asked about teacher's general background and Section B asked class-specific questions about instructional practices. The information about instruction was directly tied to the learners tested and the specific mathematics classes in which they were taught.

3.4 DATA COLLECTION

South Africa and Australia were responsible for carrying out all aspects of the data collection, using standardised procedures developed for the study. Training manuals were created for school coordinators and test administrators that explained procedures for receipt and distribution of materials as well as for the activities related to the testing sessions (Mullis et al., 2003; Martin & Mullis, 2004). Each country was responsible for conducting quality control procedures and this is described in the National Research Coordinator's report documenting procedures used in the study. International quality control monitors were trained and observed testing sessions and conducted interviews with the National Research Coordinators in each country, South Africa and Australia. The reason for participation of quality control monitors are to quality assure the process of data collection (testing, interviews, and data capturing).

The data collection in South Africa and Australia for TIMSS 2003 was conducted in October-December 2002 as both countries are located in the Southern Hemisphere. The data collection was administered at the eighth grade. This helped to assess countries' comparative standing and gauge the effectiveness of the mathematics programmes (Mullis et al., 2004). The mathematics teachers of sampled learners responded to questions about teaching emphasis on the topics in the curriculum frameworks, instructional practices, professional training and education and their views on mathematics (Martin et al., 2004, p.12)

3.5 DATA ANALYSIS

Data analysis entailed breaking down data into constituent parts to obtain answers to research questions and to test research hypotheses (Creswell, 2005; Field, 2009). The Statistical Package for the Social Sciences (SPSS) software was used to analyse the data. The study was a secondary data analysis; questionnaire data was available electronically in data editor. The variable viewer enables the researcher to define and view the different fields or variables and the data viewer allows viewing of the data for each variable. Data were analysed using the analysis option, then a number of different analysis options can be chosen from the menu. The results of performing analysis create outputs (Bryman, 2004; Field, 2009; Pallant, 2007). The statistical procedures for analysis used in this study are 3.5.1 descriptive statistics, 3.5.2 factor analysis 3.5.3 reliability analysis, 3.5.4 correlation analysis, and 3.5.5 multiple regression. The following is a brief description of each statistical procedure:

3.5.1 Descriptive Statistics

In analysing the data, a descriptive statistical procedure was used. The reason for using the descriptive statistics was to explore, describe, compare and summarise observations in the data with regard to classroom factors affecting mathematics achievement (Bryman, 2004; Creswell, 2005; Jansen, 2010; Lewin, 2011; Pietersen & Maree, 2007c; Scherman & van Staden, 2010; Weinberg & Abramowitz, 2008). Descriptive statistics were used to explore the data and identify outliers (extreme values) and confirm that it is worth continuing with further data analysis. The data exploration assisted in identifying factors that influence mathematics achievement in South Africa and Australia.

In running the descriptive analyses, the first step was to obtain the frequency distributions of the data by means of frequency tables. The tables displayed the frequency of occurrence of each value in the data set (Bryman, 2004; Creswell, 2005; Jansen, 2010; Pietersen & Maree, 2007c; Scherman & van Staden, 2010; Weinberg & Abramowitz, 2008).

Missing data is part of almost all research; the researcher has to decide how to deal with it. There are three types of missing data, which is missing completely at random, missing at random, and missing not random (Howell, 2007; 2008; McKnight, McKnight, Sidani & Figueredo, 2007). There are factors influencing the relative performance of most missing data procedures: sample size, number of variables missing, mechanisms of missing data, proportion of missing data average inter-correlation among variables, characteristics of the variables, and psychometric properties of the measures. The mean was used to replace data where the data was skewed and missing. When the data was normal then the frequency was conducted. Also missing data was replaced with the mean in places where alignment of learner and teacher data was done (McKnight, McKnight, Sidani & Figueredo, 2007, p. 214). The following measures, central tendency, variability, normal distributions and normality, were included:

3.5.1.1 Measure of Central Tendency

The central tendency is a measure of the most typical value or central value in a frequency distribution and can be measured in three ways (mean, mode and median). The **mean** is the average value, which is the sum of all average values in a distribution and then divided by the number of values. The mean can be influenced by the extreme values. The **mode** is the most common value. It is a score obtained by the greatest number of learners. This is the value that occurs most frequently in the data. The **median** is the middle score when scores are ranked in order of magnitude. It is obtained by the middle learner in a ranked group of learners, it has equal number of scores above it and below it (Bryman, 2004; Creswell, 2005; Field, 2009; Jansen, 2010; Lewin, 2011; Pietersen & Maree, 2007c; Scherman & van Staden, 2010; Weinberg & Abramowitz, 2008).

3.5.1.2 Measures of variability

The *measures of variability* are the spread of data around the average. The range is the distance between the highest and lowest score or the difference between the maximum and the minimum value in a distribution of values. The standard deviation is a measure of the dispersal or range of scores, calculated as the square root of the variance, whilst standard error is the standard deviation of sample means, and the variance is a measure of how far scores are from the mean, calculated as the average of the squared deviations of individual scores from the mean (Bryman, 2004; Creswell, 2005; Field, 2009; Jansen, 2010; Lewin, 2011; Pietersen & Maree, 2007; Scherman & van Staden, 2010; Weinberg & Abramowitz, 2008).

3.5.1.3 Normal distributions

The normal distribution is represented by a bell-shaped curve. It represents a set of values commonly clustered around the mean value (the point where the curve turns) with smaller number of values at each end of the range. The *measures of distribution* include kurtosis and skewness. **Kurtosis or the pointyness** indicates how steep or flat is the shape of a graph or distribution of data, a measure of how peaked a distribution is and how steep is the slope or spread of data around the peak. The distribution can either be positive kurtosis or negative kurtosis. A positive kurtosis (leptokurtic distribution) is a distribution which has many scores in the tail. A negative kurtosis (platykurtic distribution) is a distribution which is thin in the tail and tends to be flatter than normal distribution. **Skewness** refers to the lack of symmetry, how far the data are asymmetrical in relation to a normal curve of distribution. A skewed distribution can either be positively skewed or negatively skewed. A positively skewed distribution is where the frequent scores are clustered at the lower end and the tail points towards a more positive end. A negatively skewed distribution is where the frequent scores are clustered at the higher end and the tail points the more negative scores (Creswell, 2005; Field, 2005, 2009; Pietersen & Maree, 2007d; Scherman & van Staden, 2010). The values of skew and kurtosis are 0 in a normal distribution, and where values of skew and kurtosis are above or below 0 then this indicate a deviation from normal (Field, 2009, p. 19).

In assessing *normality*, the researcher used histogram graphs. Histograms provide information about the distribution of scores on the continuous variables (Field, 2005, 2009; Pallant, 2007; Pietersen & Maree, 2007d; Scherman & van Staden, 2010). The advantage of representing data graphically is that the main characteristics of the distribution are immediately observed.
Descriptive tables indicate how much of a problem the outlier cases were likely to be. Outliers are scores that are substantially lower or higher than the other scores in the data (Field, 2005; Pallant, 2007). They are different from the rest of the data. The value which the researcher was interested in was the 5% trimmed mean. If the trimmed mean and mean values were very different, the researcher will need to investigate these data points. The graph also indicates how the scores on each of the variables are normally distributed, if they follow the normal curve.

Descriptive statistics describe and present data in terms of summary frequencies (Cohen et al., 2007; Creswell, 2005; Field, 2005; Pietersen & Maree, 2007c; Scherman & van Staden, 2010). Thereafter, frequencies of all classroom factors are explored to make constructs and a correlation matrix was examined (Howie, 2003; Bryman, 2004).

3.5.2 Factor Analysis

Factor analysis is a statistical technique that seeks to identify underlying structure in a set of items. It explains the pattern of correlations within a set of items (Cohen et al., 2007; De Coster, 1998; Maree, 2007; Pietersen & Maree, 2007b; Tredoux & Pretorius, 1999). It assists the researcher in reducing large data to smaller manageable numbers and assists in scale development. Factor analysis was appropriate for this study because it summaries the underlying patterns or correlation and looking for "clumps" or groups of closely related items. It determined which items belong together in the sense that they were answered similarly and therefore measured the same construct or dimension (Babbie & Mouton, 2001; Field, 2005, 2009; Pallant, 2007; Pietersen & Maree, 2010).

There are two main forms of factor analysis, namely exploratory and confirmatory. Exploratory factor analysis, which was used in this research, refers to the uses of factor analysis (principal components analysis) which involve exploring previously unknown groupings of variables and seek underlying patterns. Whilst, confirmatory factor analysis is more stringent, testing a found set of factors against a hypothesised model of groupings and relationships (Cohen et al., 2005, 2007; Pietersen & Maree, 2010; Stapleton, 1997). Factor analysis was performed in the following steps:

3.5.2.1 Determining the sample size and the strength of inter-item correlation
The *first step* was to determine whether the set of items were suitable for factor analysis by investigating the sample size and strength of the inter-item correlation. A correlation matrix was generated through the SPSS to examine item homogeneity. This was a matrix that contained, for each item, a loading on each factor. These loadings were correlations between the items and factors, and big values indicated which items belonged to which factor (Babbie & Mouton, 2001; Pietersen & Maree, 2007b). The generation of factors, however, has no reference to the meaning of variables. SPSS generated the Kaiser-Meyer-Olkin

and Bartlett's test of sphericity as measures of sample size and strength of correction. The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was used and normally varies between 0 and 1. A value of 0 indicates the sum of partial correlations is large relative to the sum of correlations, indicating diffusion in the pattern of correlations. A value of close to 1 indicates that patterns of correlations are relatively compact and so factor analysis should yield distinct and reliable factors (Field, 2009). Kaiser (1974) recommends accepting values greater than 0, 5 as barely acceptable, and the Barlett's Test of Sphericity should be significant ($p<.001$) (Field, 2009, Pallant, 2007). Table 3.4 displays the criteria used to ascertain sampling adequacy.

Table 3.6 KMO measure of sampling adequacy

Values	Interpretation
0,5 – 0,7	Mediocre
0,7 – 0,8	Good
0,8 – 0,9	Great
Greater 0,9	Superb

Source: Hutcheson & Sofroniou (1999, p. 28)

3.5.2.2 Factor extraction that explains the pattern of co-variation

Communality is the proportion of common variance which is present in a variable. The total variance for a variable has two components, **firstly,** that is shared with other variables or measure (common variance) and **secondly**, some of it will be specific to the measure (unique variance). A variable that has no specific or random variance would have a community of 1 and also a variable that shares none of its variance with other variables, has a communality of 0 (Field, 2005, p. 630). As the aim of using factor analysis is to find common underlying dimensions within data, the variance present in data which is common variance was of interest (Field, 2005, 2009, p. 637). Therefore, the criterion used was to assume that all the variance was common variance and that the communality of every variable was 1. Communalities represent the proportion of variability for a given variable that is explained by the factors (Field, 2009, p. 637). Besides KMO, the communalities were examined and if it was found that certain items did have low communalities (below 0.4) then the items were deleted because they would not load on the factors extracted. The researcher also evaluated components loading value above 0.4 as a criterion, the size of the loading is important and the highest loading was taken and the criterion was applied in all analyses. Items loading on more than one factor were eliminated to make a rotated factor pattern to form a simple structure. The details of the results are presented in Appendix A and B.

3.5.2.3 Identify factors related to the most shared co-variation

Factor loadings are described as the correlation between a factor and a variable. The primary result obtained from factor analysis consists of factor loadings. A factor loading is interpreted as the Pearson correlation coefficient of an original variable with a factor. Like correlations, loadings range in value from -1.00 (a perfect negative correlation with the factor) through 0 to +1.00 (perfect positive correlation) and the higher absolute value indicates the stronger relationship. Variables typically have loadings on all factors but will have high loadings on only one factor.

The significance of factor loading depends on the sample size. Stevens (1992) argues that the significance of factor loading depends on the sample size. The following are critical values against which the significance of factor loading can be compared:

Table 3.7 Factor loading

Sample size	Factor Loading
50	Loading of 0,722
100	Loading greater than 0,512
200	Loading greater than 0,364
300	Loading greater than 0,298
600	Loading greater than 0,21
1000	Loading greater than 0,162

Source: Stevens (1992, 2002)

Stevens (2002) concluded that with variables of 30 or more and communalities greater than 0.7 for all variables, it is unlikely to have different solutions; however, with fewer than 20 variables and any low communities, less than 0.4 differences can occur. The following criteria for factor loading were used. **Firstly**, factor loading less than 0.4 has to be suppressed. **Secondl**y, variables are listed in the order of size of their factor loadings. **Thirdly,** all other parts of the output suppress the variable labels to aid interpretation on the printed parts (Field, 2009, Pallant, 2007). For the purpose of this research, loadings greater than 0.4 were considered and acceptable.

3.5.2.4 Factor Rotation

Rotation is a process by which factor solution is made more interpretable without altering the underlying mathematical structure (De Coster, 1998; Field, 2009). Rotation can be represented in geometric perspective. There are two types of rotation which are orthogonal and oblique rotation. In orthogonal rotation there are three methods (varimax, quartimax and equamax) and in oblique rotation there are two methods (direct oblimin and promax). Oblique rotation means that factors are allowed to correlate to each other while with orthogonal rotation the factors are factors uncorrelated with each other (unrelated).

This study used an orthogonal method which is varimax rotation. Varimax rotation encourages the detection of factors each of which is related to few variables and discourages the detection of factors influencing all variables. The resultant output is a loading matrix of correlations between all observed variables and factors (Cornish, 2007; De Coster, 1998; Field, 2005; Pallant, 2007; Riitters' et al., 1995).

3.5.2.5 Kaiser's criterion used the eigenvalue rule and scree test

Kaiser's criterion used the eigenvalue rule and scree plot techniques to confirm the proper number of factors to retain. A minimum eigenvalue of 1 was utilised and Scree test was used that all factors within the sharp descent, before eigenvalue level off when analysing the scree plot are retained (Field, 2009; Pallant, 2007). This criterion is fairly reliable when the number of individuals >250 and communalities are > 0.30.

For the purpose of this study, the following four criteria to determine the number of components to retain were used. **Firstly,** components with eigenvalues greater than 1 were retained. This criterion is fairly reliable when: the number of variables is <30 and communalities are > 0.70, or the number of individuals is > 250 and the mean communality is ≥ 0.60. **Secondly,** components that account for at least 70% total variability were retained. **Thirdly**, all components within the sharp descent, before eigenvalues level off when analysing the scree plot were retained. This criterion is fairly reliable when the number of individuals >250 and communalities are > 0.30. **Fourthly,** the components generated by the model if only a few residual exceed 0.05 were retained. Once the appropriate number of components to retain has been determined, the researcher then interprets and names the components by evaluating the type of variables included in each factor, the strength and direction of factor loadings (De Coster, 1998; Field, 2009; Pietersen & Maree, 2007b; Singh, 2007).

3.5.3 Reliability analysis

Reliability means that the scores from an instrument are stable and consistent over time (Cohen et al., 2007; Creswell, 2005, 2010, 2011; Field, 2009; Singh, 2007). There are different types of reliability, namely test-retest, equivalent form, split-half and internal reliability. Internal reliability or internal consistency was used in this study because it was appropriate to measure the degree of similarity among the scores measuring the same construct (Creswell, 2005; Pietersen & Maree, 2007b). Internal consistency is the degree of similarity among the items that measure one common construct. Cronbach's alpha coefficient was used to measure the internal reliability of an instrument.

In order to establish whether the test was reliable or not, internal consistency using Cronbach's Alpha coefficient was used as an indication of reliability. According to Anastasi and Urbina (1997), any value higher than 0.7 indicates that the scale of items can be said to be reliable. Therefore, the test with a higher reliable value shows that it is highly reliable (Anastasi & Urbina, 1997; Cohen et al., 2007). Pietersen and Maree (2007b, p. 216) suggest the following guidelines for the interpretation of Cronbach's alpha coefficient:

Table 3.8 Guideline for the interpretation of Cronbach's alpha coefficient

Interpretation	Reliability Value
High reliability	0,90
Moderate	0,80
Low reliability	0,70
Unacceptable	0,60

Source: Pietersen & Maree (2007b, p. 216)

Pietersen and Maree (2007b); Creswell (2005); Cohen et al. (2000, 2007) state that the Cronbasch's alpha (reliability as internal consistency) provides a coefficient of inter-item correlations. The relation of each item with the sum of all other items is the average correlation among all the items in question, and is used for multiple-item scales (Cohen et al., 2007, p. 148). The SPSS package provides the facility of conducting reliability analysis to assess the additive nature of individual items (Singh, 2007, p. 253). Item-total correlations are the correlations between each item and the total score from the questionnaire. The researcher searches for the items that do not correlate with the overall score from the scale. If any of these values is below 0.3, then all items with low correlation have to be dropped. All items must contribute positively to improve the reliability analysis to be above the overall reliability α value of 0.8. An overall α value above 0.8 indicates good reliability (Field, 2009, p. 679). The reliabilities values of 0, 5 were retained. This is a secondary analysis and exploratory, the absolute minimum coefficient value of 0.5 is acceptable for the purpose of further analysis (Cho, 2010; Field, 2009; Howie, 2002).

3.5.4 Correlation Analysis

Correlation analysis is a statistical technique which measure whether and how strong two or more pairs of variables are associated. Correlation gives an opportunity to explain the strength of the association between the pairs of variables. Creswell (2005) describes correlation as a statistical test to determine the tendency or pattern for two (or more) variables or two sets of data to vary consistently. In this study, there is no attempt to control or to manipulate the variables because it is a secondary data analysis.

Correlations measure the following three characteristics. Firstly, whether the association is positive or negative; secondly, whether the relationship is linear or not and thirdly, the strength of the relationship (Creswell, 2005; Maree & Pietersen, 2007). A positive correlation indicates that as one variable increases (decreases), so does the other. A negative correlation indicates that as one variable increases, the other decreases or vice versa (Field, 2009; Pallant, 2007).

SPSS was used to conduct a bivariate correlation analysis. A bivariate correlation is a correlation analysis between two variables that is conducted without controlling one of the two variables. Bivariate correlation was conducted after the reliability analysis of all constructs was tested. Each of the components and previously identified individual variables were explored in relation to the mean mathematics score. The criterion used was that, all variables with a correlation coefficient (r) value greater than 0.2 were included. The cut off for inclusion in further analysis was $r > 0.2$ (Cho, 2010; Cohen, 2000; 2007; Creswell, 2010; Howie, 2002). The study adopted a correlation coefficient of an absolute value above 0.2 and the significance level 0.01 (0.99 confidence interval) as a criterion to include the scales for further analysis. The criterion for cut-off seems low, a slight relationship, considering the strength of a relationship to coefficient value described above. Nonetheless, when correlations are ranging from 0.20 to 0.35, and if the number of cases is more than 100, it may be statistically significant and valuable enough to explore the interconnection of variables in particular in explanatory studies such as this (Cohen et al., 2000; 2007; Creswell, 2008). As for the significance level, the level of statistical significance or a correlation tends to depend largely on the sample size. The greater the sample size, the smaller the correlation needs to be in order to be significant at a given level of confidence (Cohen et al., 2005; 2007).

In addition to correlation coefficients, the coefficient of determination and the significance level could be investigated through regression approach in correlation analysis. The coefficient of determination can be calculated by squaring and multiplying the y value by 100 to make a change into percentage of variance. It represents how much variance is shared. A correlation of 0.2 means that only 4% of the variance is shared, but it cannot be ignored in large sampled and exploratory studies (Cohen et al., 2007, p 536).

The size of the value of the correlation coefficient was determined. Correlation coefficient range from -1, 00 to +1, 00 and the closer r is to -1 or +1 the correlation is the stronger, then the two variables are related. A correlation coefficient of 0 indicates no relationship at all between the variables. A correlation of +1, 00 indicates a perfect positive correlation, and a positive sign indicates that the variables are directly related. A correlation value of -1, 00 indicates a perfect negative correlation, and a negative sign indicates that variables are inversely related.

The following guidelines for the interpretation were used (Cohen, 1988; Cohen et. al., 2000, 2007).

Table 3.9 Interpretation of the size of a correlation

Correlation	Negative	Positive
Small	-0,3 to -0,1	+0,1 to +0,3
Medium	-0,5 to -0,3	+0,3 to +0,5
Large	-1, 0 to -0,5	+0,5 to +1.0

Source: (Cohen, 1988; Cohen et al., 2000, 2007)

A coefficient of correlation between dependent and independent variables is a quantitative index of association between the two variables (Field, 2009). In its squared form, as a coefficient of determination, indicates the amount of variance in the criterion (dependent, Y) which is the mathematics score variable which is accounted for by the variation in the predictor (independent, X) variables. Coefficient of determination is computed as a value between 0 (0 percent) and 1 (100 percent). The higher the value, the better the fit. A low r-square indicates that there is no significant relationship between the two variables. This study goes beyond just looking at the associations between variables but also includes multiple regressions to ascertain the nature of the associations

3.5.5 Multiple regression analysis

Multiple regressions enable the researcher to predict and weight the relationship between two or more independent variables and a dependent variable (Cohen et al., 2007; Field, 2005). There are different types of multiple regression analyses that are available to address the questions. Multiple regression analysis is an extension of correlation and was used to explore and identify factors which influence the achievement in mathematics and which classroom factors added the most value to the achievement of learners in mathematics (Creswell, 2005; Pallant, 2007; Pietersen & Maree, 2007a; Maree, 2007). There are three main types of multiple regression analyses: standard or simultaneous; hierarchical or sequential; and stepwise (Field, 2005; Pallant, 2007).

In choosing an appropriate stepwise method, it is important to note that all stepwise methods (forward, backward, and stepwise) rely on the computer selecting variables based on the mathematical criteria. This study used a stepwise method. In the stepwise regression, the computer defines the initial model that contains only the constant, and the predictor that best predicts the outcome variable which is selected. The procedure selects the predictor that has the highest simple correlation with the outcome. If the predictor is retained in the model, then the second predictor is included. The criterion used for selecting this second predictor is that it is the variable that has the largest semi-partial correlation with the outcome. If the predictor makes a significant contribution to the predictive power of the model, it is retained and another predictor is considered. Each time a predictor is added to regression equation, a removal test is made of the least useful predictor. Redundant predictors are removed and the regression equation is reassessed (Field, 2009; Pallant, 2007).

The criteria for interpretation of the multiple regression output, the researcher used the descriptive, correlation, model summary and coefficient tables. The descriptive information is shown in the descriptive and correlation tables; that is the value of Pearson's correlation coefficient for every pair of variables; the number of cases contributing to each correlation. The significance of each correlation is displayed, $p < .001$ (Field, 2009, p. 133). The descriptive is useful to get a sense of the relationship between the predictors (variables) and the outcome (mathematics achievement). Summary of model table describes the overall model (whether the model is successful in predicting mathematics achievement). Regression model summary is produced. The table provided the researcher with very important information about the model to interpret the values of R, R square, Adjusted R square, R square change and Sig F change.

The coefficients of the regression model gave the parameters of the final model in which all the predictors were included. The b-values indicate the individual contribution of each predictor to the model. If the coefficient is positive it means there is a positive relationship between the predictor and the outcome, whereas if the coefficient is negative, there is a negative relationship. The b-values give the researcher to what degree each predictor affects the outcome if the effects of all other predictors are held constant. The standardised beta values are provided by the SPSS and provide the information about the number of standard deviations that the outcome will change as a result of one standard deviation change in the predictor. The standardized beta values are measured in standard deviation units, which make it comparable (Field, 2009, p.239).

3.6 RESEARCH PROCEDURES

For the purpose of this study, secondary data was used after permission was requested from IEA offices to use the existing data which was available for public use. The existing mathematics Grade 8 TIMSS 2003 teacher questionnaire data and learner performance data for South Africa and Australia were downloaded from the TIMSS database. Thereafter, the South Africa and Australia teacher questionnaire data was prepared for analysis which included exploring the data set and recoding of the variables.

Data analysis of the quantitative data included complex statistical procedures employed to respond to the research questions. The data were organised and summarised through descriptive methods, central tendency, variability, normal distributions and normality. Further analysis, which goes beyond summarising and describing the data, was done. This is known as statistical inferences and the purpose of statistical inference is to generalise data to the broader population. Statistical procedures like factor analysis (reduce data), reliability analysis (look at consistency), correlation analysis (look at relationship between the variables), and multiple regression (predict) were applied (Field, 2009; Pallant, 2007; Pietersen & Maree, 2007c, 2007d).

3.7 METHODOLOGICAL NORMS

3.7.1 Reliability

Reliability is an indication of consistency between two scores of the same instrument over time (Alias, 2005; Creswell, 2005; Field, 2009; Treiman, 2009; Welman, 2005). It signifies the issue of consistency of measures, which is the ability of a measurement instrument to measure the same thing each time it is used. There are three important factors involved in assessing reliability. Firstly, stability, which entails whether a measure is stable over time, confident that results relating to the measure for a sample of respondents will not fluctuate. Secondly, internal reliability, which seeks to assess whether the indicators that make up the scale are consistent. Thirdly, inter-observer consistency, which arises due to the involvement of more than one observer in activities, observation or translation (Cohen et al., 2007; Creswell, 2011; Singh, 2007).

As discussed above in the section on reliability analysis, internal reliability was used in this study, because it was an appropriate instrument to measure the degree of similarity among the scores measuring the same construct (Creswell, 2005; Pietersen & Maree, 2007b).

3.7.2 Validity

Validity is the degree to which an instrument measures what it is supposed to measure. The scores received from respondents are meaningful indicators of the construct being measured (Alias, 2005; Borsboom & Mellenbergh, 2004; Creswell, 2011; Creswell & Clark, 2011; Field, 2009; Lewin, 2011). Borsboom and Mellenbergh (2004) argue that there is a conceptual development of validity. Firstly, that validity evolved from the question whether an instrument measures what it is intended to measure; secondly, whether the empirical relations between instruments scores match theoretical relations in a nomological network, and thirdly, whether interpretations and actions based on instrument scores are justified (p. 1061). They concluded that the first conception is more powerful, simple and effective (Borsboom & Mellenbergh, 2004, p. 1070). There are different types of validity. Construct validity is the degree to which a measure does what it purports to do. This means that the measure should provide a good degree of fit between the conceptual and definitions of the construct, and the instrument should be usable for the particular purposes for which it was designed (Durrheim, 1999, p. 83). In quantitative research, validity can be improved through careful sampling, appropriate instrumentation and appropriate statistical treatment of the data. It is important for the instrument to be valid in order for the results to be accurately applied and interpreted. With regard to validity, there are three related types of measurement validity, but in this chapter the researcher will look at content and construct validity.

3.7.1.1 Content validity

As discussed earlier with the background of TIMSS 2003, content validity was explored as part of the main study (see Table 1.5 and 1.6). Content validity refers to the extent to which questions on the instrument and the scores from these questions are representative of all the possible questions that could cover the complete content or skills of the particular construct that it is set out to measure (Cohen et al., 2000; Creswell, 2005; Linn, 1988; Pietersen & Maree, 2007b). The development of the TIMSS 2003 assessment was a collaborative process involving mathematics educators and specialists from all over the world. Central to this effort was updating and revision of existing TIMSS assessment frameworks to address changes in the curricula and the way mathematics is taught (Cohen et al., 2000; Mullis et al., 2004; Pietersen & Maree, 2007b; Twycross, 2004) .

3.7.1.2 Construct validity

A construct represents a collection of behaviours that are associated in a meaningful way to create an image or an idea invented for a research purpose.

Construct validity can be defined as the degree to which an instrument measures the characteristics being investigated not something else (Mullis et al., 2004; Pietersen & Maree, 2007b; 2010; Trochim, 2001; Stone-Romero, 2009; Welman, 2005). Construct validity is measured using a correlation coefficient (r). When the value of the correlation coefficient is high, the instrument is considered to be valid (Twycross, 2004, p. 28).

Construct validity was important for this study as the factors included for further analysis had to measure the same theoretical construct or concept. Construct validity is established by determining if the scores on the instrument are meaningful, useful or significant. Construct validity can establish statistical procedures such as factor analysis and reliability analysis (Creswell, 2005, p. 165). Construct validity seeks agreement between a theoretical concept and a specific measuring procedure or device.

To understand whether TIMSS 2003 data for South Africa and Australia has construct validity, three steps were taken. First, the theoretical relationships were specified. Secondly, the empirical relationships between measures of the concepts were explained. Thirdly, the empirical evidence was interpreted in terms of how it clarifies the construct validity of the particular measure being tested (Cohen et al., 2000; Messick, 1981, 1989; Trochim, 2001). Construct validity provides a rational approach to predictive hypothesis as well as basis to judge the relevance of a test to the criterion domain (Messick, 1981, p. 12).

Statistical validity is concerned about basing conclusions on a proper use of statistics especially whether the assumptions of statistical procedure are met. The conclusion drawn must be in agreement with the statistical and scientific laws (Garson, 2008; Golbeck, 1986).

3.8 ETHICAL CONSIDERATIONS

IEA makes TIMSS 2003 survey data available countries to conduct comparative studies to reflect on the performance of education systems. The aim is to improve mathematics and science performance by means of secondary analysis of the data. As part of ethical considerations of IEA, NRC's were requested to obtain permission from the respective Ministries of Education and from the schools and other stakeholders to make data available from all participating countries (Martin, 2005). Permission was requested and granted from all participating countries. As part of the informed consent, anonymity and confidentiality of participants were guaranteed through the whole research process. For this secondary study, permission was requested from the IEA, the response was that secondary analysis falls within the scope of the original consent, and the data was available for public use.

3.9 LIMITATIONS OF THE STUDY

The limitation of the secondary data analysis study is that it was not possible to control data collection errors because the data was collected in 2002. The original objectives of the research constrain the analysis because the data was collected based on the original objectives even though TIMSS collected data to provide allowance for further comparability of the data. There is a possibility of misunderstanding of the objectives of the original study (Babbie & Mouton, 2001; Mouton, 2001). The study looked at the classroom level and there is a possibility that there may be additional factors on the school and learner level which are important.

Estimates produced using data from TIMSS 2003 are subject to sampling and non-sampling errors. Sampling errors occur when the discrepancy between a population characteristic and the sample estimates arise because not all members of the South African and Australian population were sampled for the survey. The variability arises from using a sample of learners in eighth grade rather than all learners in the Grade 8 in 2003. Non-sampling errors are errors made in collecting and processing data. The variations in the estimates were caused by population coverage limitations, data collection, processing, and reporting procedures (Gonzales et al., 2004, p. 48).

When it comes to organisation of data archives and the subtleties of conducting secondary analysis, there is no substitute for experience. Another limitation of secondary analysis is that creativity is restricted. The use of the same data sets repeatedly are limited by variables contained in the TIMSS 2003 data. Surveys rarely contain all the variables of interest to the secondary researcher. However, there are disadvantages of a secondary analysis. One disadvantage of using secondary data is related to the fact that selection and quality, and the methods of collection, are not under the control of the researcher and that they are sometimes impossible to validate (Sorensen, Sabroe & Olsen, 1998, p.435).

3.10 CONCLUSION

A quantitative research approach is used for this secondary data analysis, which is a comparative study between South Africa and Australia using TIMSS 2003 data. A survey research method is used. The data is analysed using statistical procedures like frequency table, factor analysis and multiple regression. Factor analysis is a technique used to identify factors that explain common variance among variables. SPSS was used to reduce data by grouping variables that measure a common construct. Principal components analysis was used for extraction since it evaluates all sources of variability for each variable. Orthogonal rotation method (Varimax) was used for rotation of factors to make the components more interpretable. The researcher used the following four criteria to determine the number of components to retain. Firstly, components with eigenvalues greater than 1 were retained, secondly, components that account for at least 70% total variability were retained, thirdly, all components on the scree-plot within the sharp descent, before eigenvalues level off were retained, and fourthly, the components generated by the model if only a few residual exceed 0.05. The researcher then interpreted and named the components by evaluating the type of variables included in each factor, the strength and direction of factor loadings (De Coster, 1998; Field, 2007, Pietersen & Maree, 2007b; Singh, 2007). Bivariate correlation analysis was used after the reliability analysis of all constructs was tested to establish correlation between variables. Each of the components and previously identified individual variables were explored in relation to the mean mathematics score. The criterion used was that all the variables with a correlation coefficient (r) value above 0.2 were included for further analysis. Multiple regression analysis is an extension of correlation analysis. It was used to explore and identify factors which influence the achievement in mathematics and which classroom factors added the most value to the achievement of learners in mathematics. Stepwise procedure was used. Stepwise method selects the predictor that has the highest simple correlation with the outcome.

The next chapter, Chapter 4, presents the research findings with regard to the key classroom level factors affecting mathematics achievement. The chapter further discusses how the factors affect mathematics achievement in South Africa and Australia.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

South Africa participated in TIMSS 2003, and the mathematics performance of Grade 8 learners revealed an average scale score of 264, which was significantly below all 46 participating countries, including developing countries such as Tunisia, Chile, Morocco and the Philippines. Australia also participated in the same international study, TIMSS 2003, and was ranked 14th in terms of mathematics performance. Australian learners achieved an average scale score of 505, which is above the international average scale score of 467 (Mullis, Martin, Gonzalez & Chrostowski, 2004, p. 34). Descriptive and inferential quantitative statistical methods were used to analyse the data. This included descriptive statistics, factor analysis, reliability analysis, correlation and multiple regressions. Data analysis was conducted through the use of a computer software program, SPSS.

An extensive literature review was conducted on classroom level factors affecting learner performance in mathematics, and it was apparent that the teacher plays a central role in determining the key classroom level factors affecting learner performance in mathematics (Bos & Kuiper, 1999; Howie, 2001; 2003; 2005; Lokan & Greenwood, 2000; Mac Iver, 1987; Muijs & Reynolds, 2000). In exploring the classroom level factors through factor analysis and conducting a reliability test, the following factors were identified as affecting learner achievement in mathematics: teaching load, teachers' beliefs, topic coverage, class size, qualifications, time on task, attitudes to teaching, teaching style, sex, experience of teacher, teachers' age, textbooks, teachers' confidence, limitations, and resources. The data preparation and methodology for analysis was described in detail in the Chapter 3 data analysis section. The following is a brief description of the results of each statistical procedure: descriptive statistics (4.2), reliability analysis (4.4), correlation analysis (4.5) and finally, multiple regressions (4.6).

4.2 DESCRIPTIVE STATISTICS

4.2.1 Teacher background

In South Africa, 40% of mathematics learners are taught by female teachers and 60% by male teachers. In Australia, 54% of mathematics learners are taught by female teachers and 46% by male teachers. The highest percentage which is 57% comprise the majority of South African TIMSS mathematics teachers which are aged between 30-39 years, whereas in Australia 35% of mathematics teachers are aged between 40-49 years and 25% aged between 30-39 years. In South Africa, more than 80% of teachers have taught more than 5 years, whereas in Australia, 75% of teachers have taught for more than 5 years.

4.2.2 How ready to teach the mathematics topics

The TIMSS questionnaire included an item pertaining to how ready teachers felt to teach the mathematics topics detailed in the TIMSS 2003 mathematics framework. Across the five content areas (number, algebra, measurement, geometry and data), the Grade 8 teachers were asked about readiness in 18 sub-areas. Table 4.1 below shows the percentage of teachers both in South Africa and Australia who indicated topics that they are very ready to teach. Table 4.1 illustrates that in South Africa over 60% of teachers indicated their readiness (very ready) to teach eight of the 18 topics listed. In Australia a similar pattern regarding the issue of readiness to teach was observed but at a higher rate: over 80% of teachers indicated their readiness (very ready) to teach 15 of the 18 topics listed.

Table 4.1 Topics by percentage, indicated very ready to teach

	Topic	Percentage	
		SOUTH AFRICA	AUSTRALIA
1	Decimal and fractions	69	88
2	Integers including words	80	90
3	Geometric pattern	60	83
4	Simple linear equations	71	80
5	Functions	61	83
6	Graphs	54	77
7	Estimations	53	89
8	Measurement in problem situation	43	87
9	Measures of irregular or compound Areas	40	80
10	Precision of measurement	48	83
11	Pythagorean theorem	76	88
12	Congruent figures	74	84
13	Cartesian plan	64	84
14	Translation, reflection, rotation	39	80
15	Organizing data	34	74
16	Data collection methods	39	85
17	Characteristics of data sets	56	86
18	Simple probability	38	79

4.2.3 Class size

The table below presents information on the class size for South Africa and Australia. The international average number of learners per TIMSS mathematics class was 30. In South Africa, the average class size was 45 while in Australia the average class size was 28.

Table 4.2 Mathematics class size by percentage of learners

	Class Size	1-24 learners	25–32 learners	33-40 learners	>40 learners
South Africa	45	7%	16%	30%	48%
Australia	28	38%	58%	3%	1%
International Average	30	29%	35%	24%	13%

Source: Reddy, 2006, p.102

4.2.4 Textbook

The Mathematics textbook is an important resource for the teaching and learning of mathematics (Rezat, 2009, p. 1260). In South Africa, 34% of mathematics teachers reported that they used the textbook as the primary basis for lessons; the other 67% used it as a supplementary resource. In Australia, 56% mathematics teachers reported that they used the textbook as the primary basis for lessons; the other 44% used the textbook as a supplementary resource. In South Africa, 54% of mathematics teachers reported that shortage of textbooks for learners was one of the factors that limited the teaching in the classroom. In Australia, 80% of mathematics teachers reported that shortage of textbooks for learners was not a factor limiting the teaching in the classroom.

In South Africa, 95% of teachers said they use the textbook in teaching mathematics and in Australia, 93% did as well. In South Africa, 66% of teachers indicated that they use textbook(s) as a supplementary resource and 34% said they use textbook(s) as the primary basis for lessons in teaching mathematics. In Australia, 42% indicated that they use textbook(s) as a supplementary resource and 51% indicated that they use textbook(s) as a primary basis for lessons.

4.2.5 Test item format

Mathematics teachers were asked to report on the extent to which they used multiple- choice and constructed-response questions in their classroom tests and examinations. Table 4.3 provides information on the percentage of learners who were given the two item format in classroom test and examinations, as reported by teachers. From the table it is clear that South Africa strike a balance for using only or mostly constructed response and about half constructed response and half MCQ, very few 13% of only or mostly objective responses. This is contrary to Australia and international, Australia uses 75% only or mostly constructed response and 18% about half constructed response and half MCQ. Only 7% only or mostly objectives.

Table 4.3 Test Item Format

	Only or mostly constructed response	About half constructed response and half MCQs	Only or mostly Objective
South Africa	43	45	13
Australia	75	18	7
International	56	32	12

Source: Reddy, 2006, p.107

4.2.6 Interactions with other teachers

Teachers were asked about their interactions with other teachers and how they use the textbook in teaching mathematics in their classes. In their responses, 39% of South African teachers indicated that they discuss particular concepts one to three times per week whereas in Australia, 34% of teachers indicated two or three times per week with 42% indicating never or almost never. With regard to visiting other teacher's classroom to observe, 56% of SA teachers said they never visit other teachers' classroom to observe, but in Australia 82% of teachers indicate that they visit classrooms two or three times per week. With regard to informal classroom observation by another teacher, 49% of SA teachers said they had never experienced informal classroom observation by another teacher, and in contrast in Australia, 80% indicated that had informal classroom visits by other teachers.

4.2.7 Teachers' expectations for learner achievement

Teachers' response the question about the Teachers' expectations for learner achievement was 69% for South Africa medium to high expectation, whereas in Australia, 75% of teachers have medium to high expectation for learners. With regard to parental support for learner achievement, 54% of South African teachers indicated low to medium, whereas in Australia 67% indicated medium to high expectations.

4.2.8 Homework

With the frequency of homework, 97% of SA teachers indicated that they assign homework to their learners, whereas 98% of teachers in Australia indicated that they assign homework to their learners. 68% of SA teachers indicated that they assign mathematics homework in every or almost every lesson; fifty three percent said they assign homework in every or almost every lesson. 59% of SA teachers indicated that the duration of homework is 15 – 30 minutes; teachers in Australia indicated that the duration of the homework is 15 to 30 minutes; 52% SA and Australia teachers indicated median on emphasis on mathematics homework.

4.2.9 School Climate

School climate includes teachers' perception on school facility, security and policies. In South Africa, 45% of teachers indicated that school climate has a scale rating of medium, and 56% of teachers in Australia indicated that the school climate scale rating of medium. Only 30% of teachers indicated that schools are safe in South Africa, in contrast to 79% of Australian teachers indicating that schools are safe.

4.3 FACTOR ANALYSIS

Factor analysis was conducted for South African and Australian data, a principal component analysis was conducted on all items with orthogonal rotation (varimax) (See Appendices A and B). The Kaiser-Meyer Olkin (KMO) measure verified the sampling adequacy for the analysis. The KMO criterion is that the value should be greater than 0.5 as a minimum (Field, 2009; Hutcheson &

Sofroniou, 1999). The KMO statistics for individual variables is available at the diagonal of the Anti-Image Matrices, provided in appendices; these values should also be above 0.5. The Bartlett's Test of Sphericity should also be significant; the value of significance should be less than .05.

4.3.1 South Africa: Teacher confidence

A principal component analysis (PCA) was conducted on the 18 items with orthogonal rotation (Varimax) on items relating to teacher confidence. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO = .835), great according to Field (2009) and Hutcheson & Sofroniou (1999). All the KMO values for individual items were (greater than) >.58 which is above the acceptable limit of .5 (Field, 2009; Hutcheson & Sofroniou).Bartlett's Test of Sphericity, x^2 (153) = 33524.83, p <.001, indicated that correlations between items were sufficiently large for principal component analysis. An initial analysis was run to obtain eigenvalues for each component in the data. Three components had eigenvalues over Kaiser's criterion of 1and in combination explained 71% of the variance. For communalities, the researcher retained factors with eigenvalues greater than 0.4, (see Appendix A) but the final guide was the use of the scree plot. The scree plot showed inflexions that justify retaining three components. Factors that loaded in more than one factor, factors where they had highest loadings were used and some factors were included in factors with high loadings. Table 4.4 shows the factor loadings after rotation. The items that cluster on the same component suggest that component1 represents data collection methods, component 2 represents graphical function and component 3 represents decimal fraction.

Table 4.4 South Africa teacher confidence: Rotated component loadings for 18 items

	Component		
	1	**2**	**3**
Measurements in problem situations	**.793**		
Data collection methods	**.773**		
Measures of irregular or compound areas	**.772**		
Precision of measurements	**.759**		
Sources of error in collecting and organising data	**.748**		
Estimations of length, circumferences	**.747**		
Simple probability	**.665**		.563
Translation, reflection, rotation	**.663**	.582	
Cartesian plan		**.886**	.503
Functions as ordered pairs, tables, graphs, words		**.780**	
Simple linear equations		**.608**	
Pythagorean theorem	.466	**.587**	
Attributes of graphs as intercepts	.481	**.585**	
Characteristics of data sets			**.737**
Integers including words, numbers, models			**.710**
Representing decimals and fractions using words, numbers		.445	**.701**
Geometric pattern or sequence		.414	**.696**
Congruent figures		.434	**.614**
Eigenvalues	5.283	3.901	3.633
% of Variance	29.348	21.674	20.181

4.3.2 Australia: Teacher confidence

A principal component analysis with a Varimax (orthogonal) rotation of 18 items was conducted on the items related to teacher confidence for Australia. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO = .710), good according to Field (2009) and Hutcheson and Sofroniou (1999).All the KMO values for individual items were (greater than) > .58 which is above the acceptable limit of .5 (Field, 2009; Hutcheson & Sofroniou).Bartlett's Test of Sphericity, x^2 (153) = 26329.999, p< .001,indicated that correlations between items were sufficiently large for principal component analysis. An initial analysis was run to obtain eigenvalues for each component in the data. Four components had eigenvalues over Kaiser's criterion of 1 and in combination explained 74% of the variance. For communalities, the researcher retained factors with eigenvalues greater than 0.4, (see Appendix B) but the final guide was the use of the scree plot. The scree plot showed inflexions that justify retaining four components. Factors that loaded in more than one factor, factors where they had highest loadings were used and some factors were included in factors with high loadings. Table 4.5 shows the factor loadings after rotation. The items that cluster on the same component suggest that component 1 represent graphical function, component 2 represents data collection methods and component 3 represent decimal fraction.

Table 4.5 Australia teacher confidence: Rotated component loadings for 18 items

	Component			
	1	**2**	**3**	**4**
Attributes of graphs as intercepts	**.810**			
Functions as ordered pairs, tables, graphs, words	**.772**		.479	
Simple linear equations	**.750**		.426	
Cartesian plan	**.708**	.446		
Translation, reflection, rotation	**.675**	.602		
Geometric pattern or sequence	**.630**			

Congruent figures	**.603**			
Simple probability		**.784**		
Measurements in problem situations		**.769**		.408
Data collection methods		**.749**	.512	
Precision of measurements		**.727**		.426
Characteristics of data sets		**.724**		
Sources of error in collecting and organizing data		**.650**	.463	
Integers including words, numbers, models			**.793**	
Representing decimals and fractions using words, numbers			**.784**	
Estimations of length, circumferences			**.585**	
Pythagorean theorem	.447			**.781**
measures of irregular or compound areas				**.722**
Eigenvalues	4.363	4.143	2.858	2.013
% of Variance	24.232	23.015	15.877	11.184

4.3.3 South Africa: Limiting factors

The Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO = .711), great according to Field (2009) and Hutcheson and Sofroniou (1999).All the KMO values for individual items were (greater than) > .503 which is above the acceptable limit of .5 (Field, 2009; Hutcheson & Sofroniou). Bartlett's Test of Sphericity, x^2 (91) = 20277.451, p< .001, indicated that correlations between items were sufficiently large for principal component analysis. An initial analysis was run to obtain eigenvalues for each component in the data. Three components had eigenvalues over Kaiser's criterion of 1and in combination, explained 73% of the variance. For communalities, the researcher retained factors with eigenvalues greater than 0.4, (see Appendix A) but the final guide was the use of the scree plot. The scree plot was slightly ambiguous and showed inflexions that justify retaining four components. Factors that loaded in more than one factor, factors where they had highest loadings were used and some factors were included in factors with high loadings. Table 4.6 shows the factor loadings after rotation. The items that cluster on the same component suggest that component1 represent shortage of computers, component 2 unhappy students, component 3 represents shortage of instructional equipment, and component 4 shows students diversity.

Table 4.6 SA Limiting factors: Rotated component loadings for 14 items

	Component			
	1	2	3	4
Shortage of computer hardware	**.899**			
Shortage of computer software	**.874**			
Inadequate physical facilities	**.810**			
Shortage of support for using computers	**.759**			.415
Shortage of equipment	**.658**		.546	
Uninterested students		**.832**		
Low morale among students		**.816**		
Disruptive students		**.741**		
Students with special needs		**.503**		
Student/teacher ratio			**.798**	
Shortage of other instructional equipment for students' usage			**.781**	
Shortage of textbooks			**.577**	
Wide range of background				**.861**
Student diversity limit academic ability				**.643**
Eigenvalues	3.652	2.498	2.268	1.772
% of Variance	26.088	17.841	16.201	12.657

4.3.4 Australia: Limiting factors

The Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO = .809), characterised as great according to Field (2009) and Hutcheson and Sofroniou (1999). Not all the KMO values for individual items were (greater than) > .5 which is the acceptable limit of .5 (Field, 2009; Hutcheson & Sofroniou). Those items (less than) < .5 were not retained for further analysis. Removal of one variable affects the KMO statistics, therefore the researcher had re-examined the new anti-image correlation matrix. Bartlett’s Test of Sphericity, x^2 (91) = 10376.54, p< .001, indicated that correlations between items were sufficiently large for principal component analysis. An initial analysis was run to obtain eigenvalues for each component in the data. Three components had eigenvalues which were each over Kaiser’s criterion of 1 and in combination explained 66% of the variance. For communalities, the researcher retained factors with eigenvalues greater than 0.4, (see Appendix B) but the final guide was the use of the scree plot. The scree plot showed inflexions that justified retaining three components: Factors that loaded in more than one factor, factors where they had highest loadings were used and some factors were included in factors with high loadings. Table 4.7 shows the factor loadings after rotation. The items that cluster on the same component suggest that component1 represents unhappy students, component 2 represents shortage of instructional equipment, and component 3 represents shortage of computers.

Table 4.7 Australia Limiting factors: Rotated component loadings for 14 items

	Component		
	1	2	3
Disruptive students	**.848**		
Low morale among students	**.793**		
Uninterested students	**.789**		
Student diversity limit academic ability	**.787**		
Wide range of background	.496	.431	
Student/teacher ratio	.487		
Shortage of other instructional equipment for students' usage		**.809**	
Shortage of textbooks		**.755**	
Shortage of equipment		**.672**	.457
Inadequate physical facilities		**.663**	
Shortage of computer hardware			**.826**
Shortage of computer software			**.772**
Shortage of support for using computers		.495	**.691**
Students with special needs			**.632**
Eigenvalues	3.358	2.852	2.833
% of Variance	23.987	20.368	20.238

4.3.5 South Africa: Homework

Kaiser – Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO = .826), great according to Field (2009) and Hutcheson & Sofroniou (1999).Bartlett's Test of Sphericity, x^2 (45) = 8251.860, $p < .001$.Three components had eigenvalues of each over Kaiser's criterion of 1 and in combination explained 64% of the variance. For communalities, the researcher retained factors with eigenvalues greater than 0.4, (see Appendix A) but the final guide was the use of the scree plot. The scree plot showed inflexions that justify retaining three components. Table 4.8 shows the factor loadings after rotation.

The items that cluster on the same component suggest that component 1 represents homework contribute to learning, component 2 represents homework contribute to performance, and component 3 represent content application.

Table 4.8 South Africa - Homework: Rotated component loadings for 14 items

	Component		
	1	**2**	**3**
How often assign homework	**.829**		
Doing problem or question sets	**.774**		
Correct assignments and give feedback	**.721**		
Monitor homework completion	**.643**	.448	
Gathering data and reporting	**.586**		
Minutes assigned for homework		**.823**	
Use homework as basis for discussion		**.682**	
Use homework to contribute towards marks	.443	**.547**	
Finding application of content covered			**.720**
Students correct their own homework		.460	**-.627**
Eigenvalues	3.016	2.276	1.123
% of Variance	30.162	22.765	11.228

4.3.6 Australia: Homework

The Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO = .631), mediocre according to Field (2009) and Hutcheson and Sofroniou (1999). Bartlett's Test of Sphericity, x^2 (45) = 4229.77, $p < .001$. Three components had eigenvalues of each over Kaiser's criterion of 1 and in combination explained 62% of the variance. For communalities, the researcher retained factors with eigenvalues greater than 0.4, (see Appendix B) but the final guide was the use of the scree plot. The scree plot showed inflexions that justified retaining three components. Table 4.9 shows the factor loadings after rotation. The items that cluster on the same component suggest that component 1 represents homework which contributes to learning, component 2 represents homework which contributes to performance, and component 3 represents content application.

Table 4.9 Australia Homework: Rotated component loadings for 14 items

	Component		
	1	**2**	**3**
Doing problem or question sets	**.808**		
Students correct their own homework	**.672**		
Minutes assigned for homework	**.649**	.423	
Use homework as basis for discussion	**.570**		
How often assign homework	**.489**		.443
Use homework to contribute towards marks		.828	
Monitor homework completion		**.774**	
Correct assignments and give feedback		**.700**	
Finding application of content covered			.829
Gathering data and reporting			**.597**
Eigenvalues	2.416	2.202	1.558
% of Variance	24.156	22.024	15.580

4.3.7 South Africa: Working conditions

A principal component analysis with a Varimax (orthogonal) rotation of 12 out of 12 scale questions was conducted on SA data. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO = .814), great according to Field (2009) and Hutcheson and

Sofroniou (1999). Not all the KMO values for individual items were (greater than) > .5 which is the acceptable limit (Field, 2009; Hutcheson & Sofroniou). Bartlett's Test of Sphericity, x^2 (66) = 1081.453, p <.001, indicated that correlations between items were sufficiently large for principal component analysis. Three components had eigenvalues of each over Kaiser's criterion of 1 and in combination explained 65% of the variance. For communalities, the researcher retained factors with eigenvalues greater than 0.4, (see Appendix A) but the final guide was the use of the scree plot. The scree plot was slightly ambiguous and showed inflexions that justify retaining three components. Table 4.10 shows the factor loadings after rotation. The items that cluster on the same component suggest that component 1 represents success and understanding of curricular goals, component 2 represents parental supports and involvement in students' achievements and component 3 represents safety and security.

Table 4.10 South African teachers belief on working conditions: Rotated component loadings for 11 items

	Component		
	1	**2**	**3**
Teachers' understanding curricular goals	.835		
Degree of success in school curriculum	.791		
Teachers' expectation of students	.723		
Teachers' job satisfaction	.683		
parental involvement in school activities		.860	
parental support student achievement		.812	
students' regard for school property		.702	

students desire to do well	.415	.653	
School facility		-.424	
Feel safe at school			.870
security policies and practices			.824
school safe neighbourhood			.802
Eigenvalues	2.762	2.681	2.359
% of Variance	23.013	22.341	19.655

4.3.8 Australia: Working conditions

A principal component analysis with a Varimax (orthogonal) rotation of 11 out of 12 scale questions was conducted on Australian data. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO = .874), great according to Field (2009) and Hutcheson and Sofroniou (1999). All the KMO values for individual items were (greater than) > .63 which is above the acceptable limit of .5 (Field, 2009; Hutcheson & Sofroniou). Bartlett's Test of Sphericity, x^2 (66) = 1309.96, $p < .001$. Three components had eigenvalues of each over Kaiser's criterion of 1 and in combination explained 68% of the variance. For communalities, the researcher retained factors with eigenvalues greater than 0.4, (see Appendix B) but the final guide was the use of the scree plot. The scree plot was slightly ambiguous and showed inflexions that justify retaining four components: Factors that loaded in more than one factor and factors where they had highest loadings were used. Table 6 shows the factor loadings after rotation. The items that cluster on the same component suggest that component 1 represents parental support and involvement in students' achievements, component 2 represents success and understanding of curricular goals, and component 3 represents safety and security.

Table 4.11 Australia teachers belief on working conditions: Rotated component loadings for 11 out of 12 items

	Component		
	1	2	3
Parental involvement in school activities	**.843**		
Parental support student achievement	**.826**		
Students' regard for school property	**.710**		
Students desire to do well	**.646**	.444	
Degree of success in school curriculum	.	**. 851**	
Teachers' understanding curricular goals		**.739**	
Teachers' job satisfaction		**.733**	
Teachers' expectation of students	.480	**.634**	
School safe neighbourhood			**.838**
Feel safe at school			**.824**
Security policies and practices			**.784**
Eigenvalues	2.880	2.717	2.503
% of Variance	24.001	22.644	20.856

4.4 RELIABILITY ANALYSIS

Reliability analysis measures the consistency of the questionnaire. All the items on the original questionnaire that had reversed phrased were recoded before any analysis took place. Separate reliability analysis was conducted for all sub constructs of the questionnaire, (see Appendices C and D). Cronbach's alpha indicates the overall reliability of a questionnaire, which is internal consistency measure (Treiman, 2009, p. 224). Cronbach's alpha (α) reliability coefficient normally ranges between 0 and 1. The closer Cronbach's alpha coefficient is to

1.0, the greater the internal consistency of the items in the scale. The size of alpha is determined by both the number of items in the construct and the average inter-item correlations (Field, 2009; Gliem & Gliem, 2003; Treiman, 2009). Table 4.12 shows Cronbach's α value, reliability analysis.

Table 4.12 SA: Reliability analysis for classroom factors

Construct	**Sub - construct**	**Component**	**Cronbach's alpha**
Teacher characteristics	Teachers attitude to teaching (7 items)	Real world problems Problem solving Memorizing Maths	.531 .285 .195
Instructional Quality	Teachers confidence (18 items)	Graphical functions Data collection methods Decimal fractions	.898 .935 .837
	Interaction with other teachers (4 items)	Observation Collaboration	.705 .449
	School climate (4 items)	School climate	.550
	Teachers belief on working conditions	Parental involvement Working conditions	.891 .769
	Opportunity to learn (9 items)	Maths application Practice mathematics together	.678 .657
	Homework (10 items)	Contribute to learning Contribute to performance	.780 .629
Curriculum Quality	Topic coverage (45 items)	Number operations Geometric shapes Data organisation Measurement Functions Algebraic Functions	 .834 .863 .708 .641 .770

Construct	**Sub - construct**	**Component**	**Cronbach's alpha**
	Learning resources (9 items)	Practice Skills and Procedures Use of calculator	.972 .817
Classroom Quality	Student limiting factors (6 items)	Unhappy students Student diversity	.824 .526
	Shortage of learning resources (8 items)	Shortage of instructional equipment Computer shortages	.782 .914

Table 4.12 shows important values of Cronbach's alpha (α) for South Africa and Australia, this is the overall reliability of the scale. The values indicate high reliability for most of the scales as the values are above 0.8 (Pietersen & Maree, 2007b). All items have item total correlations above 0.3 and therefore were retained.

The values in the column Corrected Item –Total Correlation are the correlation between each item and the total score from the questionnaire. All items correlate with the total score, all values are above 0.3 (see Appendix C and D). This means all items correlate very well with the scale overall. Deleting these items will not improve the reliability, as the overall α will remain unchanged. Therefore, none of the items affect reliability if deleted. All items positively contribute to the overall reliability. All items with Cronbach's α above .5 are worthy of retention (Field, 2005; 2009).

Table 4.13 Australia: Reliability analysis for classroom factors

Construct	Sub - construct	Component	Cronbach's alpha Australia
Teacher characteristics	Teachers attitude to teaching (7 items)	Real world problems Problem solving Memorizing Maths	.612 .581 .499
Instructional Quality	Teachers confidence (18 items)	Graphical functions Data collection methods Decimal fractions	.913 .880 .797
	Interaction with other teachers (4 items)	Observation Collaboration	.673 .240
	School climate (4 items)	School climate	.876
	Teachers belief on working conditions	Parental involvement Working conditions	 .918
	Opportunity to learn (9 items)	Maths application Practice mathematics together	.546 .659
	Homework (10 items)	Contribute to learning Contribute to performance	.731 .745
Curriculum Quality	Topic coverage (45 items)	Number operations Geometric shapes Data organisation Measurement Functions Algebraic Functions	.889 .828 .773 .733 .621 .703
	Learning resources (9 items)	Practice Skills and Procedures Use of calculator	.967 .885
Classroom Quality	Student limiting factors (6 items)	Unhappy students Student diversity	.819
	Shortage of learning resources (8 items)	Shortage of instructional equipment Computer shortages	.651 .889

4.5 CORRELATION ANALYSIS

Correlation is a statistical technique that shows whether and how strongly pairs of variables are related to each other. In conducting correlation analysis, the researcher wanted to identify key classroom level factors that affect learner achievement in mathematics for South Africa and Australia. The researcher used SPSS to establish two things: firstly, if there was a relationship between the two variables (bivariate correlation), that is between classroom factors and mathematics achievement score; secondly, the strength of the relationship, which is determined by the value of the correlation coefficient. A coefficient of +1 indicates that the two variables are perfectly positively correlated, as one variable increases, the other variable increases by the proportionate amount or as one variable decreases, the other variable decreases proportionately. A coefficient of -1 indicates that the two variables are perfectly negatively correlated, as one variable increases, the other variable decreases by the proportionate amount, or vice versa (Field, 2009, p. 170).

In South Africa, there are four variables that had a correlation coefficient that is above 0.2 (Cho, 2010; Cohen et al., 2007; Howie, 2002). The researcher has indicated earlier in the methodology section that 0.2 is acceptable for this exploratory study. Teacher's age is positively related to the mathematics score with a Pearson correlation coefficient of $r = .24$ and the significance value is less than 0.001 (see Appendix E).The significance value is influenced by the sample size. A large sample tends to indicate significant results and the magnitude of the correlation is important. The matrix of the correlation coefficient also shows the variable, years been teaching had a correlation coefficient of $r = .33$ and the significance value is p (two tailed) $< .001$. The other variable is outside school day grading test, $r = .28$, which is also significant at p (two tailed) $< .001$. These variables contribute positively in the mathematics score for South Africa.

Table 4.14 South Africa: Correlation of classroom factors with mathematics score

Factor	Individual variables	Pearson Correlation mathematics score
Age	Teacher's age	.267**
Years been teaching	Number of years as a teacher	.306**
Outside school day grading tests	Number of hours teacher spends on teaching – related activities outside the formal school day	.285**
Outside school day other	Number of hours teacher spends on other duties	.319**
Computer shortage	Shortage of computers in mathematics classroom	-.266**

*

*Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

In Australia, the following variables had a correlation coefficient that is above 0.2 (Cho, 2010; Howie, 2002). The teacher perception of school climate is positively correlated to mathematics scores with a Pearson correlation coefficient of r = .38, and had significance value which is p (two tailed) < .001. Teachers' perception of school safety had a correlation coefficient of r = .22 and p (two tailed) < .001 (see Appendix F). Teachers' emphasis on homework had a correlation coefficient of r = .26, p (two tailed) < .001. Teacher repeat mathematics limiting factors, r = .27, p (two tailed) < .001. Homework contributing to learning, r = .30, p (two tailed) < .001; geometric shapes r = .23, p (two tailed) <.001; algebraic function r = .25 and p (two tailed) < .001; and work conditions r = .44, p (two tailed) < .001.There were two variables which are negatively correlated (see Appendix F), these are unhappy students r = -.23, p (two tailed) < .001; and shortage of instructional equipment r = -.27, p (two tailed) < .001). In the case of these two variables, as one variable increases the other variable decreases. As the level of unhappiness of students increase, the mathematics achievement decreases. Also, the shortage of instructional equipment negatively affects the mathematics achievement. Table 4.13 below shows a summary of the Pearson Correlation of mathematics score for South Africa and Australia. It is interesting to note that factors correlating to mathematics performance between the two countries are different.

Table 4.15 Australia: Correlation of classroom factors with mathematics score

Factor	Individual variables	Pearson Correlation mathematics score
Teacher perception of school climate	Teacher's perception of school facility, security and policies.	.374**
Teacher perception of school safety	Teachers perception and feeling of safety at school and neighbourhood	.240**
Teacher emphasis on mathematics homework	Teacher emphasis on mathematics homework with regard to frequency, amount, type and use.	.259**
Teacher repeat maths limiting factors	Extent to which the teacher perceives various student and resource factors to limit teaching	.323**
Homework contribute towards learning	Teacher's use of homework to contribute towards mathematics learning	.324**
Work conditions	Teacher's perception of teacher's job satisfaction and expectations for student achievement; of parental support and involvement; and students' regard for school property and desire to do well in school.	.437**
Unhappy students	Composite factor	-.340**
Shortage instructional equipment	Composite factor	-.271**
Geometric shapes	Composite factor	.205**
Algebraic functions	Composite factor	.212**

4.6 MULTIPLE REGRESSION

Multiple regression analysis is a method for explanation of phenomena and prediction of an outcome. All variables with a correlation value greater than 0.2 were retained for further analysis. A coefficient of correlation between dependent and independent variables is a quantitative index of association between the two variables (Field, 2009). In its squared form, as a coefficient of determination, this indicates the amount of variance in the criterion (dependent, Y) which is the mathematics score variable which is accounted for by the variation in the predictor (independent, X) variables. Coefficient of determination (R square) is computed as a value between 0 (0 percent) and 1 (100 percent). The higher the value, the better the fit. A low r-square indicates that there is no significant relationship between the two variables. The set of predictor variables is used to explain variability of the criterion variable. Initially, a matrix of correlations is computed for all variables involved in the analysis.

Coefficient of determination is a measure of the goodness of fit of the relationship between the dependent and independent variables in a regression analysis, also called r-square (Field, 2009; Brace, Kemp & Snelgar, 2006; Neill, 2007). The Standard Beta Coefficients gives a measure of the contribution of each variable to the model. A large value indicates that a unit change in this predictor variable has a large effect on the criterion variable. The *t* and significant (*p*) values give a rough indication of the impact of each predictor variable. A big absolute *t* value and small *p* value suggests that a predictor variable haves a large impact on the criterion variable (Brace, Kemp & Snelgar, 2006, p. 216).

In the model summary, the Adjusted R square value (see Appendix G) for SA tells us that model 1, which included only outside school day other, accounted for 10% of variance in the mathematics achievement. The inclusion of computer shortage into model 2 resulted in an additional 6% of the variance being explained (R square changed = 0.062). The inclusion of outside school day grading tests into model 3 resulted in an additional 5% of the variance being explained (R square changed = 0.050). The inclusion of years been teaching into model 4 resulted in an additional 3% of the variance explained (R square changed = 0.025). The final model 5 also included age of teacher, and this model accounted for 24% of the variance (Adjusted R square = .240).

The standardized beta coefficients (β) are provided by the SPSS (see Appendix G) below is a brief discussion of the contribution of the standardized beta coefficients to the final model. The standardized beta coefficients give a measure of the contribution of each variable to the model, and the values are all measured in standard deviation units (Field, 2009, p. 239). Outside school day other = .23, this value indicates that outside school other increases by one standard deviation, learner achievement by .23 standard deviations. Computer shortage = -.23, this value indicates that outside school other increases by one standard deviation, learner achievement by .23 standard deviations. Outside school grading test = .17, this value indicates that outside school grading tests increases by one standard deviation, learner achievement by .17 standard deviations; Years been teaching/teaching experience = .12, this value indicates that years been teaching increases by one standard deviation, learner achievement by .12 standard deviations; and Age of teacher = .08, this value indicates that age of teacher increases by one standard deviation, learner achievement by .08 standard deviations. Therefore, every additional increase in the standardized beta coefficients is associated with an increase in learner achievement of the relevant value of the standardized beta coefficient. The effects are true if the effects of the other standardized beta coefficient are held constant (Field, 2009, p. 239). The model is adequate when taking into consideration that some key variables on school level and learner level were not included which could explain the variance. Table 4.14 below, depicts the summary of multiple regressions for South Africa, for more details (see Appendix G).

In both ANOVA and multiple regressions, the researcher seeks to account for the variance in the scores observed. In ANOVA the researcher was determining how much of the variance is accounted for by the manipulation of the independent variables, that is relative to the percentage that cannot be accounted for. The F – ratio for the final model is 141, 78, which is very unlikely to have happened by chance ($p < .001$). It is possible to interpret the results as the final model is significant and predict the learner achievement outcome (Field, 2009, p. 237).

In this case, the regression equation	[y'= bx + a]
Final model becomes	y' = 10.003 (x) + 215.553

Table 4.16 South Africa: Coefficients

	B	SE B	β	t	Sig.
Model 1					
Constant	223.34	2.35		95.06	.000
Outside school day other	13.92	.88	.32	15.89	.000
Model 2					
Constant	278.33	4.83		57.64	.000
Outside school day other	13.35	.85	.31	15.77	.000
Computer shortage	-3.79	.29	-.25	-12.90	.000
Model 3					
Constant	254.69	5.09		50.05	.000
Outside school day other	11.75	.85	.27	14.13	.000
Computer shortage	-3.61	.29	-.24	-12.67	.000
Outside school day grading tests	5.06	.43	.23	.23	.000
Model 4					
Constant	234.32	5.55		42.20	.000
Outside school day other	9.85	.85	.23	11.61	.000
Computer shortage	-3.55	.28	-.24	-12.65	.000
Outside school day grading tests	4.06	.44	.18	9.32	.000
Years been teaching	2.82	.33	.17	8.51	.000
Model 5					
Constant	215.55	8.48		25.41	.000
Outside school day other	10.00	.85	.23	11.78	.000
Computer shortage	-3.51	.28	-.23	-12.53	.000
Outside school day grading tests	3.90	.44	.17	8.89	.000
Years been teaching	1.98	.34	.12	5.50	.000
Age of teacher	9.28	3.18	.08	2.92	.037

Note: R^2 = .10 for Model 1, ΔR^2 = .06 for model 2, ΔR^2 = .05 for model 3, ΔR^2 = .03 for model 4, ΔR^2 = .00 for model 5, ($p<.001$),* $p < .001$

In Australia, the model summary, the Adjusted R square value (see Appendix H) shows that the model accounts for 31% of variance in teacher repeat mathematics limiting factors (R square changed = .318). The standardized beta coefficients give a measure of the contribution of each variable to the model (Field, 2009, p. 239). Homework contributes to learning = .12, this value indicates that outside school other increases by one standard deviation, learner achievement by .12 standard deviations. Work conditions = .37, this value indicates that outside school other increases by one standard deviation, learner achievement by .37 standard deviations. Unhappy students = -.10, this value indicates that outside school other increases by one standard deviation, learner achievement by -.10 standard deviations. Shortage of instructional equipment = -

.02, this value indicates that outside school other increases by one standard deviation, learner achievement by -.02 standard deviations. Geometric shapes = -.11, this value indicates that outside school other increases by one standard deviation, learner achievement by -.11 standard deviations. Algebraic function = .23, this value indicates that outside school other increases by one standard deviation, learner achievement by .23 standard deviations. Teacher perception of school climate = -.07, this value indicates that outside school other increases by one standard deviation, learner achievement by -.07 standard deviations. Teacher perception of school safety = .04, this value indicates that outside school other increases by one standard deviation, learner achievement by .04 standard deviations. Teacher emphasis on mathematics homework = .24, this value indicates that outside school other increases by one standard deviation, learner achievement by .24 standard deviations. Teacher repeat mathematics limiting factors = .03, this value indicates that outside school other increases by one standard deviation, learner achievement by .03 standard deviations.

Therefore, every additional increase in the standardized beta coefficients is associated with extra learner achievement of the relevant value of the standardized beta coefficient. If the effects of other standardized beta coefficients are held constant, the effects are true (Field, 2009, p. 239). This is a good model for the reason that some important variables on school and learner levels were not included that could explain the variance (Brace, Kemp & Snelgar, 2006, p. 218). Table 4.15 below, depicts the summary of multiple regressions for Australia, for more details (see Appendix H).

For Australia, ANOVA tests whether the model is significantly better at predicting the outcome rather than using the mean as best guess. Only one model, the F – ratio is 52. 11 which is very unlikely to have happened by chance, $p < .001$.

In this case, the regression equation	[y'= bx + a]
becomes	y' = (3.948) x + 267.122

Table 4.17 Australia: Coefficients

	B	SE B	*β*	t	Sig.
Model 1					
Constant	267.12	28.86		9.26	.000
Work conditions	5.41	.98	.37	5.54	.000
Algebraic function	10.35	1.28	.23	8.12	.000
Geometric shapes	-2.79	.80	-.11	-3.48	.001
Homework contribute to learning	3.95	1.18	.12	3.35	.001
Shortage of instructional equipment	-.61	.95	-.02	-.64	.522
Unhappy students	-1.85	.94	-.10	-1.96	.050
Teacher repeat mathematics limiting factors	3.09	5.24	.03	.59	.555
Teacher emphasis on mathematics homework	30.93	4.15	.24	7.46	.000
Teacher perception of school safety	5.79	4.84	.04	1.20	.231
Teacher perception of school climate	-8.84	6.81	-.07	-1.30	.194

Note: $R^2 = .32$ for Model 1, $\Delta R^2 = .32$, $*p < .001$, ($p< .001$)

4.7 SUMMARY

Data exploration was conducted to identify factors that may affect learner achievement in mathematics in South Africa and Australia. Factor analysis, principal component analysis and reliability analysis were conducted on sets of items. Sets of items with a reliability coefficient Cronbach α of at least .50 were retained as composite variables or components (Field, 2009, p. 659). A correlation analysis was used to identify possible variables linked to mathematics learner achievement. All variables with a correlation coefficient above .2 were retained for further analysis.

Multiple regressions was then conducted, and five models for South Africa and one model for Australia was created through SPSS output. The models are good considering that this secondary analysis is an exploratory study with involve a lot of data. All the statistical techniques explain the variance in the level of one variable on the basis of the level or one or more other variables, and the coefficient of determination representing the percent of the data that is the closest to the line of best fit. The fit of the regression model was assessed using the model summary and ANOVA tables from SPSS. ANOVA depicted that the South Africa and Austria models are significant fit of the data overall, $p < .001$.

CHAPTER 5

RESEARCH FINDINGS AND RECOMMENDATIONS

5.1 INTRODUCTION

This study used TIMSS 2003 survey data to explore key classroom level factors affecting mathematics achievements for South Africa and Australia. The data collection in South Africa and Australia was conducted in October-December 2002 as both countries are located in the Southern Hemisphere. The data collection was administered at the eighth grade. The sample for South Africa consisted of 255 schools with 100% coverage and stratification done by a total of nine provinces, and language. This resulted in 8952 learners tested across the provinces (Joncas, 2004, p. 212). For Australia, the sample consisted of 207 schools with 100% coverage and stratification done by a total of 8 States and Territories and school type. This resulted in 4791 learners participating in the study (Joncas, 2004, p. 212).

The sample includes teachers of learners who were selected to participate in the TIMSS 2003 study for South Africa and Australia. The intended target is the teachers of all learners at the end of their eight year of schooling. For each participating school, a single mathematics class was sampled and the mathematics teacher of the selected class was asked to complete a mathematics questionnaire. The mathematics teachers of sampled learners responded to questions about teaching emphasis on the topics in the curriculum frameworks, instructional practices, professional training and education and their views on mathematics (Martin et al., 2004, Mullis et al., 2003). The mathematics teacher questionnaire was designed to take about 45 minutes to complete.

In this chapter, summary of the research findings is discussed in terms of several statistical analyses that were conducted in order to establish factors affecting mathematics achievement and able to respond to the research questions. The data wer analyzed through the use of statistical analyses which included factor, reliability, correlation and multiple regressions for South Africa and Australia. The selection of variables for the inclusion in the models was guided by the conceptual framework and extensive preliminary analyses. Preliminary statistical analyses included exploring descriptive statistics, factor, reliability and correlation analysis to better identify the factors associated with classroom level factors affecting mathematics achievement.

The structure of the chapter is as follows. First, summary of the findings in section 5.2, followed by summary of results per research question in section 5.3, followed by reflection on literature in section 5.4, followed by reflection on conceptual framework in section 5.5, followed by reflection on methodology in section 5.6, followed by recommendations in section 5.7. Lastly is discussion in section 5.8.

5.2 SUMMARY OF THE FINDINGS

This secondary analysis study used the TIMSS 2003 data to explore relationships and patterns among the variables through factor, reliability, correlation and multiple regressions analyses. A sample of 255 schools and 8952 learners for South Africa and 207 schools and 4791 learners for Australia participated in the study. The selection was one teacher per school per class, that is 255 teachers for South Africa and 207 teachers for Australia participated.
This was a secondary analysis, for the two countries, large sample size and missing data was not serious, it was less than 5%, a mean was used to replace the missing data.

The Statistical Package for the Social Sciences (SPSS) software was used to analyze data. South Africa and Australian data was explored through descriptive statistics. Descriptive statistics assisted to describe and present data in terms of summary frequencies (Cohen et al., 2007; Creswell, 2005, Field, 2009). Thereafter, frequencies of all classroom factors was explored and used to design construct and correlation matrix was examined. Male teachers still seem to be predominantly South Africa. The study found that in South Africa, 40% of mathematics learners are taught by female teachers and 60% by male teachers. In Australia, 54% of mathematics learners are taught by female teachers and 46% by male teachers. The majority of South African TIMSS mathematics teachers (57%) are aged between 30-39 years, whereas in Australia 35% of mathematics teachers are aged between 40-49 years and 25% aged between 30-39 years. In South Africa, more than 80% of teachers have taught for more than 5 years, whereas in Australia, 75% of teachers have taught for more than 5 years.

Factor analysis was conducted to identify factors that explain common variance among variables (Cohen et al., 2007; De Coster, 1998; Field, 2009). That is trying to measure things that cannot be directly measured. It assisted the researcher to reduce data to smaller manageable number and assist in scale development. Principal components analysis was used for extraction since it evaluates all sources of variability for each variable. Orthogonal rotation method (Varimax) was used for rotation of factors to make the components more interpretable. Four criteria to determine the number of components to retain was used. *Firstly*, components with eigenvalues greater than 1 were retained, *secondly*, components that account for at least 70% total variability were retained, *thirdly*, all components on the scree-plot within the sharp descent, before eigenvalues level off were retained, and *fourthly*, the components generated by the model if only a few residual exceed 0.05. The researcher then interpreted and named the components (see Appendix A and B, and Table 4.12) by evaluating the type of variables included in each factor, the strength and direction of factor loadings (De Coster, 1998; Field, 2007, Pietersen & Maree, 2007b; Singh, 2007). The factor analysis for South Africa identified 26 factors whilst 25 factors were extracted from the Australian teacher data.

The reliability analysis of all constructs was tested to establish correlation between variables. The reliability coefficients were calculated to construct internal consistency for subscales. Factors below the criterion, alpha = 0.5 were eliminated.

Table 5.1 Reliability analysis for classroom factors

Construct	Sub - construct	Component	Cronbach's alpha	
			South Africa	Australia
Teacher characteristics	Teachers attitude to teaching (7 items)	Real world problems	.531	.612
		Problem solving	**.285**	.581
		Memorizing Maths	**.195**	**.499**
Instructional Quality	Teachers confidence (18 items)	Graphical functions	.898	.913
		Data collection methods	.935	.880
		Decimal fractions	.837	.797
	Interaction with other teachers (4 items)	Observation	.705	.673
		Collaboration	**.449**	**.240**
	School climate (4 items)	School climate	.550	.876
	Teachers belief on working conditions	Parental involvement	.891	
		Working conditions	.769	.918
	Opportunity to learn (9 items)	Maths application	.678	.546
		Practice mathematics together	.657	.659
	Homework (10 items)	Contribute to learning	.780	.731
		Contribute to performance	.629	.745
Curriculum Quality	Topic coverage (45 items)	Number operations		.889
		Geometric shapes	.834	.828
		Data organisation	.863	.773
		Measurement	.708	.733
		Functions	.641	.621
		Algebraic Functions	.770	.703
	Learning resources (9 items)	Practice Skills and Procedures	.972	.967
		Use of calculator	.817	.885
Classroom Quality	Student limiting factors (6 items)	Unhappy students	.824	.819
		Student diversity	.526	
	Shortage of learning resources (8 items)	Shortage of instructional equipment	.782	.651
		Computer shortages	.914	.889

Bivariate correlation analysis was conducted to identify factors that correlate with mathematics achievement. Each of the components and previously identified individual variables were explored in relation to the mean mathematics score. The criterion used was that all the variables with a correlation coefficient (r) value above 0.2 were included for further analysis (Cho, 2010; Cohen et al., 2007; Creswell, 2005; .Howie, 2002). Finally, correlation between the factors and achievement was examined. Correlation analyses for South Africa identified 5 significant scales, namely: age, years been teaching, outside school day grading tests, outside school day other, and computer shortage, see Table 5.2. Whilst correlation analyses for Australia identified 10 significant scales at the 0.01 and 0.05 significant level, namely, teacher perception of school climate, teacher perception of school safety, teacher emphasis on mathematics homework, teacher repeat mathematics limiting factors, homework contribute towards learning, work conditions, unhappy students, shortage of instructional equipment, geometric shapes, and algebraic functions, see Table 5.2. The above analyses assisted to identify factors for further analysis. Table 5.2 presents a summary of correlation analysis for both South Africa and Australia.

Table 5.2 Correlation of classroom factors

Factor	Individual variables	Pearson Correlation mathematics score	
		South Africa	Australia
Age	Teacher's age	.267**	
Years been teaching	Number of years as a teacher	.306**	
Outside school day grading tests	Number of hours teacher spends on teaching – related activities outside the formal school day	.285**	
Outside school day other	Number of hours teacher spends on other duties	.319**	
Computer shortage	Shortage of computers in mathematics classroom	-.266**	
Teacher perception of school climate	Teacher's perception of school facility, security and policies.		.374**
Teacher perception of school safety	Teachers perception and feeling of safety at school and neighbourhood		.240**
Teacher emphasis on mathematics homework	Teacher emphasis on mathematics homework with regard to frequency, amount, type and use.		.259**
Teacher repeat maths limiting factors	Extent to which the teacher perceives various student and resource factors to limit teaching		.323**
Homework contribute towards learning	Teacher's use of homework to contribute towards mathematics learning		.324**
Work conditions	Teacher's perception of teacher's job satisfaction and expectations for student achievement; of parental support and involvement; and students' regard for school property and desire to do well in school.		.437**
Unhappy students	Composite factor		-.340**
Shortage instructional equipment	Composite factor		-.271**
Geometric shapes	Composite factor		.205**
Algebraic functions	Composite factor		.212**

Multiple regression analysis is an extension of correlation analysis. It was used to explore and identify factors which influence the achievement in mathematics and which classroom factors added the most value to the achievement of learners in mathematics. Stepwise procedure was used. Stepwise method selects the predictor that has the highest simple correlation with the outcome. The results for the final South African model is presented in Table 4.16, five factors, age of teacher, years been teaching, outside school day grading tests, outside school day other and computer shortage were identified to predict learner achievement. For Australia ten classroom factors, namely teacher perception of school climate, teacher perception of school safety, teacher emphasis on mathematics homework, teacher repeat mathematics limiting factors, homework contribute towards learning, work conditions, unhappy learners, shortage of instructional equipment, geometric shapes, and algebraic functions) were identified to predict learner achievement (see Table 4.17). Part of the SPSS output contains ANOVA that tests whether the model is significantly better at predicting the learner achievement than using the mean as a best guess. The F ratio represents the ratio of improvement in prediction (Field, 2009, p. 236).

5.3 SUMMARY OF RESULTS PER RESEARCH QUESTION

The purpose of this research was to explore and compare classroom level factors affecting mathematics achievement between South Africa and Australia from the perspective of school effectiveness. South African and Australian data was explored through statistical analyses including descriptive, factor, reliability and correlation analyses. Variables were selected for further analysis in multiple regressions analysis. The results of descriptive, factor, reliability, correlation and multiple regressions were discussed in Chapter 4.

The main research question, which is “*What are the key classroom level factors that influence learner performance in mathematics?”* The mathematics teacher questionnaire consists of a large number of variables concerning background information. Some of the items were single and others consisted of sets of items. Based on the conceptual framework described in Chapter 2, items of the questionnaire were reorganized and renamed. Factor analysis was conducted to identify the underlying constructs in the two countries.

A number of classroom level factors were identified from literature and these resulted in including the following factors: teachers gender, teaching experience, level of education, time on task, lesson preparation, teaching load, time spent on activities, resources, limitations, class size, teacher's attitudes, teacher's beliefs. This question examines the classroom level factors that influence learner performance in mathematics between South Africa and Australia. It takes into account the classroom processes and the teacher characteristics as the main contributing factors to learner performance. The main research question is translated into three sub-questions. Each sub-question is presented and answered separately according to the findings:

5.3.1 What key variables on classroom level are related to learner achievement in mathematics for South Africa?

Taking into account the literature review, the conceptual framework and the analysis, there are 5 factors in South Africa that were identified and had significant correlation with mathematics achievement (see Table 5.3). The results for the final South African model were: age of teacher; years been teaching; outside school day grading tests; outside school day other; and computer shortage were identified to predict learner achievement. The other factors like work done outside school day other and grading tests contribute positively, that it has positive correlation with learner achievement. This could include work like planning, reflecting on the lessons presented and interactions as well as providing immediate effective feedback to learners and involving parents where necessary (Cotton, 1988, Taylor & Vinjevold, 1999). Feedback provided to learners has proved to be the single most powerful factor that enhances learning achievement (Todd & Mason, 2005; Schelfhout, Van Landeghem, Van den Broeck, & Van Damme, 2007).

Interestingly, the literature in South Africa has identified factors that have an effect on poor performance of learners, this included inadequate subject knowledge of teachers, inadequate ability of learners in the language of instruction, lack of instructional materials; difficulties experienced by teachers to manage classroom activities, lack of professional leadership, pressure to complete examination driven syllabi, heavy workloads, overcrowded classrooms, lack of support from professional staff, poor communication between policy makers and practitioners; high rates of teacher absenteeism and teacher unionism (Adler, 1998; Arnott & Kubeka, 1997; Kahn, 1993; Monyana, 1996; Setati & Adler, 2000; Taylor & Vinjevold, 1999). The above factors did not form part of any of the factors identified to predict learner performance of this study.

However, the literature confirmed that there is consistency in finding correlation between years of teaching experience and higher learner achievement (Ferguson & Ladd, 1996; Greenwald, Hedges & Laine, 1996; Rice, 2003). Shortage of computers is negatively correlated to learner achievement, which means the increase in computer shortage is the decrease in learner achievement.

In South Africa, the final model included standardized age of teacher, and this model accounted for 24% of the variance (Adjusted R square = .24). The standardized beta coefficients (β) are provided by the SPSS. The standardized beta coefficients give a measure of the contribution of each variable to the model, and the values are all measured in standard deviation units (Field, 2009, p. 239). This is a very good model, taking into consideration that some key variables on school level and learner level were not included which could explain the variance (see Appendix G).

5.3.2 What key variables on classroom level are related to learner achievement in mathematics for Australia?

In Australia majority of mathematics learners (54%) are taught by female teachers, and 35% are aged between 40 – 49 and 25% are aged between 30 – 39. Austrian highest age percentages are spread over two age groups. The study found that teacher qualifications have little influence on classroom achievement. This is despite the popular notion about teacher qualification, may be what matters most is the relevance of qualification to the subjects that teachers teach. The teacher experience and education level are characteristics that are commonly assumed to correlate with greater teacher effectiveness. Similarly, the level of teacher education was found to have no effect on learner achievement. The same findings by Giglio (2009) in the study conducted in Los Angeles public schools.

In Australia, classroom level performance in mathematics is affected by factors which include the teaching and learning environment, teacher quality, teacher competence, time on task, disruptions in class, teacher confidence, teacher attitude towards mathematics, teacher qualifications, class size, content coverage, assessment, learner attitude towards mathematics, teacher personality, instructional material, language of instruction, teaching load, opportunity to learn and academic orientation (Bos & Kuiper, 1999; Howie, 2005; Lokan & Greenwood, 2000; Mac Iver, 1987; Muijs & Reynolds, 2000). Reviews of the literature found that factors such as textbooks, teacher quality and time on task were identified as being key factors for learner achievement (Creemers, 1996; Greenwald, Hedges & Laine, 1996; Riddell, 1997)

Similarly, Australia has an average class size of 28 (see Table 4.2 above). The average class size of Australia is almost half of South Africa. However, a meta-analysis study on class sizes conducted by Glass & Smith (1979) and Glass, McGaw & Smith (1981) concluded that class size of less than 20 learners are more effective in teaching and learning and yield better improved learner achievement. The average class size (28) for Australia is almost comparable to the 20 learners as recommended by the meta-analysis study.

Similarly, based on the literature review, the conceptual framework and the analysis, there are 10 factors in Australia that were identified and had significant correlation with mathematics achievement (see Table 5.1). For Australia ten classroom factors, namely, teacher perception of school climate; teacher perception of school safety; teacher emphasis on mathematics homework; teacher repeat mathematics limiting factors; homework contribute towards learning; work conditions; unhappy learners; shortage of instructional equipment; geometric shapes; and algebraic functions were identified to predict learner achievement.

In Australia, the model summary, the Adjusted R square value (see Appendix H) shows that the model accounts for 32% of variance in teacher repeat mathematics limiting factors (R square changed = .32). The standardized beta coefficients (β) give a measure of the contribution of each variable to the model (Field, 2009, p. 239). This is a good model for the reason that some important variables on school and learner levels were not included that could explain the variance (Brace, Kemp & Snelgar, 2006, p. 218).

5.3.3 How does the classroom level factors in mathematics performance of South Africa compare with classroom level factors in Australia?

Based on the responses of question 5.3.2 and 5.3.3, there are 5 and 10 factors

According to the literature for South Africa and Australia, classroom performance is affected by factors in terms of similarities which include content coverage; teaching load; language of instruction; instructional materials; disruptions in class/difficulties to manage classroom activities and subject knowledge. In terms of differences for South Africa: lack of professional leadership; overcrowded classrooms, poor communication between policy-makers and practitioners and lack of support from professional staff; and for Australia: teaching and learning environment, teacher quality, time on task, teacher attitudes towards mathematics, teacher qualifications, class size; opportunity to learn and academic orientation achievement (Adler, 1998; Arnott & Kubeka, 1997; Creemers, 1996; Greenwald, Hedges & Laine, 1996; Kahn, 1993; Monyana, 1996; Riddell, 1997; Setati & Adler, 2000; Taylor & Vinjevold, 1999).

A study conducted by Darling-Hammond (1999) found that teacher's knowledge of the content is a consistent strong predictor of learner performance, even though studies differ in how strong are the effects. In addition, Goldhaber and Brewer (1996) found that the presence of a teacher with at least a major in the subject area was the most reliable predictor of learner achievement in mathematics. Furthermore, is that the correlation analysis conducted revealed that there is a statistically significant relationship between improvement in mathematics performance and the amount of time spent on the activity (Louw, Muller & Tredoux, 2008; Sciarra & Seirup, 2008).

5.4 REFLECTION ON LITERATURE

The study can contribute to the research literature from the point of view of comparing a developing country and a developed country. Effectiveness and success of an education system is determined through the quality of learner achievement (Scheerens, 1992; Scheerens & Bosker, 1997). International studies, such as TIMSS, MLA, SACMEQ II, Systemic Evaluation, and Annual National Assessment (ANA) suggest that learners' scores particular in mathematics are far below what is expected at all levels of the schooling system, both in relation to other countries (including other developing countries) and in relation to the expectations of the South African curriculum developers and policy makers (Taylor, Muller & Vinjevold, 2003, p. 41). Educational quality in historically black schools which constitute 80% of enrolment has not improved since political transition, despite large resource transfers to such schools (van der Berg, 2008). Furthermore, a study conducted by Taylor (2007) concludes that "interventions in poorly performing schools, which constitute around 80%, have realized some impact but proved to be highly inefficient."

The results from South Africa and Australia revealed two different set of factors that can affect learner performance. For Australia, there are 10 factors to predict or explain learner achievement as compared to 5 factors to predict or explain learner achievement. South Africa has factors like teacher background and outside school activities by the teacher. Australia has factors like classroom climate, work conditions and curriculum quality.

In the light of schools effectiveness research and school improvement research, a comparative study like this one would require more than one level (classroom level), two or three levels would have been ideal to draw other variables and enrich the analysis, especially the teacher and the learner level or school level. School effectiveness places an emphasis on the ability and social background of the learners as factors that shape academic performance (Lamb & Fullarton, 2002; Townsend, 1994).

5.5 REFLECTION ON CONCEPTUAL FRAMEWORK

The study focused in the classroom where teaching and learning takes place. Mathematics classroom is a complex social setting where teachers and learners interact continuously. The interaction in the classroom is characterized by a number of factors (Clarke, 2001, Froyen, 1988, Papanastasiou, 2000).

Mathematics teacher and the learner are main role players in the classroom. Mathematics classrooms exist within the social contexts of schools, which are characterized by school environment/climate that often translate into the classrooms. The study aims to explore and compare key classroom factors affecting mathematics achievement between South Africa and Australia, using TIMSS 2003 data.

The conceptual framework stressed classroom level factors including instructional quality, which includes teacher background factors, classroom climate, teaching requirements and mathematics curriculum. Thereafter, this translates into learner achievements. The model describes the factors related to classroom interactions within the comprehensive education system, with regard to inputs – process – outputs – outcomes (Howie, 2002; Shavelson et al., 1987; Travers & Westbury, 1989). There are factors identified in South Africa and Australia (Table 5.3) below and other factors.

Figure 5.2 includes school and learner characteristics in the framework which was not included in the initial conceptual framework. Learner characteristics include learner background factors

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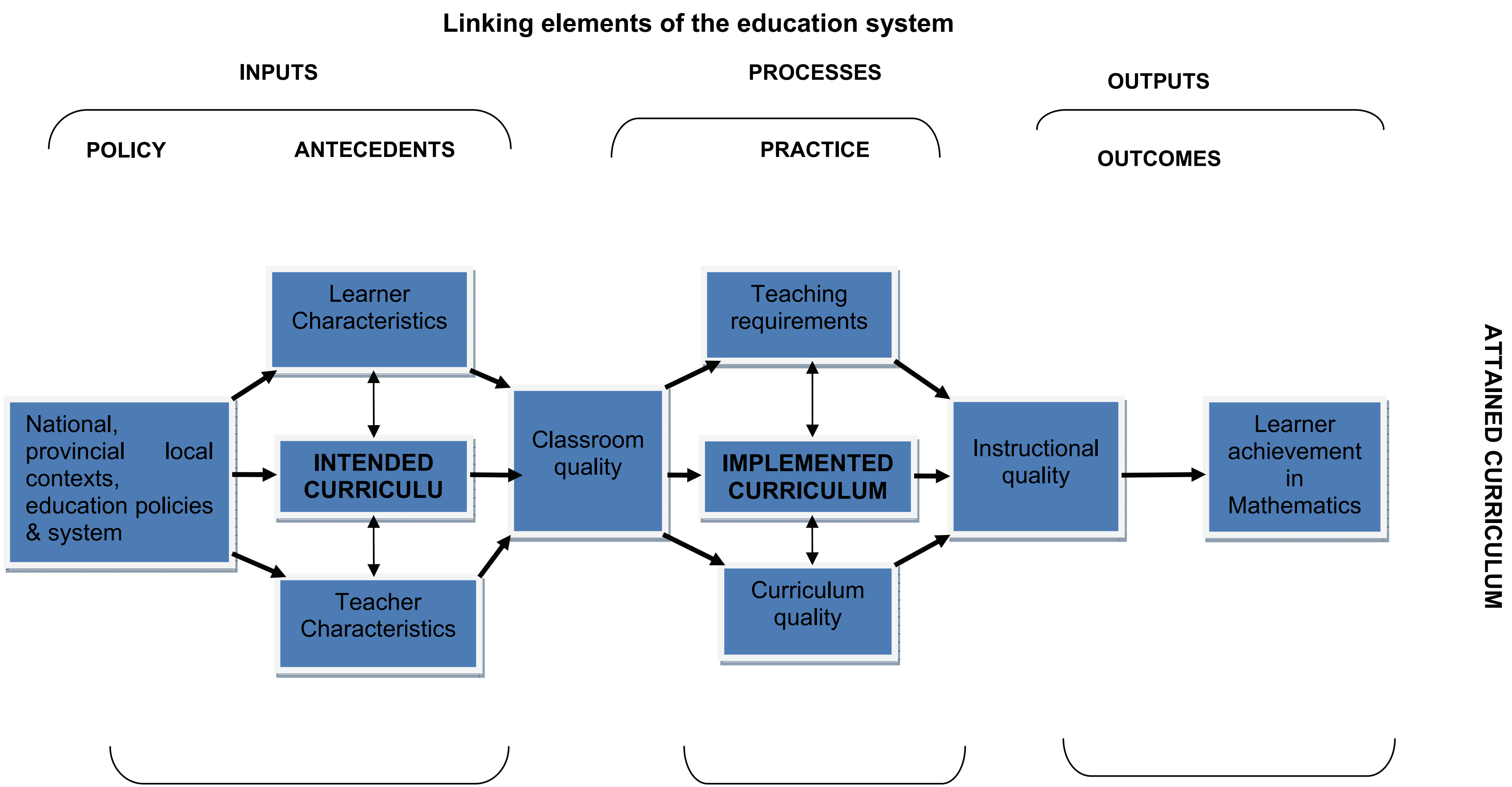

Figure 5.1: Classroom factors related to Mathematics achievement (Adapted from Shavelson et al., 1987, p. 14)

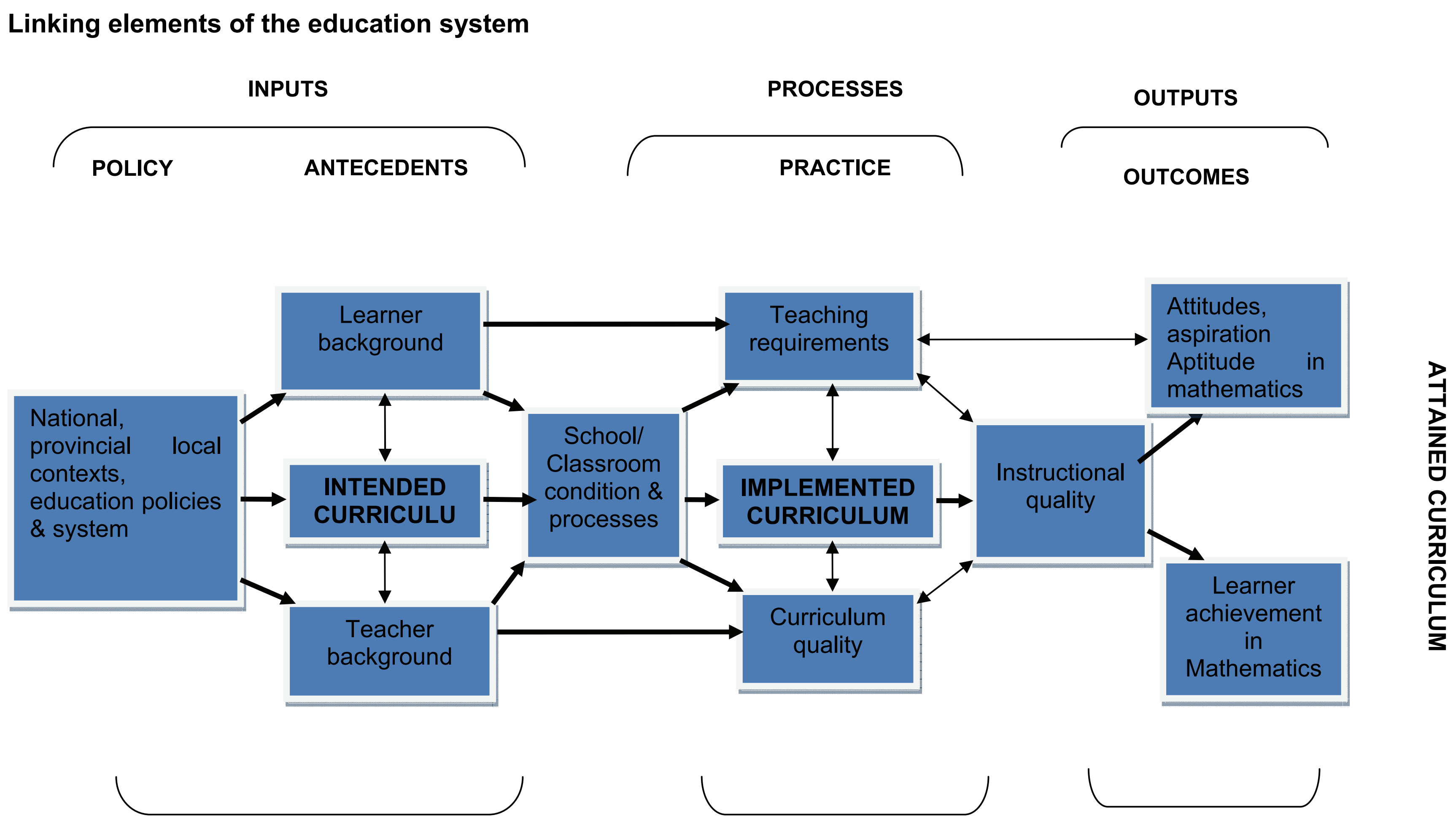

Figure 5.2: Audited Classroom factors related to Mathematics achievement
(Adapted from Shavelson et al., 1987, p. 14)

The changes in the conceptual framework take into consideration the findings of this study, the inclusion of the two levels, school and learner. The school context and learner background are very important in determining learner achievement. School effectiveness places an emphasis on the ability and social background of the learners as factors that shape academic performance, and suggests that schools have little direct effect on learner achievement (Hedges, Laine, & Greenwald, 1994; Lamb & Fullarton, 2002).

Table 5.3 Factors significant at the classroom level

Effective factors		South Africa	Australia
Instructional quality	Mathematics curriculum quality		Geometric shapes. Algebraic functions.
	Teacher Characteristics	Teacher age. Years been teaching	
	Classroom quality		Teachers' perception of school facility, security and policies. Work conditions. Unhappy students.
	Safety and security		Teacher perception and feeling of safety at school and neighbourhood
	Teaching requirements	Computer shortage.	Shortage of instructional equipment
	Limiting factors		Limiting factors.
Opportunity to learn	Homework		Homework contribute to learning Teacher emphasis on homework
Time on task		Outside school day grading test. Outside school other	

The quality is determined by the nature of interactions (time on task, opportunity to learn) inside the classroom, teacher characteristics, curriculum packaging, learner characteristics and the quality of instruction. In the case of South Africa, factors that influence mathematics achievements include teacher background, teaching requirements and activities outside school hours. For Australia, factors that predict learner performance include mathematics curriculum, classroom climate, teaching requirements, safety and security, homework, student background, and work conditions.

5.6 REFLECTION ON METHODOLOGY

This study is a secondary analysis of TIMSS 2003 data which used a large dataset collected under the auspices of IEA. The researcher used the existing high quality data which saved time and cost in collecting sufficient data, in that case it allowed the researcher enough time for data analysis. The limitation is that the researcher could not include variables of interest as the data had already been collected. The study was exploratory in nature and consisted of descriptive, factor, reliability, correlation and multiple regressions which measure the direct effects of the variables, alternative methods to measure indirect effects of the variables were not considered for this research. The study explored the key classroom level factors affecting mathematics achievements. Multiple regressions analysis was used to explain the variance in achievement. The study only considered one level, which is the classroom level, it was not possible to compare or contrast variables in other levels. The researcher did not include variables from other questionnaire background like school and learner level variables and some variables that were not included in the questionnaire.

5.7 RECOMMENDATIONS

Recommendations were made on the basis of the findings of this research for both South Africa and Australia. It is worth noting that factors affecting learner achievement are interrelated, therefore should be addressed with that in mind.

5.7.1 Recommendations for South Africa

5.7.1.1 Recommendation one

The two factors outside school day other and outside school day grading tests came as predictors of learner achievement. This is an indication that the more teachers spend time preparing their lessons after school hours; the better is the South African learner achievement in mathematics. This is an indication of dedicated and committed teachers. Teachers' work done outside the school hours brings benefits to the school. This has implications to the school work environment that teachers are unable to do their work at school or it might be due to heavy work load. It is recommended that heads of departments and district officials monitor and evaluate teachers' planning and teaching as part of the normal practice of a school and quality assurance for the education system.

5.7.1.2 Recommendation two

The shortage of computers at classroom level has a negative correlation to learner achievement. It is recommended that learners as well as teachers have a minimum access and support on the usage of computers as a policy. This could be amended to the existing policies like ICT and e-learning.

5.7.1.3 Recommendation three

The last two factors are years been teaching and age of teachers are predictors of learner achievement. In South Africa the experience and age are predictors of learner performance. It is recommended that majority of the new appointed teachers to enter the profession at an early age. Policy makers should try to focus on these variables in order to raise achievement in mathematics in South Africa (Van der Berg, 2008).

5.7.2 Recommendations for Australia

5.7.2.1 Recommendation one

It is good that curriculum topics algebraic function and geometric shapes and homework emphasis came as predictors of learner achievement. But it is important to investigate why other important curriculum issues and topics did not come as predictors of learner achievement.

5.7.2.2 Recommendation two

The factors unhappy students, limiting factors, shortage of instructional equipment were negatively correlated to learner achievement. It is recommended that the curriculum planners and policy makers to further investigate these issues and come with relevant solution. Perhaps it is because effective teachers are able to organise and manage classrooms as effective environments in which academic activities run smoothly, transitions are brief and little time is spent getting organised or dealing with resistance (Muijs & Reynolds, 2000; Werry, 1998)

5.7.2.3 Recommendation three

The last three factors are work conditions, school climate and school safety all were positively correlated to learner achievement. According to school effectiveness research these are pertinent factors in the developed countries, as resources and other material things are less important factors. It is recommended that Australia take note of these predictors and applies them across all the states and territories.

5.8 SUGGESTIONS FOR FUTURE RESEARCH

The study provides policy makers with several policy implications, that some teachers are more effective than others in improving learner academic achievement. The study findings suggest that teacher quality do not predict classroom performance. Education experts need to rethink the current knowledge requirements of new teachers and develop alternative measures that will be more accurate to predict classroom performance. It might be effective to reward teachers for their performance rather than for qualifications that are not associated with their ability to improve learner achievement. At the moment, most compensation systems reward teachers for their years of experience and education.

The study's findings suggest that these factors do accurately predict a teacher's effect on learner achievement. The current reward system provides too little incentive for the more effective teachers to deliver their best performance. Characteristics such as age, experience and education should remain valued, but other incentives like bonus pay for performance programs can motivate teachers in the classroom.

For future research, a study to investigate factors affecting mathematics learner performance in developing country and a developed country, including other levels of the education system, as well as exploring more depth the influence of the intended, implemente and attainted curriculum. In addition, it will of interest to compare national assessment programmes such as systemic evaluation, annual national assessment with TIMSS and SACMEQ.

5.9 CONCLUSIONS

The identified classroom level factors have effect on mathematics achievement. These factors help to explain the overall results and inform authorities about effect of the variables on learner achievement in mathematics. In terms of variance explained, the study did not identify any findings that were different from the previous studies on mathematics achievements conducted in South Africa and Australia. It should be noted that the comparison of studies are not the same in terms of methods and variables selected. There are school and learner variables that are more important than teacher variables.

This is opposite of what was observed in the Australian data and consistent with previous research (Howie, 2002; Scherman, 2007). Howie (2002) found that 55% is the proportion of variance explained was on the school level, and 45% of the variance was on the student level in South Africa using mathematics in TIMMS-R. Scherman (2007) documented 46% of the total variance as attributed to the school level, 5% to the teacher level, and 49% to the student level in the study to ascertain which factors influence performance of South African learners of the Middle Years Information System assessment.

Equality of educational opportunity therefore must strengthen the effect of school so that it is independent of the child's immediate environment (Coleman et al., 1966). Also, Scheerens (1993) argues that several studies have concluded that classrooms as well as schools are important and that teacher and classroom variables account for more variance than school variables. Yet recent work on the effect of classroom and school has suggested that teacher effectiveness accounts for a large part of variation in mathematics achievement (Lamb & Fullarton, 2002; Naker, 2007).

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APPENDICES

APPENDIX A

SOUTH AFRICA: FACTOR ANALYSIS

A1. Teacher confidence

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.835
Bartlett's Test of Sphericity	Approx. Chi-Square	33524.828
	df	153
	Sig.	.000

Communalities

	Initial	Extraction
representing decimals and fractions using words, numbers	1.000	.701
integers including words, numbers, models	1.000	.598
geometric pattern or sequence	1.000	.717
simple linear equations	1.000	.644
functions as ordered pairs, tables, graphs, words	1.000	.816
attributes of graphs as intercepts	1.000	.668
estimations of length, circumferences	1.000	.762
measurements in problem situations	1.000	.662
measures of irregular or compound areas	1.000	.759
precision of measurements	1.000	.742
pythagorean theorem	1.000	.612
congruent figures	1.000	.658
cartesian plan	1.000	.857
translation, reflection, rotation	1.000	.799
sources of error in collecting and organizing data	1.000	.688
data collection methods	1.000	.709
characteristics of data sets	1.000	.658
simple probability	1.000	.766

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.851	54.731	54.731	9.851	54.731	54.731	5.283	29.348	29.348
2	1.773	9.849	64.579	1.773	9.849	64.579	3.901	21.674	51.022
3	1.192	6.624	71.204	1.192	6.624	71.204	3.633	20.181	71.204
4	.911	5.060	76.264						
5	.764	4.244	80.508						
6	.681	3.781	84.289						
7	.514	2.856	87.145						
8	.474	2.632	89.777						
9	.399	2.215	91.992						
10	.279	1.552	93.544						
11	.252	1.399	94.943						
12	.207	1.147	96.090						
13	.191	1.061	97.152						
14	.158	.880	98.032						
15	.123	.684	98.715						
16	.106	.591	99.306						
17	.080	.444	99.750						
18	.045	.250	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
measurements in problem situations	.793		
data collection methods	.773		
measures of irregular or compound areas	.772		
precision of measurements	.759		
sources of error in collecting and organizing data	.748		
estimations of length, circumferences	.747		
simple probability	.665		.563
translation, reflection, rotation	.663	.582	
cartesian plan		.886	
functions as ordered pairs, tables, graphs, words		.780	
simple linear equations		.608	.481
pythagorean theorem	.466	.587	
attributes of graphs as intercepts	.481	.585	
characteristics of data sets			.737
integers including words, numbers, models			.710
representing decimals and fractions using words, numbers		.445	.701
geometric pattern or sequence		.414	.696
congruent figures		.434	.614

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

A2. Teachers' belief on working condition

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.814
Bartlett's Test of Sphericity	Approx. Chi-Square	1081.453
	df	66
	Sig.	.000

Communalities

	Initial	Extraction
GEN\THINKING ABT CURR SCH\SCHOOL FACIL	1.000	.387
GEN\THINKING ABT CURR SCH\SAFE NEIGHBORH	1.000	.686
GEN\THINKING ABT CURR SCH\FEEL SAFE	1.000	.789
GEN\THINKING ABT CURR SCH\SECURITY POLIC	1.000	.724
GEN\CHARACTERIZE\JOB SATISFACTION	1.000	.536
GEN\CHARACTERIZE\TCHS UNDERSTANDING	1.000	.739
GEN\CHARACTERIZE\TCHS DEGREE OF SUCESS	1.000	.662
GEN\CHARACTERIZE\TCHS EXPECTATIONS	1.000	.572
GEN\CHARACTERIZE\PARENTAL SUPPORT	1.000	.732
GEN\CHARACTERIZE\PARENTAL INVOLVEMENT	1.000	.760
GEN\CHARACTERIZE\STUDENTS REGARDS	1.000	.608
GEN\CHARACTERIZE\STUDENTS DESIRE	1.000	.606

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.539	37.823	37.823	4.539	37.823	37.823	2.762	23.013	23.013
2	1.808	15.068	52.890	1.808	15.068	52.890	2.681	22.341	45.354
3	1.454	12.119	65.009	1.454	12.119	65.009	2.359	19.655	65.009
4	.828	6.904	71.913						
5	.686	5.718	77.630						
6	.636	5.300	82.931						
7	.459	3.826	86.756						
8	.414	3.450	90.206						
9	.379	3.158	93.364						
10	.321	2.672	96.036						
11	.268	2.235	98.272						
12	.207	1.728	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
GEN\CHARACTERIZE\TCHS UNDERSTANDING	.835		
GEN\CHARACTERIZE\TCHS DEGREE OF SUCESS	.791		
GEN\CHARACTERIZE\TCHS EXPECTATIONS	.723		
GEN\CHARACTERIZE\JOB SATISFACTION	.683		
GEN\CHARACTERIZE\PARENTAL INVOLVEMENT		.860	
GEN\CHARACTERIZE\PARENTAL SUPPORT		.812	
GEN\CHARACTERIZE\STUDENTS REGARDS		.702	
GEN\CHARACTERIZE\STUDENTS DESIRE	.415	.653	
GEN\THINKING ABT CURR SCH\SCHOOL FACIL		-.424	
GEN\THINKING ABT CURR SCH\FEEL SAFE			.870
GEN\THINKING ABT CURR SCH\SECURITY POLIC			.824
GEN\THINKING ABT CURR SCH\SAFE NEIGHBORH			.802

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

A3. Teacher attitudes to teaching

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.560
Bartlett's Test of Sphericity	Approx. Chi-Square	2606.931
	df	21
	Sig.	.000

Communalities

	Initial	Extraction
attitudes mathematics representation	1.000	.796
mathematics as set of algorithm	1.000	.740
solving mathematics involves hypothesizing	1.000	.679
learning mathematics involves memorizing	1.000	.472
different ways to solve problems	1.000	.537
few new discoveries in mathematics	1.000	.777
modelling real world problem	1.000	.641

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.010	28.713	28.713	2.010	28.713	28.713	1.943	27.751	27.751
2	1.495	21.352	50.065	1.495	21.352	50.065	1.416	20.229	47.980
3	1.139	16.269	66.334	1.139	16.269	66.334	1.285	18.355	66.334
4	.797	11.384	77.718						
5	.648	9.260	86.978						
6	.506	7.229	94.207						
7	.405	5.793	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
modeling real world problem	.796		
different ways to solve problems	.727		
solving mathematics involves hypothesizing	.683		.460
learning mathematics involves memorizing	-.522		.400
few new discoveries in mathematics		.856	
attitudes mathematics representation		-.793	
mathematics as set of algorithm			.850

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

A4. Interaction with other teachers

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.549
Bartlett's Test of Sphericity	Approx. Chi-Square	1333.362
	df	6
	Sig.	.000

Communalities

	Initial	Extraction
discuss particular concept	1.000	.687
preparing instructional material	1.000	.606
visit other teacher's classroom to observe	1.000	.759
informal classroom observation by another teacher	1.000	.791

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.749	43.723	43.723	1.749	43.723	43.723	1.549	38.720	38.720
2	1.095	27.373	71.096	1.095	27.373	71.096	1.295	32.376	71.096
3	.717	17.913	89.009						
4	.440	10.991	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component	
	1	2
informal classroom observation by another teacher	.889	
visit other teacher's classroom to observe	.856	
discuss particular concept		.829
preparing instructional material		.762

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

A5. School climate

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.697
Bartlett's Test of Sphericity	Approx. Chi-Square	3207.610
	df	6
	Sig.	.000

Communalities

	Initial	Extraction
school facility repair	1.000	.064
school safe neighborhood	1.000	.664
feel safe at school	1.000	.811
security policies and practices	1.000	.727

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.266	56.662	56.662	2.266	56.662	56.662
2	.970	24.254	80.916			
3	.475	11.883	92.800			
4	.288	7.200	100.000			

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.266	56.662	56.662	2.266	56.662	56.662
2	.970	24.254	80.916			
3	.475	11.883	92.800			
4	.288	7.200	100.000			

Extraction Method: Principal Component Analysis.

A6. Opportunity to learn

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.623
Bartlett's Test of Sphericity	Approx. Chi-Square	5045.801
	df	36
	Sig.	.000

Communalities

	Initial	Extraction
practice adding, subtracting, multiplying	1.000	.739
work on fractions and decimals	1.000	.497
no immediate obvious method of solution	1.000	.572
interpret data tables	1.000	.585
functions to represent relationship	1.000	.532
work together in small group	1.000	.674
relate mathematics to daily lives	1.000	.513
explain their answers	1.000	.707
own procedure to solve problems	1.000	.701

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.701	30.009	30.009	2.701	30.009	30.009	2.079	23.098	23.098
2	1.597	17.749	47.759	1.597	17.749	47.759	1.816	20.178	43.276
3	1.221	13.572	61.330	1.221	13.572	61.330	1.625	18.054	61.330
4	.933	10.371	71.701						
5	.724	8.040	79.741						
6	.615	6.832	86.573						
7	.484	5.382	91.956						
8	.401	4.457	96.413						
9	.323	3.587	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
interpret data tables	.744		
no immediate obvious method of solution	.727		
work on fractions and decimals	.693		
functions to represent relationship	.676		
practice adding, subtracting, multiplying		.846	
work together in small group		.798	
relate mathematics to daily lives		.582	
explain their answers			.838
own procedure to solve problems			.796

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

A7. Homework

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.826
Bartlett's Test of Sphericity	Approx. Chi-Square	8251.860
	df	45
	Sig.	.000

Communalities

	Initial	Extraction
how often assign homework	1.000	.711
minutes assigned for homework	1.000	.702
doing problem or question sets	1.000	.660
gathering data and reporting	1.000	.466
finding application of content covered	1.000	.736
monitor homework completion	1.000	.663
correct assignments and give feedback	1.000	.746
students correct their own homework	1.000	.685
use homework as basis for discussion	1.000	.509
use homework to contribute towards marks	1.000	.538

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.097	40.974	40.974	4.097	40.974	40.974	3.016	30.162	30.162
2	1.228	12.282	53.256	1.228	12.282	53.256	2.276	22.765	52.927
3	1.090	10.899	64.155	1.090	10.899	64.155	1.123	11.228	64.155
4	.788	7.882	72.037						
5	.671	6.713	78.750						
6	.570	5.701	84.451						
7	.520	5.203	89.654						
8	.434	4.341	93.994						
9	.334	3.338	97.332						
10	.267	2.668	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
how often assign homework	.829		
doing problem or question sets	.774		
correct assignments and give feedback	.721		
monitor homework completion	.643	.448	
gathering data and reporting	.586		
minutes assigned for homework		.823	
use homework to contribute towards marks		.681	
use homework as basis for discussion	.443	.547	
finding application of content covered			.720
students correct their own homework		.460	-.627

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

A8. Limiting factors

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.711
Bartlett's Test of Sphericity	Approx. Chi-Square	20277.451
	df	91
	Sig.	.000

Communalities

	Initial	Extraction
student diversity limit academic ability	1.000	.567
wide range of background	1.000	.774
students with special needs	1.000	.510
uninterested students	1.000	.820
low morale among students	1.000	.773
disruptive students	1.000	.559
shortage of computer hardware	1.000	.853
shortage of computer software	1.000	.842
shortage of support for using computers	1.000	.772
shortage of textbooks	1.000	.616
shortage of other instructional equipment for students' usage	1.000	.788
shortage of equipment	1.000	.771
inadequate physical facilities	1.000	.840
student/teacher ratio	1.000	.704

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.632	33.086	33.086	4.632	33.086	33.086	3.652	26.088	26.088
2	2.754	19.673	52.759	2.754	19.673	52.759	2.498	17.841	43.930
3	1.661	11.864	64.623	1.661	11.864	64.623	2.268	16.201	60.131
4	1.143	8.164	72.787	1.143	8.164	72.787	1.772	12.657	72.787
5	.877	6.264	79.051						
6	.753	5.378	84.429						
7	.565	4.035	88.465						
8	.470	3.358	91.823						
9	.339	2.424	94.247						
10	.256	1.829	96.076						
11	.203	1.447	97.523						
12	.174	1.244	98.767						
13	.106	.758	99.525						
14	.066	.475	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
shortage of computer hardware	.899			
shortage of computer software	.874			
inadequate physical facilities	.810			
shortage of support for using computers	.759			.415
shortage of equipment	.658		.546	
uninterested students		.832		
low morale among students		.816		
disruptive students		.741		
students with special needs		.503		
student/teacher ratio			.798	
shortage of other instructional equipment for students' usage			.781	
shortage of textbooks			.577	
wide range of background				.861
student diversity limit academic ability				.643

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
shortage of computer hardware	.899			
shortage of computer software	.874			
inadequate physical facilities	.810			
shortage of support for using computers	.759			.415
shortage of equipment	.658		.546	
uninterested students		.832		
low morale among students		.816		
disruptive students		.741		
students with special needs		.503		
student/teacher ratio			.798	
shortage of other instructional equipment for students' usage			.781	
shortage of textbooks			.577	
wide range of background				.861
student diversity limit academic ability				.643

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

A9. Topic Coverage

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.389
Bartlett's Test of Sphericity	Approx. Chi-Square	94206.034
	df	990
	Sig.	.000

Communalities

	Initial	Extraction
whole number including place value	1.000	.817
computations, estimations, etc	1.000	.703
common fractions	1.000	.880
decimal fractions	1.000	.858
representing decimals and fractions	1.000	.769
computations with fractions	1.000	.790
computations with decimals	1.000	.908
addressed integers	1.000	.797
addressed ratios	1.000	.864
addressed conversions	1.000	.893
addressed expressions	1.000	.800
addressed expressions	1.000	.778
addressed simple linear equations	1.000	.837
addressed functions	1.000	.795
addressed proportional	1.000	.699
addressed graphs	1.000	.752
measure of length, area, volume	1.000	.760
addressed relationships	1.000	.816
use standard tools to measure length	1.000	.744
addressed estimates	1.000	.852
computations with measurements	1.000	.795
measurement formula	1.000	.806
measures of irregular or compound areas	1.000	.785
precision of measurements	1.000	.794
addressed angles	1.000	.800

addressed relationships	1.000	.891
addressed properties of angels	1.000	.795
properties of geometric shapes	1.000	.865
properties of polygons	1.000	.805
construct triangles and rectangles	1.000	.796
pythagorean theorem	1.000	.857
congruent figures	1.000	.711
similar triangles	1.000	.764
cartesian plane	1.000	.767
relationship between two dimensional and three dimensional shapes	1.000	.812
line and rotational symmetry	1.000	.823
translation, reflection, rotation, and enlargement	1.000	.767
organising set of data	1.000	.823
sources of error in collecting and organizing data	1.000	.808
data collection methods	1.000	.794
drawing and interpreting graphs	1.000	.800
characteristics of data sets	1.000	.785
interpretation of data	1.000	.696
evaluating, interpreting data	1.000	.871
simple probability	1.000	.889

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.202	27.115	27.115	12.202	27.115	27.115	4.746	10.548	10.548
2	4.388	9.751	36.866	4.388	9.751	36.866	3.682	8.183	18.731
3	2.848	6.330	43.195	2.848	6.330	43.195	3.643	8.095	26.826
4	2.430	5.399	48.595	2.430	5.399	48.595	3.091	6.869	33.695
5	2.218	4.929	53.523	2.218	4.929	53.523	2.979	6.620	40.316
6	2.163	4.806	58.330	2.163	4.806	58.330	2.793	6.206	46.521
7	2.071	4.602	62.932	2.071	4.602	62.932	2.735	6.078	52.600
8	1.680	3.734	66.666	1.680	3.734	66.666	2.716	6.036	58.636
9	1.566	3.480	70.145	1.566	3.480	70.145	2.636	5.857	64.493
10	1.290	2.866	73.012	1.290	2.866	73.012	2.516	5.591	70.084
11	1.205	2.678	75.690	1.205	2.678	75.690	1.712	3.805	73.888
12	1.084	2.409	78.099	1.084	2.409	78.099	1.608	3.573	77.462
13	1.064	2.364	80.463	1.064	2.364	80.463	1.351	3.001	80.463
14	.852	1.894	82.357						
15	.823	1.830	84.187						
16	.735	1.633	85.820						
17	.675	1.501	87.321						
18	.611	1.358	88.679						
19	.571	1.270	89.949						
20	.524	1.165	91.114						
21	.486	1.080	92.193						
22	.444	.987	93.181						
23	.401	.891	94.072						

24	.346	.768	94.840						
25	.295	.655	95.495						
26	.282	.627	96.122						
27	.256	.569	96.691						
28	.225	.500	97.191						
29	.199	.443	97.634						
30	.189	.421	98.055						
31	.157	.349	98.404						
32	.127	.283	98.687						
33	.119	.265	98.952						
34	.101	.223	99.175						
35	.080	.178	99.353						
36	.076	.169	99.522						
37	.054	.120	99.642						
38	.050	.110	99.753						
39	.036	.080	99.832						
40	.027	.061	99.893						
41	.022	.049	99.942						
42	.011	.024	99.966						
43	.010	.022	99.987						
44	.003	.008	99.995						
45	.002	.005	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
organising set of data	.815											
sources of error in collecting and organizing data	.754	.430										
data collection methods	.729											
drawing and interpreting graphs	.712											
evaluating, interpreting data	.647					.513						
interpretation of data	.619											
simple probability	.573					.560						
computations with measurements	.506											
relationship between two dimensional and three dimensional shapes		.835										
line and rotational symmetry		.677		.425								
similar triangles		.630										
translation, reflection, rotation, and enlargement		.538							.437			
properties of polygons		.503			.501							
addressed relationships			.810									
use standard tools to measure length			.741									
measure of length, area, volume			.697									

computations, estimations, etc			.611									
measurement formula			.547									
addressed estimates			.523									.401
addressed graphs				.801								
cartesian plane				.640								
addressed functions				.580				.483				
addressed relationships					.866							
addressed angles					.658		.401					
properties of geometric shapes		.428			.639							
addressed properties of angels				.545	.625							
addressed expressions						.787						
characteristics of data sets						.491						
computations with decimals							.871					
computations with fractions							.862					
construct triangles and rectangles							.407					
whole number including place value								.755				
addressed simple linear equations				.424				.587				
addressed expressions						.404		.534		.427		
congruent figures		.454						.497				
precision of measurements									.803			
measures of irregular or compound areas									.619			

addressed integers							.424		-.496			
addressed proportional									.404			
common fractions										.793		
decimal fractions										.790		
representing decimals and fractions						.419				.536		
addressed ratios											.853	
addressed conversions							.495				.560	
pythagorean theorem												.843

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

A10. Learning Resources

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.656
Bartlett's Test of Sphericity	Approx. Chi-Square	166.053
	df	36
	Sig.	.000

Communalities

	Initial	Extraction
MAT\CALCULATOR\USE\CHECK ANSWERS	1.000	.795
MAT\CALCULATOR\USE\DO ROUTINE COMPUT	1.000	.825
MAT\CALCULATOR\USE\SOLVE COMPLEX PROBLEM	1.000	.745
MAT\CALCULATOR\USE\EXPLORE NR CONCEPTS	1.000	.841
MAT\CALCULATOR\PERMITTED DURING TESTS	1.000	.670
MAT\COMPUTER\USE\DISC MATHS PRINCIPLE	1.000	.896
MAT\COMPUTER\USE\PRACTICE SKILLS	1.000	.831
MAT\COMPUTER\USE\LOOK UP IDEAS	1.000	.777
MAT\COMPUTER\USE\PROCESS DATA	1.000	.717

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.344	37.153	37.153	3.344	37.153	37.153	3.183	35.371	35.371
2	2.627	29.193	66.346	2.627	29.193	66.346	2.056	22.850	58.221
3	1.127	12.517	78.863	1.127	12.517	78.863	1.858	20.642	78.863
4	.724	8.047	86.910						
5	.414	4.598	91.508						
6	.330	3.669	95.177						
7	.212	2.359	97.536						
8	.151	1.682	99.218						
9	.070	.782	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
MAT\COMPUTER\USE\DISC MATHS PRINCIPLE	.944		
MAT\COMPUTER\USE\PRACTICE SKILLS	.910		
MAT\COMPUTER\USE\PROCESS DATA	.835		
MAT\COMPUTER\USE\LOOK UP IDEAS	.818		
MAT\CALCULATOR\USE\EXPLORE NR CONCEPTS		.911	
MAT\CALCULATOR\USE\SOLVE COMPLEX PROBLEM		.741	.426
MAT\CALCULATOR\USE\CHECK ANSWERS		.706	.501
MAT\CALCULATOR\USE\DO ROUTINE COMPUT			.856
MAT\CALCULATOR\PERMITTED DURING TESTS			.818

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

APPENDIX B

AUSTRALIA: FACTOR ANALYSIS

B1. Teacher confidence

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.710
Bartlett's Test of Sphericity	Approx. Chi-Square	26329.999
	df	153
	Sig.	.000

Communalities

	Initial	Extraction
representing decimals and fractions using words, numbers	1.000	.787
integers including words, numbers, models	1.000	.775
geometric pattern or sequence	1.000	.651
simple linear equations	1.000	.775
functions as ordered pairs, tables, graphs, words	1.000	.865
attributes of graphs as intercepts	1.000	.845
estimations of length, circumferences	1.000	.541
measurements in problem situations	1.000	.840
measures of irregular or compound areas	1.000	.736
precision of measurements	1.000	.766
pythagorean theorem	1.000	.854
congruent figures	1.000	.475
cartesian plan	1.000	.757
translation, reflection, rotation	1.000	.842
sources of error in collecting and organizing data	1.000	.649
data collection methods	1.000	.832
characteristics of data sets	1.000	.633
simple probability	1.000	.754

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.546	47.475	47.475	8.546	47.475	47.475	4.362	24.232	24.232
2	2.313	12.848	60.323	2.313	12.848	60.323	4.143	23.015	47.247
3	1.464	8.135	68.459	1.464	8.135	68.459	2.858	15.877	63.124
4	1.053	5.850	74.308	1.053	5.850	74.308	2.013	11.184	74.308
5	.890	4.942	79.250						
6	.761	4.227	83.477						
7	.665	3.697	87.174						
8	.613	3.407	90.582						
9	.472	2.622	93.204						
10	.309	1.718	94.922						
11	.244	1.357	96.279						
12	.200	1.111	97.390						
13	.166	.920	98.310						
14	.103	.570	98.880						
15	.090	.500	99.381						
16	.056	.311	99.692						
17	.033	.184	99.876						
18	.022	.124	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
attributes of graphs as intercepts	.810			
functions as ordered pairs, tables, graphs, words	.772		.479	
simple linear equations	.750		.426	
cartesian plan	.708	.446		
translation, reflection, rotation	.675	.602		
geometric pattern or sequence	.630			
congruent figures	.603			
simple probability		.784		
measurements in problem situations		.769		.408
data collection methods		.749	.512	
precision of measurements		.727		.426
characteristics of data sets		.724		
sources of error in collecting and organizing data		.650	.463	
integers including words, numbers, models			.793	
representing decimals and fractions using words, numbers			.784	

estimations of length, circumferences			.585	
pythagorean theorem	.447			.781
measures of irregular or compound areas				.722

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

B2. Teachers' belief on working conditions

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.874
Bartlett's Test of Sphericity	Approx. Chi-Square	1309.960
	df	66
	Sig.	.000

Communalities

	Initial	Extraction
GEN\THINKING ABT CURR SCH\SCHOOL FACIL	1.000	.254
GEN\THINKING ABT CURR SCH\SAFE NEIGHBORH	1.000	.740
GEN\THINKING ABT CURR SCH\FEEL SAFE	1.000	.764
GEN\THINKING ABT CURR SCH\SECURITY POLIC	1.000	.722
GEN\CHARACTERIZE\JOB SATISFACTION	1.000	.635
GEN\CHARACTERIZE\TCHS UNDERSTANDING	1.000	.669
GEN\CHARACTERIZE\TCHS DEGREE OF SUCESS	1.000	.773
GEN\CHARACTERIZE\TCHS EXPECTATIONS	1.000	.643
GEN\CHARACTERIZE\PARENTAL SUPPORT	1.000	.807
GEN\CHARACTERIZE\PARENTAL INVOLVEMENT	1.000	.733
GEN\CHARACTERIZE\STUDENTS REGARDS	1.000	.704
GEN\CHARACTERIZE\STUDENTS DESIRE	1.000	.657

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.537	46.141	46.141	5.537	46.141	46.141	2.880	24.001	24.001
2	1.434	11.952	58.094	1.434	11.952	58.094	2.717	22.644	46.645
3	1.129	9.407	67.501	1.129	9.407	67.501	2.503	20.856	67.501
4	.847	7.062	74.563						
5	.581	4.841	79.404						
6	.528	4.402	83.806						
7	.435	3.628	87.435						
8	.393	3.275	90.709						
9	.331	2.760	93.469						
10	.314	2.617	96.086						
11	.279	2.327	98.413						
12	.190	1.587	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
GEN\CHARACTERIZE\PARENTAL INVOLVEMENT	.843		
GEN\CHARACTERIZE\PARENTAL SUPPORT	.826		
GEN\CHARACTERIZE\STUDENTS REGARDS	.710		
GEN\CHARACTERIZE\STUDENTS DESIRE	.646	.444	
GEN\THINKING ABT CURR SCH\SCHOOL FACIL			
GEN\CHARACTERIZE\TCHS DEGREE OF SUCESS		.851	
GEN\CHARACTERIZE\TCHS UNDERSTANDING		.739	
GEN\CHARACTERIZE\JOB SATISFACTION		.733	
GEN\CHARACTERIZE\TCHS EXPECTATIONS	.480	.634	
GEN\THINKING ABT CURR SCH\SAFE NEIGHBORH			.836
GEN\THINKING ABT CURR SCH\FEEL SAFE			.824
GEN\THINKING ABT CURR SCH\SECURITY POLIC			.784

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

B3. Teachers' attitude to teaching

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.409
Bartlett's Test of Sphericity	Approx. Chi-Square	67.198
	df	21
	Sig.	.000

Communalities

	Initial	Extraction
attitudes mathematics representation	1.000	.728
mathematics as set of algorithm	1.000	.866
solving mathematics involves hypothesizing	1.000	.687
learning mathematics involves memorizing	1.000	.744
different ways to solve problems	1.000	.821
few new discoveries in mathematics	1.000	.925
modelling real world problem	1.000	.812

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.967	28.107	28.107	1.967	28.107	28.107	1.530	21.855	21.855
2	1.442	20.599	48.706	1.442	20.599	48.706	1.426	20.365	42.219
3	1.171	16.731	65.437	1.171	16.731	65.437	1.406	20.084	62.303
4	1.001	14.304	79.741	1.001	14.304	79.741	1.221	17.438	79.741
5	.690	9.862	89.603						
6	.432	6.165	95.768						
7	.296	4.232	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
modelling real world problem	.884			
attitudes mathematics representation	.815			
different ways to solve problems		.861		
solving mathematics involves hypothesizing		.765		
mathematics as set of algorithm			.902	
learning mathematics involves memorizing			.736	
few new discoveries in mathematics				.957

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

B4. Interaction with other teachers

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.556
Bartlett's Test of Sphericity	Approx. Chi-Square	509.817
	df	6
	Sig.	.000

Communalities

	Initial	Extraction
discuss particular concept	1.000	.776
preparing instructional material	1.000	.468
visit other teacher's classroom to observe	1.000	.730
informal classroom observation by another teacher	1.000	.716

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.642	41.062	41.062	1.642	41.062	41.062	1.563	39.082	39.082
2	1.048	26.207	67.269	1.048	26.207	67.269	1.127	28.186	67.269
3	.818	20.460	87.729						
4	.491	12.271	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component	
	1	2
visit other teacher's classroom to observe	.854	
informal classroom observation by another teacher	.842	
discuss particular concept		.873
preparing instructional material		.597

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

B5. School Climate

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.775
Bartlett's Test of Sphericity	Approx. Chi-Square	2358.544
	df	6
	Sig.	.000

Communalities

	Initial	Extraction
school facility repair	1.000	.285
school safe neighbourhood	1.000	.765
feel safe at school	1.000	.760
security policies and practices	1.000	.815

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.625	65.637	65.637	2.625	65.637	65.637
2	.803	20.077	85.715			
3	.327	8.164	93.879			
4	.245	6.121	100.000			

Extraction Method: Principal Component Analysis.

B6. Opportunity to learn

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.706
Bartlett's Test of Sphericity	Approx. Chi-Square	2714.444
	df	36
	Sig.	.000

Communalities

	Initial	Extraction
practice adding, subtracting, multiplying	1.000	.448
work on fractions and decimals	1.000	.616
no immediate obvious method of solution	1.000	.700
interpret data tables	1.000	.624
functions to represent relationship	1.000	.600
work together in small group	1.000	.550
relate mathematics to daily lives	1.000	.704
explain their answers	1.000	.687
own procedure to solve problems	1.000	.525

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.115	34.607	34.607	3.115	34.607	34.607	2.113	23.479	23.479
2	1.249	13.874	48.480	1.249	13.874	48.480	1.679	18.654	42.133
3	1.092	12.137	60.618	1.092	12.137	60.618	1.664	18.484	60.618
4	.881	9.791	70.408						
5	.809	8.993	79.401						
6	.648	7.205	86.607						
7	.481	5.343	91.950						
8	.392	4.353	96.302						
9	.333	3.698	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
explain their answers	.814		
relate mathematics to daily lives	.690		
no immediate obvious method of solution	.642		.516
work together in small group	.583		.448
interpret data tables		.780	
functions to represent relationship		.673	
own procedure to solve problems	.450	.554	
work on fractions and decimals			.768
practice adding, subtracting, multiplying			.601

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

B7. Homework

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.631
Bartlett's Test of Sphericity	Approx. Chi-Square	4229.768
	df	45
	Sig.	.000

Communalities

	Initial	Extraction
how often assign homework	1.000	.436
minutes assigned for homework	1.000	.694
doing problem or question sets	1.000	.665
gathering data and reporting	1.000	.544
finding application of content covered	1.000	.750
monitor homework completion	1.000	.759
correct assignments and give feedback	1.000	.551
students correct their own homework	1.000	.486
use homework as basis for discussion	1.000	.499
use homework to contribute towards marks	1.000	.792

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.723	37.230	37.230	3.723	37.230	37.230	2.416	24.156	24.156
2	1.426	14.256	51.486	1.426	14.256	51.486	2.202	22.024	46.181
3	1.027	10.275	61.761	1.027	10.275	61.761	1.558	15.580	61.761
4	.962	9.616	71.377						
5	.795	7.947	79.324						
6	.637	6.369	85.693						
7	.528	5.283	90.975						
8	.383	3.834	94.809						
9	.360	3.603	98.412						
10	.159	1.588	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
doing problem or question sets	.808		
students correct their own homework	.672		
minutes assigned for homework	.649	.423	
use homework as basis for discussion	.570		
how often assign homework	.489		.443
use homework to contribute towards marks		.828	
monitor homework completion		.774	
correct assignments and give feedback		.700	
finding application of content covered			.829
gathering data and reporting			.597

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 8 iterations.

B8. Limiting factors

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.809
Bartlett's Test of Sphericity	Approx. Chi-Square	10376.535
	df	91
	Sig.	.000

Communalities

	Initial	Extraction
student diversity limit academic ability	1.000	.709
wide range of background	1.000	.438
students with special needs	1.000	.520
uninterested students	1.000	.695
low morale among students	1.000	.704
disruptive students	1.000	.760
shortage of computer hardware	1.000	.748
shortage of computer software	1.000	.698
shortage of support for using computers	1.000	.734
shortage of textbooks	1.000	.671
shortage of other instructional equipment for students' usage	1.000	.781
shortage of equipment	1.000	.669
inadequate physical facilities	1.000	.608
student/teacher ratio	1.000	.307

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
disruptive students	.848		
low morale among students	.793		
uninterested students	.789		
student diversity limit academic ability	.787		
wide range of background	.496	.431	
student/teacher ratio	.487		
shortage of other instructional equipment for students' usage		.809	
shortage of textbooks		.755	
shortage of equipment		.672	.457
inadequate physical facilities		.663	
shortage of computer hardware			.826
shortage of computer software			.772
shortage of support for using computers		.495	.691
students with special needs			.632

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

B9. Topic coverage

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.388
Bartlett's Test of Sphericity	Approx. Chi-Square	61325.003
	df	990
	Sig.	.000

Communalities

	Initial	Extraction
whole number including place value	1.000	.700
computations, estimations, etc	1.000	.717
common fractions	1.000	.863
decimal fractions	1.000	.666
representing decimals and fractions	1.000	.763
computations with fractions	1.000	.750
computations with decimals	1.000	.807
addressed integers	1.000	.806
addressed ratios	1.000	.684
addressed conversions	1.000	.726
addressed expressions	1.000	.703
addressed expressions	1.000	.755
addressed simple linear equations	1.000	.760
addressed functions	1.000	.763
addressed proportional	1.000	.701
addressed graphs	1.000	.869
measure of length, area, volume	1.000	.734

addressed relationships	1.000	.832
use standard tools to measure length	1.000	.817
addressed estimates	1.000	.847
computations with measurements	1.000	.754
measurement formula	1.000	.828
measures of irregular or compound areas	1.000	.718
precision of measurements	1.000	.743
addressed angles	1.000	.806
addressed relationships	1.000	.815
addressed properties of angels	1.000	.833
properties of geometric shapes	1.000	.842
properties of polygons	1.000	.837
construct triangles and rectangles	1.000	.698
pythagorean theorem	1.000	.798
congruent figures	1.000	.766
similar triangles	1.000	.854
cartesian plane	1.000	.820
relationship between two dimensional and three dimensional shapes	1.000	.771
line and rotational symmetry	1.000	.828
translation, reflection, rotation, and enlargement	1.000	.851
organising set of data	1.000	.888
sources of error in collecting and organizing data	1.000	.779
data collection methods	1.000	.752
drawing and interpreting graphs	1.000	.805
characteristics of data sets	1.000	.763
interpretation of data	1.000	.825
evaluating, interpreting data	1.000	.756

simple probability	1.000	.753

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.440	23.200	23.200	10.440	23.200	23.200	5.963	13.251	13.251
2	4.603	10.229	33.429	4.603	10.229	33.429	3.419	7.599	20.850
3	2.865	6.366	39.795	2.865	6.366	39.795	3.028	6.730	27.579
4	2.582	5.738	45.533	2.582	5.738	45.533	2.918	6.484	34.063
5	2.416	5.370	50.903	2.416	5.370	50.903	2.713	6.030	40.092
6	2.074	4.608	55.511	2.074	4.608	55.511	2.636	5.857	45.950
7	1.968	4.373	59.884	1.968	4.373	59.884	2.391	5.312	51.262
8	1.740	3.867	63.752	1.740	3.867	63.752	2.294	5.097	56.359
9	1.587	3.527	67.279	1.587	3.527	67.279	2.218	4.928	61.287
10	1.374	3.053	70.331	1.374	3.053	70.331	2.086	4.636	65.923
11	1.275	2.833	73.164	1.275	2.833	73.164	1.957	4.349	70.273
12	1.163	2.585	75.748	1.163	2.585	75.748	1.818	4.041	74.314
13	1.059	2.354	78.102	1.059	2.354	78.102	1.705	3.788	78.102
14	.947	2.104	80.206						
15	.911	2.024	82.230						
16	.841	1.870	84.100						
17	.800	1.778	85.879						
18	.690	1.533	87.412						
19	.657	1.460	88.872						
20	.612	1.359	90.232						
21	.528	1.174	91.406						

22	.479	1.064	92.470						
23	.410	.910	93.380						
24	.388	.863	94.243						
25	.313	.697	94.940						
26	.305	.678	95.618						
27	.290	.644	96.262						
28	.263	.584	96.846						
29	.225	.499	97.346						
30	.216	.480	97.826						
31	.179	.399	98.225						
32	.152	.338	98.563						
33	.119	.265	98.828						
34	.108	.241	99.069						
35	.092	.203	99.272						
36	.073	.162	99.434						
37	.059	.131	99.565						
38	.052	.116	99.681						
39	.039	.087	99.768						
40	.032	.071	99.839						
41	.030	.067	99.905						
42	.019	.042	99.947						
43	.013	.029	99.976						
44	.007	.015	99.991						
45	.004	.009	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component												
	1	2	3	4	5	6	7	8	9	10	11	12	13
common fractions	.857												
representing decimals and fractions	.799												
whole number including place value	.769												
computations with decimals	.744							.415					
decimal fractions	.725												
computations with fractions	.715												
computations, estimations, etc	.564												
addressed angles	.505										.472		
addressed conversions	.458							.437					
line and rotational symmetry		.787											
translation, reflection, rotation, and enlargement		.767											
pythagorean theorem		.575								.441			
properties of polygons		.552											
simple probability			.714										
evaluating, interpreting data			.709										
interpretation of data			.597		.431								
characteristics of data sets			.580				.405						
computations with measurements			.531										
addressed estimates				.815									
measure of length, area, volume				.672									
measurement formula				.652				.430					
addressed relationships	.403			.628									

use standard tools to measure length				.429									
organising set of data					.829								
drawing and interpreting graphs					.787								
data collection methods					.479			.404			.411		
cartesian plane						.718							
addressed functions						.693							
addressed proportional						.675							
addressed graphs						.554							
addressed expressions						.452			-.412				
similar triangles							.886						
congruent figures							.666						
addressed ratios								.703					
sources of error in collecting and organizing data			.471					.579					
precision of measurements									.784				
relationship between two dimensional and three dimensional shapes									.727				
addressed properties of angels										.690			
addressed relationships										.502	.437		
construct triangles and rectangles										.423			
measures of irregular or compound areas											.798		

addressed simple linear equations												.793	
addressed expressions												.612	
properties of geometric shapes													.692
addressed integers	.405												.641

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

B10. Learning Resources

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.812
Bartlett's Test of Sphericity	Approx. Chi-Square	10851.518
	df	36
	Sig.	.000

Communalities

	Initial	Extraction
how often students use calculators to check answers	1.000	.761
how often students use calculators to do routine	1.000	.696
use calculator to solve complex problems	1.000	.738
use calculator to explore concepts	1.000	.643
use calculator during tests or exams	1.000	.628
use computer to discover mathematics principles	1.000	.897
practice skills and procedures	1.000	.930
look up ideas and information	1.000	.875
process and analyze data	1.000	.952

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.153	46.146	46.146	4.153	46.146	46.146	3.674	40.820	40.820
2	2.965	32.947	79.093	2.965	32.947	79.093	3.445	38.273	79.093
3	.691	7.680	86.774						
4	.355	3.939	90.713						
5	.324	3.603	94.316						
6	.238	2.647	96.964						
7	.120	1.338	98.302						
8	.098	1.090	99.392						
9	.055	.608	100.000						

Communalities

	Initial	Extraction
how often students use calculators to check answers	1.000	.761
how often students use calculators to do routine	1.000	.696
use calculator to solve complex problems	1.000	.738
use calculator to explore concepts	1.000	.643
use calculator during tests or exams	1.000	.628
use computer to discover mathematics principles	1.000	.897
practice skills and procedures	1.000	.930
look up ideas and information	1.000	.875
process and analyze data	1.000	.952

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component	
	1	2
process and analyze data	.972	
practice skills and procedures	.960	
use computer to discover mathematics principles	.942	
look up ideas and information	.934	
how often students use calculators to check answers		.862
use calculator to solve complex problems		.857
how often students use calculators to do routine		.833
use calculator to explore concepts		.792
use calculator during tests or exams		.788

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

APPENDIX C

SOUTH AFRICA: RELIABILITY ANALYSIS

C1.1 Teacher Confidence: Data Collection Methods

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.935	.937	8

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
measurements in problem situations	15.6904	16.572	.681	.567	.933
data collection methods	15.6856	16.115	.772	.713	.927
measures of irregular or compound areas	15.8196	14.780	.847	.787	.921
precision of measurements	15.6426	15.730	.821	.740	.923
sources of error in collecting and organizing data	15.8215	15.807	.767	.692	.927
estimations of length, circumferences	15.5139	16.376	.807	.711	.925
simple probability	15.7727	16.014	.714	.561	.931

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
measurements in problem situations	15.6904	16.572	.681	.567	.933
data collection methods	15.6856	16.115	.772	.713	.927
measures of irregular or compound areas	15.8196	14.780	.847	.787	.921
precision of measurements	15.6426	15.730	.821	.740	.923
sources of error in collecting and organizing data	15.8215	15.807	.767	.692	.927
estimations of length, circumferences	15.5139	16.376	.807	.711	.925
simple probability	15.7727	16.014	.714	.561	.931
translation, reflection, rotation	15.7923	14.918	.804	.733	.925

C1.2 Teacher Confidence: Graphical Functions

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.898	.901	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
cartesian plan	10.2539	4.033	.787	.685	.867
functions as ordered pairs, tables, graphs, words	10.1877	4.456	.804	.697	.868
simple linear equations	10.2125	4.295	.720	.549	.882
pythagorean theorem	10.1343	4.362	.711	.512	.884
attributes of graphs as intercepts	10.3763	4.111	.739	.556	.879

C1.3 Teacher Confidence: Decimal Fractions

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.837	.842	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
characteristics of data sets	10.7092	2.506	.551	.317	.832
integers including words, numbers, models	10.4457	2.711	.649	.473	.805
representing decimals and fractions using words, numbers	10.5270	2.487	.690	.534	.790
geometric pattern or sequence	10.6297	2.485	.681	.504	.793
congruent figures	10.5588	2.413	.653	.461	.801

C2.1 Teachers belief on working conditions: Parental involvement

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.891	.891	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
parental involvement in school activities	8.2049	7.551	.764	.660	.859
students' regard for school property	7.9455	8.240	.784	.617	.852
parental support student achievement	8.1530	7.518	.827	.709	.833
students desire to do well	7.5773	8.559	.673	.495	.890

C2.2 Teachers belief on working conditions: working conditions

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.769	.769	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
understanding curricular goals	7.1966	2.010	.645	.417	.641
job satisfaction	7.4193	2.037	.594	.363	.698
teachers' expectation of students	6.9871	2.126	.568	.329	.726

C3.1 Teachers attitude to teaching: Real world problems

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.531	.532	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
MAT\AGREE\DIFERENT WAYS TO SOLVE PROBL	1.55	.396	.363	.132	.
MAT\AGREE\MODELING REAL WORLD PROBL	1.46	.342	.363	.132	.

C3.2 Teachers attitudes to teaching: Problem solving

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.285	.285	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
MAT\AGREE\MATHEMATICS SHOULD BE	3.01	.764	.171	.045	.179
MAT\AGREE\USE MORE THAN 1 REPRESENTATION	3.37	.865	.220	.053	.080
MAT\AGREE\DIFERENT WAYS TO SOLVE PROBL	3.46	1.014	.087	.010	.345

C3.3 Teachers attitudes to teaching: Memorizing mathematics

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.195	.195	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
MAT\AGREE\FEW NEW DISCOVERIES	3.18	.651	.108	.012	.
MAT\AGREE\LEARNING MATHS MEMORIZING	2.22	.536	.108	.012	.

C4.1 Interaction with other teachers: Observation

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.705	.707	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
informal classroom observation by another teacher	.5771	.444	.547	.299	.
visit other teacher's classroom to observe	.7001	.530	.547	.299	.

C4.2 Interaction with other teachers: Collaboration

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.449	.449	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
discuss particular concept	1.9529	.758	.289	.084	.
preparing instructional material	1.6830	.736	.289	.084	.

C5. School climate

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.550	.565	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
school facility repair	7.7551	4.810	-.143	.032	.825
school safe neighborhood	8.3492	2.861	.549	.413	.295
feel safe at school	8.3166	2.753	.590	.577	.254
security policies and practices	8.8897	2.647	.544	.487	.277

C6.1 Opportunity to learn: Mathematics application

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.678	.679	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
interpret data tables	3.6962	2.721	.474	.244	.603
no immediate obvious method of solution	3.9003	2.486	.491	.247	.593
work on fractions and decimals	3.5999	2.907	.411	.182	.643
functions to represent relationship	3.7343	2.851	.470	.247	.607

C6.2 Opportunity to learn: Practice mathematics together

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.657	.660	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
practice adding, subtracting, multiplying	7.5508	5.728	.311	.264	.653
work together in small group	7.4074	5.385	.500	.325	.566
relate mathematics to daily lives	7.6204	5.059	.482	.239	.569
explain their answers	7.7379	6.002	.300	.256	.654
own procedure to solve problems	8.1527	5.381	.477	.346	.575

C7.1 Homework: Contribute to learning

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.780	.798	7

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
how often assign homework	14.2226	6.673	.506	.339	.757
doing problem or question sets	14.1863	7.248	.557	.354	.742
correct assignments and give feedback	13.8141	7.140	.706	.571	.719
monitor homework completion	13.7984	7.187	.700	.558	.721
gathering data and reporting	14.6368	7.519	.553	.337	.745
finding application of content covered	14.4687	7.653	.371	.279	.780
students correct their own homework	14.4004	7.961	.282	.214	.798

C7.2 Homework: Contribute to performance

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.629	.650	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
minutes assigned for homework	4.3317	1.362	.382	.146	.652
use homework to contribute towards marks	4.5313	1.582	.486	.273	.467
use homework as basis for discussion	4.3587	1.755	.482	.265	.494

C8.1 Limiting factors: Unhappy students

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.824	.828	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
low morale among students	5.0724	4.065	.700	.588	.737
uninterested students	4.7125	4.058	.779	.642	.663
disruptive students	4.9954	4.296	.575	.350	.866

C8.2 Limiting factors: Student diversity

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.526	.552	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
student diversity limit academic ability	4.4118	3.862	.396	.215	.368
wide range of background	4.4714	3.212	.414	.229	.301
students with special needs	5.3982	3.216	.246	.061	.618

C9.1 Topic coverage: Data organisation

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.834	.838	11

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
relationship between two dimensional and three dimensional shapes	15.6347	12.047	.583	.706	.814
line and rotational symmetry	15.6090	12.472	.506	.602	.821
similar triangles	15.4980	12.071	.573	.531	.815
translation, reflection, rotation, and enlargement	15.6884	12.215	.589	.518	.815
properties of polygons	15.3222	11.282	.599	.420	.812
addressed relationships	15.0120	12.500	.472	.643	.824
addressed angles	14.8398	12.550	.392	.470	.831
properties of geometric shapes	15.0617	11.822	.606	.475	.812
addressed properties of angels	15.3937	11.980	.481	.486	.824
congruent figures	15.5486	12.386	.533	.541	.819
pythagorean theorem	15.4021	12.863	.308	.207	.838

C9.2 Topic coverage: Geometric shapes

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.834	.838	11

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
relationship between two dimensional and three dimensional shapes	15.6347	12.047	.583	.706	.814
line and rotational symmetry	15.6090	12.472	.506	.602	.821
similar triangles	15.4980	12.071	.573	.531	.815
translation, reflection, rotation, and enlargement	15.6884	12.215	.589	.518	.815
properties of polygons	15.3222	11.282	.599	.420	.812
addressed relationships	15.0120	12.500	.472	.643	.824
addressed angles	14.8398	12.550	.392	.470	.831
properties of geometric shapes	15.0617	11.822	.606	.475	.812
addressed properties of angels	15.3937	11.980	.481	.486	.824
congruent figures	15.5486	12.386	.533	.541	.819
pythagorean theorem	15.4021	12.863	.308	.207	.838

C9.3 Topic coverage: Measurement

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.708	.704	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
addressed relationships	9.0510	5.032	.379	.195	.687
use standard tools to measure length	9.0641	4.174	.512	.319	.644
measure of length, area, volume	9.0358	4.039	.595	.375	.614
computations, estimations, etc	9.1554	4.928	.331	.193	.701
measurement formula	9.3022	4.785	.426	.204	.673
addressed estimates	9.2578	4.739	.399	.254	.681

C9.4 Topic coverage: Functions

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.641	.644	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
addressed graphs	5.6912	2.358	.435	.311	.571
cartesian plane	5.5897	2.157	.462	.363	.553
addressed functions	5.4598	2.163	.503	.364	.533
precision of measurements	5.6733	2.587	.209	.237	.678
measures of irregular or compound areas	5.6975	2.397	.387	.284	.592

C9.5 Topic coverage: Algebraic functions

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.770	.769	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
addressed graphs	8.6619	4.175	.458	.327	.749
cartesian plane	8.5404	3.737	.567	.465	.721
whole number including place value	7.9555	4.224	.352	.279	.778
addressed functions	8.4176	3.728	.624	.409	.706
addressed simple linear equations	8.4630	3.551	.643	.430	.699
addressed expressions	7.9399	4.334	.457	.316	.750

C10.1 Learning resources: Practice skills and procedure

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.972	.974	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
use computer to discover mathematics principles	.4467	1.704	.972	.	.952
look up ideas and information	.4427	1.703	.936	.	.961
process and analyze data	.4427	1.703	.936	.	.961
practice skills and procedures	.4312	1.578	.892	.	.978

C10.2 Learning resource: Use calculator

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.817	.815	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
use calculator to solve complex problems	8.7319	7.960	.722	.556	.745
how often students use calculators to check answers	8.8331	8.715	.650	.463	.769
use calculator during tests or exams	7.7273	8.367	.652	.452	.767
use calculator to explore concepts	8.9168	8.582	.592	.480	.786
how often students use calculators to do routine	9.1284	9.864	.429	.290	.829

C11.1 Shortage of learning resources: Shortage of instructional equipment

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.782	.787	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
shortage of textbooks	8.8493	9.448	.496	.270	.776
shortage of equipment	8.6479	8.976	.615	.497	.716
shortage of other instructional equipment for students' usage	8.5475	8.265	.770	.623	.637
student/teacher ratio	8.7575	9.112	.498	.311	.778

C11.2 Shortage of learning resources: Computer shortage

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.914	.912	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
shortage of computer software	8.5713	15.279	.906	.872	.851
shortage of computer hardware	8.5567	15.108	.874	.797	.863
shortage of support for using computers	8.5697	16.193	.803	.775	.889
inadequate physical facilities	8.5823	19.729	.651	.493	.937

APPENDIX D

AUSTRALIA: RELIABILITY ANALYSIS

D1.1 Teacher confidence: Data collection methods

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.880	.888	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
simple probability	14.3097	1.912	.670	.565	.867
measurements in problem situations	14.2657	2.033	.777	.821	.845
data collection methods	14.2299	2.152	.757	.689	.852
precision of measurements	14.2687	2.066	.728	.756	.853
characteristics of data sets	14.2247	2.237	.667	.626	.864
sources of error in collecting and organizing data	14.3455	2.026	.611	.441	.875

D1.2 Teacher confidence: Graphical functions/Pattern and relations

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.913	.916	9

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
attributes of graphs as intercepts	22.4422	6.370	.849	.895	.892
functions as ordered pairs, tables, graphs, words	22.4041	6.546	.819	.938	.895
simple linear equations	22.4378	6.554	.763	.856	.899
cartesian plan	22.4136	6.666	.741	.657	.900
translation, reflection, rotation	22.4583	6.884	.573	.733	.913
geometric pattern or sequence	22.4107	6.814	.743	.764	.901
congruent figures	22.3741	7.147	.630	.644	.908
pythagorean theorem	22.3551	7.171	.659	.770	.907
measures of irregular or compound areas	22.4846	6.832	.562	.464	.915

D1.3 Teacher confidence: Decimal fractions

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.797	.801	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
integers including words, numbers, models	5.8470	.221	.653	.510	.718
representing decimals and fractions using words, numbers	5.8155	.241	.753	.580	.614
estimations of length, circumferences	5.8221	.275	.539	.319	.825

D2. Teachers' belief on working conditions

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.918	.917	7

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
job satisfaction	18.6153	22.672	.652	.620	.914
understanding curricular goals	18.3234	22.268	.658	.568	.914
teachers' expectation of students	18.5028	20.389	.772	.677	.902
parental support student achievement	18.9992	20.124	.808	.752	.898
parental involvement in school activities	19.4076	20.500	.744	.691	.906
students' regard for school property	19.3124	20.109	.786	.701	.901
students desire to do well	18.9764	20.362	.805	.686	.899

D3.1 Teachers' attitudes to teaching: Real world problems

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.612	.612	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
modelling real world problem	3.5238	.276	.441	.195	.
attitudes mathematics representation	3.6335	.271	.441	.195	.

D3.2 Teachers' attitudes to teaching: Problem solving

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.581	.601	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
different ways to solve problems	3.3312	.473	.430	.185	.
solving mathematics involves hypothesizing	3.4928	.250	.430	.185	.

D3.3 Teachers attitudes to teaching: Memorizing mathematics

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.499	.507	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
mathematics as set of algorithm	4.4253	1.108	.276	.216	.478
learning mathematics involves memorizing	4.6917	.998	.539	.294	.017
few new discoveries in mathematics	4.4533	1.392	.176	.120	.610

D4.1 Interaction with other teachers: Observation

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.673	.674	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
visit other teacher's classroom to observe	1.7374	.273	.508	.258	.
informal classroom observation by another teacher	1.7576	.298	.508	.258	.

D4.2 Interaction with other teachers: Collaboration

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.240	.240	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
discuss particular concept	1.4632	1.169	.136	.019	.
preparing instructional material	.9214	1.052	.136	.019	.

D5. School climate

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.876	.882	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
school safe neighbourhood	6.4593	1.584	.759	.578	.828
feel safe at school	6.2477	1.763	.758	.578	.841
security policies and practices	6.5956	1.287	.802	.644	.801

D6.1 Opportunity to learn: Mathematics application

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.564	.611	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
interpret data tables	2.6780	1.166	.380	.162	.533
functions to represent relationship	2.5288	.794	.455	.224	.336
own procedure to solve problems	2.2917	.545	.404	.164	.497

D6.2 Opportunity to learn: Practice mathematics together

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.659	.677	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
explain their answers	6.8739	5.423	.495	.319	.575
relate mathematics to daily lives	7.2329	6.125	.294	.225	.652
no immediate obvious method of solution	7.7586	6.188	.515	.298	.589
work together in small group	7.7502	5.423	.551	.330	.556
work on fractions and decimals	7.3897	6.436	.301	.171	.645
practice adding, subtracting, multiplying	7.0723	5.929	.264	.116	.673

D7.1 Homework: Contribute to learning

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.731	.741	7

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
doing problem or question sets	11.4590	5.720	.566	.434	.672
students correct their own homework	12.0328	5.615	.460	.248	.696
minutes assigned for homework	12.1336	6.083	.396	.395	.710
use homework as basis for discussion	12.1221	5.907	.563	.361	.676
how often assign homework	11.6598	5.641	.382	.324	.722
finding application of content covered	12.4992	6.529	.303	.304	.729
gathering data and reporting	12.4033	6.072	.499	.354	.689

D7.2 Homework: Contribute to performance

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.745	.763	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
use homework to contribute towards marks	5.2900	1.122	.569	.391	.705
monitor homework completion	4.6937	1.474	.705	.497	.541
correct assignments and give feedback	4.7618	1.627	.500	.301	.739

D8. Students limiting factors: Unhappy students

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.819	.822	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
student diversity limit academic ability	9.0387	11.235	.687	.523	.768
wide range of background	10.0974	12.025	.462	.351	.816
students with special needs	10.5785	12.772	.350	.319	.839
uninterested students	9.3101	10.833	.688	.638	.766
low morale among students	9.8360	11.362	.641	.629	.777
disruptive students	9.5228	11.096	.712	.611	.763

D9.1 Topic coverage: Data organisation

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.773	.777	8

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
simple probability	12.1402	6.384	.209	.233	.796
evaluating, interpreting data	12.1811	5.831	.550	.367	.738
interpretation of data	11.9758	5.261	.707	.595	.706
characteristics of data sets	11.8606	5.412	.645	.489	.718
computations with measurements	11.8424	5.883	.432	.360	.756
organising set of data	11.6894	5.794	.513	.566	.742
drawing and interpreting graphs	11.5864	6.097	.394	.468	.762
data collection methods	11.8924	6.022	.401	.320	.761

D9.2 Topic coverage: Geometric shapes

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.828	.830	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
line and rotational symmetry	5.0242	2.944	.728	.639	.749
translation, reflection, rotation, and enlargement	4.9773	2.667	.811	.700	.705
pythagorean theorem	5.2811	4.166	.572	.338	.825
properties of polygons	5.1515	3.841	.571	.344	.819

D9.3 Topic coverage: Measurement

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.733	.733	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
addressed estimates	8.7212	2.124	.599	.433	.643
measure of length, area, volume	8.4379	2.252	.565	.396	.658
measurement formula	8.8364	2.945	.366	.315	.732
addressed relationships	8.5182	2.198	.580	.404	.652
use standard tools to measure length	8.2894	2.403	.395	.331	.730

D9.4 Topic coverage: Functions

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.621	.638	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
cartesian plane	6.7114	1.889	.427	.260	.540
addressed functions	6.5295	1.816	.581	.366	.467
addressed proportional	6.7167	1.918	.470	.266	.521
addressed graphs	6.8492	2.064	.317	.206	.596
addressed expressions	6.1629	2.183	.154	.086	.688

D9.5 Topic coverage: Algebraic functions

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.703	.705	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
cartesian plane	6.4614	1.985	.435	.260	.666
addressed functions	6.2795	1.929	.572	.353	.608
addressed proportional	6.4667	1.881	.592	.428	.598
addressed graphs	6.5992	2.134	.347	.229	.701
addressed expressions	6.1629	2.183	.371	.317	.688

D9.6 Topic coverage: Number operations

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.889	.893	9

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
common fractions	19.1425	9.442	.833	.738	.862
representing decimals and fractions	19.1026	9.338	.799	.677	.864
whole number including place value	18.9898	10.051	.632	.514	.878
computations with decimals	19.2381	9.559	.736	.671	.869
decimal fractions	19.2255	9.927	.651	.513	.876
computations with fractions	19.2396	9.651	.695	.637	.872
computations, estimations, etc	19.1159	10.056	.518	.442	.888
addressed angles	19.5114	9.449	.549	.411	.889
addressed conversions	19.5529	10.877	.448	.340	.890

D10.1 Learning resources: Practice skills and procedures

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.967	.968	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
process and analyze data	2.6955	5.991	.958	.921	.945
practice skills and procedures	2.6932	6.102	.922	.866	.956
use computer to discover mathematics principles	2.8561	6.751	.904	.839	.962
look up ideas and information	2.6962	6.189	.898	.812	.962

D10.2 Learning resources: Use of calculator

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.885	.886	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
how often students use calculators to check answers	10.8158	10.597	.779	.617	.847
use calculator to solve complex problems	10.8344	10.798	.771	.673	.849
how often students use calculators to do routine	10.6422	10.561	.713	.559	.864
use calculator to explore concepts	11.2439	11.103	.686	.593	.869
use calculator during tests or exams	10.2084	12.012	.680	.531	.871

D11.1 Shortage of learning resources: Shortage of instructional equipment

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.651	.662	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
student/teacher ratio	2.5545	2.547	.330	.114	.745
shortage of textbooks	3.1856	2.383	.571	.385	.416
inadequate physical facilities	3.1553	2.357	.510	.359	.488

D11.2 Shortage of learning resources: Computer shortages

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.889	.892	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
shortage of computer software	6.6455	11.031	.742	.630	.863
shortage of computer hardware	6.8523	11.341	.729	.594	.866
shortage of support for using computers	7.0379	11.337	.776	.610	.854
shortage of equipment	6.9068	12.618	.724	.629	.868
shortage of other instructional equipment for students' usage	6.9182	12.583	.702	.605	.872

APPENDIX E

SOUTH AFRICA: CORRELATION ANALYSIS

Correlations

		1ST PLAUSIBLE VALUE MATHEMATICS	GEN\AGE OF TEACHER	GEN\YEARS BEEN TEACHING	GEN\OUTSIDE SCHOOL DAY\GRADING TESTS	GEN\OUTSIDE SCHOOL DAY\OTHER	Computer shortage
Pearson Correlation	*1ST PLAUSIBLE VALUE MATHEMATICS*	1.000	.267	.306	.285	.319	-.266
	GEN\AGE OF TEACHER	.267	1.000	.694	.296	.173	-.071
	GEN\YEARS BEEN TEACHING	.306	.694	1.000	.305	.299	-.052
	GEN\OUTSIDE SCHOOL DAY\GRADING TESTS	.285	.296	.305	1.000	.164	-.059
	GEN\OUTSIDE SCHOOL DAY\OTHER	.319	.173	.299	.164	1.000	-.052
	Computer shortage	-.266	-.071	-.052	-.059	-.052	1.000
Sig. (1-tailed)	*1ST PLAUSIBLE VALUE MATHEMATICS*	.	.000	.000	.000	.000	.000
	GEN\AGE OF TEACHER	.000	.	.000	.000	.000	.000
	GEN\YEARS BEEN TEACHING	.000	.000	.	.000	.000	.007
	GEN\OUTSIDE SCHOOL DAY\GRADING TESTS	.000	.000	.000	.	.000	.003
	GEN\OUTSIDE SCHOOL DAY\OTHER	.000	.000	.000	.000	.	.007
	Computer shortage	.000	.000	.007	.003	.007	.

N	*1ST PLAUSIBLE VALUE MATHEMATICS*	2229	2229	2229	2229	2229	2229
	GEN\AGE OF TEACHER	2229	2229	2229	2229	2229	2229
	GEN\YEARS BEEN TEACHING	2229	2229	2229	2229	2229	2229
	GEN\OUTSIDE SCHOOL DAY\GRADING TESTS	2229	2229	2229	2229	2229	2229
	GEN\OUTSIDE SCHOOL DAY\OTHER	2229	2229	2229	2229	2229	2229
	Computer shortage	2229	2229	2229	2229	2229	2229

APPENDIX F

AUSTRALIA: CORRELATION ANALYSIS

Correlations

		1ST PLAUSIBLE VALUE MATHEMATICS	Homework contribute to learning	Work conditions	Unhappy students	Shortage instructional equipment	Geometric shapes	Algebraic function	teacher perception of sch climate
Pearson Correlation	*1ST PLAUSIBLE VALUE MATHEMATICS*	1.000	.324	.437	-.300	-.271	.205	.212	
	Homework contribute to learning	.324	1.000	.266	-.136	-.003	.232	-.023	
	Work conditions	.437	.266	1.000	-.406	-.530	.324	.166	
	Unhappy students	-.300	-.136	-.406	1.000	.508	-.221	-.115	
	Shortage instructional equipment	-.271	-.003	-.530	.508	1.000	-.355	-.034	
	Geometric shapes	.205	.232	.324	-.221	-.355	1.000	.351	
	Algebraic function	.212	-.023	.166	-.115	-.034	.351	1.000	
	teacher perception of school climate	.374	.256	.893	-.362	-.460	.230	.130	
	teacher perception of school safety	.240	-.023	.592	-.295	-.562	.267	-.033	
	teacher emphasis on maths homework	.259	.565	.020	-.035	-.111	.211	-.186	

	teacher repeat maths limiting factors	.323	.266	.455	-.848	-.437	.213	.039
Sig. (1-tailed)	*1ST PLAUSIBLE VALUE MATHEMATICS*	.	.000	.000	.000	.000	.000	.000
	Homework contribute to learning	.000	.	.000	.000	.465	.000	.222
	Work conditions	.000	.000	.	.000	.000	.000	.000
	Unhappy students	.000	.000	.000	.	.000	.000	.000
	Shortage instructional equipment	.000	.465	.000	.000	.	.000	.126
	Geometric shapes	.000	.000	.000	.000	.000	.	.000
	Algebraic function	.000	.222	.000	.000	.126	.000	.
	teacher perception of school climate	.000	.000	.000	.000	.000	.000	.000
	teacher perception of school safety	.000	.222	.000	.000	.000	.000	.132
	teacher emphasis on maths homework	.000	.000	.249	.119	.000	.000	.000
	teacher repeat maths limiting factors	.000	.000	.000	.000	.000	.000	.095
N	*1ST PLAUSIBLE VALUE MATHEMATICS*	1127	1127	1127	1127	1127	1127	1127
	Homework contribute to learning	1127	1127	1127	1127	1127	1127	1127
	Work conditions	1127	1127	1127	1127	1127	1127	1127
	Unhappy students	1127	1127	1127	1127	1127	1127	1127

	Shortage instructional equipment	1127	1127	1127	1127	1127	1127	1127
	Geometric shapes	1127	1127	1127	1127	1127	1127	1127
	Algebraic function	1127	1127	1127	1127	1127	1127	1127
	teacher perception of school climate	1127	1127	1127	1127	1127	1127	1127
	teacher perception of school safety	1127	1127	1127	1127	1127	1127	1127
	teacher emphasis on maths homework	1127	1127	1127	1127	1127	1127	1127
	teacher repeat maths limiting factors	1127	1127	1127	1127	1127	1127	1127

APPENDIX G

SOUTH AFRICA: MULTIPLE REGRESSIONS

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.319[a]	.102	.101	90.47548	.102	252.551	1	2227	.000	
2	.405[b]	.164	.164	87.29337	.062	166.321	1	2226	.000	
3	.463[c]	.214	.213	84.67122	.050	141.007	1	2225	.000	
4	.489[d]	.239	.238	83.34444	.025	72.404	1	2224	.000	
5	.492[e]	.242	.240	83.20363	.003	8.534	1	2223	.004	1.200

a. Predictors: (Constant), GEN\OUTSIDE SCHOOL DAY\OTHER

b. Predictors: (Constant), GEN\OUTSIDE SCHOOL DAY\OTHER, Computer shortage

c. Predictors: (Constant), GEN\OUTSIDE SCHOOL DAY\OTHER, Computer shortage, GEN\OUTSIDE SCHOOL DAY\GRADING TESTS

d. Predictors: (Constant), GEN\OUTSIDE SCHOOL DAY\OTHER, Computer shortage, GEN\OUTSIDE SCHOOL DAY\GRADING TESTS, GEN\YEARS BEEN TEACHING

e. Predictors: (Constant), GEN\OUTSIDE SCHOOL DAY\OTHER, Computer shortage, GEN\OUTSIDE SCHOOL DAY\GRADING TESTS, GEN\YEARS BEEN TEACHING, GEN\AGE OF TEACHER

f. Dependent Variable: *1ST PLAUSIBLE VALUE MATHEMATICS*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	223.343	2.349		95.061	.000	218.736	227.951			
	GEN\OUTSIDE SCHOOL DAY\OTHER	13.920	.876	.319	15.892	.000	12.202	15.638	.319	.319	.319
2	(Constant)	278.329	4.829		57.640	.000	268.860	287.798			
	GEN\OUTSIDE SCHOOL DAY\OTHER	13.348	.846	.306	15.773	.000	11.688	15.008	.319	.317	.306
	Computer shortage	-3.785	.294	-.250	-12.897	.000	-4.361	-3.210	-.266	-.264	-.250
3	(Constant)	254.689	5.089		50.045	.000	244.709	264.669			
	GEN\OUTSIDE SCHOOL DAY\OTHER	11.753	.832	.269	14.130	.000	10.122	13.384	.319	.287	.266
	Computer shortage	-3.612	.285	-.239	-12.670	.000	-4.171	-3.053	-.266	-.259	-.238
	GEN\OUTSIDE SCHOOL DAY\GRADING TESTS	5.064	.426	.227	11.875	.000	4.228	5.900	.285	.244	.223
4	(Constant)	234.318	5.552		42.203	.000	223.430	245.206			
	GEN\OUTSIDE SCHOOL DAY\OTHER	9.850	.849	.226	11.606	.000	8.186	11.515	.319	.239	.215
	Computer shortage	-3.551	.281	-.235	-12.652	.000	-4.102	-3.001	-.266	-.259	-.234
	GEN\OUTSIDE SCHOOL DAY\GRADING TESTS	4.061	.436	.182	9.316	.000	3.206	4.916	.285	.194	.172
	GEN\YEARS BEEN TEACHING	2.821	.332	.171	8.509	.000	2.171	3.471	.306	.178	.157
5	(Constant)	215.553	8.484		25.405	.000	198.914	232.191			

	GEN\OUTSIDE SCHOOL DAY\OTHER	10.003	.849	.229	11.784	.000	8.338	11.668	.319	.242	.218
	Computer shortage	-3.514	.281	-.232	-12.528	.000	-4.064	-2.964	-.266	-.257	-.231
	GEN\OUTSIDE SCHOOL DAY\GRADING TESTS	3.901	.439	.174	8.891	.000	3.040	4.761	.285	.185	.164
	GEN\YEARS BEEN TEACHING	1.977	.439	.120	4.500	.000	1.115	2.838	.306	.095	.083
	GEN\AGE OF TEACHER	9.275	3.175	.076	2.921	.004	3.049	15.502	.267	.062	.054

a. Dependent Variable: *1ST PLAUSIBLE VALUE MATHEMATICS*

APPENDIX H

AUSTRALIA: MULTIPLE REGRESSIONS

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.564[a]	.318	.312	64.57974	.318	52.114	10	1116	.000	1.548

a. Predictors: (Constant), teacher repeat maths limiting factors, Algebraic function, teacher emphasis on maths homework, teacher perception of school safety, Geometric shapes, teacher perception of school climate, Homework contribute to learning, Shortage instructional equipment, Unhappy students, Work conditions

b. Dependent Variable: *1ST PLAUSIBLE VALUE MATHEMATICS*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations		
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	267.122	28.863		9.255	.000	210.490	323.754			
	Homework contribute to learning	3.948	1.177	.116	3.353	.001	1.637	6.258	.324	.100	.083
	Work conditions	5.408	.977	.372	5.538	.000	3.492	7.325	.437	.164	.137
	Unhappy students	-1.850	.942	-.099	-1.964	.050	-3.699	-.002	-.300	-.059	-.049
	Shortage instructional equipment	-.608	.950	-.023	-.640	.522	-2.472	1.256	-.271	-.019	-.016
	Geometric shapes	-2.791	.802	-.106	-3.478	.001	-4.365	-1.216	.205	-.104	-.086
	Algebraic function	10.346	1.276	.233	8.107	.000	7.842	12.850	.212	.236	.200
	teacher perception of school climate	-8.836	6.806	-.074	-1.298	.194	-22.190	4.519	.374	-.039	-.032
	teacher perception of school safety	5.789	4.835	.042	1.197	.231	-3.697	15.275	.240	.036	.030
	teacher emphasis on maths homework	30.932	4.145	.243	7.462	.000	22.799	39.066	.259	.218	.184
	teacher repeat maths limiting factors	3.090	5.240	.030	.590	.555	-7.191	13.371	.323	.018	.015

a. Dependent Variable: *1ST PLAUSIBLE VALUE MATHEMATICS*