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List of abbreviations

ACE	Accelerated Certificates of Education
ANA	Annual National Assessment
AS	Assessment Standard
BODMAS	Brackets, Of, Division, Multiplication, Addition, Subtraction
CTLI	Cape Teaching and Leadership Institute
CTE	collective teacher efficacy
COD	Concise Oxford Dictionary
COSATU	Congress of South African Trade Unions
CKT-M	content knowledge for teaching mathematics
CHE	Council on Higher Education
CAPS	Curriculum Assessment Policy Statement
DBE	Department of Basic Education
DET	Department of Education and Training
ECD	Early Childhood Development
EMS	Economic and Management Science
EE	economics of education
EE	economics of education
EMIS	Educational Management Information System
FAL	First Additional Language
FFL	Foundations for Learning Campaign
FR	free response
FET	Further Education and Training
GPI	gender parity index
GER	Gross Enrolment Ratio
HODs	heads of departments
HLM	hierarchical linear modelling
HL	home language
HoA	House of Assembly
HoD	House of Delegates

HoR	House of Representatives
HSRC	Human Sciences Research Council
IEA	International Association for the Evaluation of Educational Achievement
IRT	item response theory
KZN	Kwazulu-Natal
LOLT	language of learning and teaching
LO	Learning Outcome
MASTEC	Maths and Science Teacher Education College
MC	multiple-choice
NAEP	National Assessment of Educational Progress
NCS	National Curriculum Statement
NIDS	National Income Dynamics Study
NPC	National Planning Commission
NSES	National School Effectiveness Study
NW	North West
OLS	Ordinary Least Squares
PCK	pedagogical content knowledge
PSU	Primary Sampling Unit
PIMRS	Principal Instructional Management Rating Scale
PNLD	Programa Nacional do Livro Didático
PISA	Programme for International Student Assessment
PIRLS	Progress in International Reading Literacy
PPP	Pupil Progress Project
SESI	school effectiveness
SER	school effectiveness research
SGB	school governing body
SLM	school leadership and management
SES	socio-economic status
SAALT	South African Association of Language Teachers
SADTU	South African Democratic Teachers Union
SASA	South African Schools Act
SACMEQ	Southern and Eastern Africa Consortium for Monitoring Education Quality
SFE	straight for English
SE	Systemic Evaluation
TIMSS	Trends in Mathematics and Science Studies

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Chapter 1

Context, theory, design

The South African school context

The country has made significant progress towards normalising its racially divided society and redressing the deprivations imposed by apartheid since the advent of democracy in 1994. Yet, enormous challenges of poverty, inequality and unemployment remain. The analysis by South Africa's National Planning Commission, situated in the Office of the Presidency, provides a balanced view of the economic and social gains made and continuing challenges faced by the country (NPC, 2011). It is estimated that 48% of the population was living on less than $2 a day in 2008 and at 0.67 in 2005 the Gini coefficient was the highest in the world. Although the incomes of both the richest and poorest 20% of the population rose by about 45 percent between 1995 and 2005, the distribution of income did not change significantly: the poorest 20% of the population earns about 2.3% of national income, while the richest 20% earns about 70%. While the proportion of Africans in the top 20% of income earners increased from 39% in 1995 to 48% in 2009, inequality within the African population has increased sharply. In 2010, unemployment stood at 25.4% of the economically active population still seeking work, with joblessness among the 15–24 year old cohort at 51.3%.

The South African struggle for democracy was spared the trauma of civil war in order to achieve universal suffrage. However, it remains a traumatised society, a situation aggravated by the highest rate of HIV/AIDS infections in the world. National mortality trends for the last 15 years illustrate the point. In a country of some 48 million, annual deaths nearly doubled from 383 000 in 1997 to over 600 000 in 2007 (Harrison, 2009; Friedman and Coovadia, 2011). By far the largest single cause of death is AIDS, more than 4.5 times more frequent than the next most common cause, which is interpersonal violence, followed by tuberculosis and preventable childhood diseases (some of which

can be linked to AIDS), and traffic injury. In other words, the overwhelmingly largest numbers of deaths are self-inflicted by the population through pathological forms of behaviour: unsafe sex, murder, reckless driving, poor parenting and high levels of intoxication and violence. Largely as a result of the AIDS epidemic, more than two million school-going children live with only one or no parents, around 17% of the cohort.

Table 1.1: Orphans at school

	Father deceased	Mother deceased	Both deceased	Total
2008				
2009				

Source: DBE, 2010

Whatever the psychological explanation for its causes may be, the roots of South Africa's psychopathy illustrated by the demography of these mortality figures must lie in large measure in a century and a half of war and subjugation, and the destabilising influence on families of migrant labour, greatly exacerbated at the present time by the exponential acceleration of urbanisation from both within and without the country's borders. Under the social conditions that South Africa finds itself in at present, educational institutions have a doubly important role in socialising young citizens into the values and skills needed to act independently and in community with others in a modern economy. Too many schools are not doing the job, as we shall see below, and the need to improve the quality of schooling must rank as the country's highest priority.

Spending on education

In 1994 the new government, after equalising teacher salaries across the races and progressively introducing school feeding for the poorest 50% of schools, embarked on a three-pronged redress strategy, redistributing the budget towards social services, towards the poorest provinces, and towards historically disadvantaged schools. Since 2006, the poorest two quintiles of schools have been classified as 'no-fee schools' and this was later extended to include the third quintile (DBE, 2011a). Non-personnel spending is redistributive: such spending on the poorest fifth of schools is roughly six times higher than spending on the richest fifth of schools (Van der Berg et al, 2011). However, although non-personnel funding received by schools is pro-poor, schools in more affluent communities remain better resourced due to the practice of charging school fees. Nevertheless, the country's per learner expenditure, at $1 383, compares very favourably with that of the Sub-Saharan ($167) and

Latin American ($614) averages (DBE, 2011a). South Africa's school system is relatively well financed when compared with those of the large majority of developing countries.

Access to school

The expansion of a Grade R programme (the year before Grade 1) in the last decade and the lowering of the age of admission to Grade 1 in 2002 resulted in a substantial improvement in access to education for five-year- and six-year-olds. By 2009, 78% of five-year-olds and 95% of six-year-olds were enrolled in an educational institution (DBE, 2011a). The participation rate of children who are of compulsory school age is extremely high with almost 99% of children aged seven to 15 enrolled in an educational institution in 2009. However, beyond compulsory school age the participation rate in any form of education begins to drop: whereas 96% of 15-year-olds participated in an educational institution in 2008, this dropped to 93% of 16-year-olds in 2009. The biggest decline in learner participation in an educational institution occurs among 17- and 18-year-olds, with fewer than 90% of 17-year-olds participating in education and among 18-year-old youth the figure is below 75%. In the age range beyond 16, South African participation rates in education are quite high, though poor progression and weak performance in matric (Grade 12) constrain graduation rates to lower than that of other middle-income countries (Gustafsson, 2011).

Quality

South Africa participates in three cross-country comparative studies: Trends in Mathematics and Science Studies (TIMSS) (Grade 8 maths and science), Progress in International Reading Literacy (PIRLS) (Grade 4 and 5 reading) and Southern and Eastern Africa Consortium for Monitoring Education Quality (SACMEQ) (Grade 6 reading and maths). The message coming from all three sources is unambiguous: the country performs poorly compared with many of its more impoverished neighbours, and very poorly in relation to developing countries in other parts of the world (Taylor et al, 2008). For example, in the round of SACMEQ testing conducted in 2000, of the 14 Southern and Eastern African countries participating, South Africa was placed ninth in both reading and mathematics. South Africa scores significantly lower than a number of countries whose per capita GNI figures are around one-tenth of South Africa's. The bad news is that things are not getting better: results from the SACMEQ III exercise conducted in 2007 again place South Africa in the bottom half of the 15 African country sample (Spaull, 2011).

Equity

Under apartheid, spending on white learners was around five or six times the amount spent on Africans (Buckland and Fielding, 1994; SAIRR, 2010) but, as mentioned above, recurrent per capita public spending is higher today for African than white learners (NPC, 2011). With respect to gender equality, the country also has an excellent record: access to schooling in South Africa has been achieved equally for male and female learners. However, girls move through the system more efficiently than boys, who repeat more frequently and drop out without completing their schooling in greater numbers than their female counterparts (see Chapter 9). As a result the gender parity index moves from 0.97 in primary schools to 1.07 in secondary schools (DBE, 2011a).

Poorer learners receive significantly inferior schooling to their more affluent peers. Disaggregating the SACMEQ III results by poverty quartile, Spaull (2011) shows that for the wealthiest 25% of learners, South Africa ranks forth out of 15 for reading. This is a noteworthy finding, showing that even the wealthiest quartile of South African schools is not only outperformed by the Seychelles and Mauritius (island nations with a higher than average socio-economic status or SES) but also by Tanzania, which, along with Malawi, has the lowest SES rating in the sample (Hungi et al, 2011). However, when ranked by the performance of the poorest 25% of learners, South Africa ranks 14th out of 15 for reading. For maths, the figures are sixth out of 15 for wealthy learners and 12th out of 15 for poor learners. Thus, the average poor South African learner performs worse at reading than the average poor Malawian or Mozambican learner; this is in spite of the fact that the average poor South African learner is significantly less poor than the average poor Malawian or Mozambican learner (Van der Berg et al, 2011).

Clearly the South African primary school system is significantly underperforming relative to its regional counterparts given its large relative advantage in material resources. South Africa is still a tale of two school sub-systems: one, which is functional, wealthy, and able to educate learners, and the other poor, dysfunctional, and unable to equip learners with the necessary numeracy and literacy skills they should be acquiring in primary school (Van der Berg et al, 2011; Spaull, 2011). This inequality of school provision has consequences for the labour market, poverty and hereditary poverty, and this pattern has strong racial overtones: residents of poor and predominantly black neighbourhoods frequently attend schools with a lack of discipline, weak management and few competent teachers.

Possible explanatory factors for the underperformance of South African schools

Much has been written about the home-, school- and classroom-level factors associated with poor learner performance (Taylor, N, 2009; Hoadley, 2010; van der Berg et al, 2011), and in this section we provide only a brief summary of the standout factors.

Poverty

Poverty has devastating effects on children's life chances, and nowhere is this more strongly felt than in schooling. The mechanism for this reproductive effect of schools is the co-variation between lack of home support, the poverty of the community, and the expertise of principals and teachers. Van der Berg et al (2011) observe that the effects of the community and the combined socio-economic status (SES) of schools are more pronounced than the individual-level effect of socio-economic status. In other words, the individual learner's socio-economic background matters less for her performance than the area she lives in and the school she attends. A principal purpose of the National School Effectiveness Study (NSES) reported on in this volume is to identify options for policy and practice which are most likely to increase the traction exerted by schools in reducing inequality, in breaking the reproductive cycle of poverty currently exercised through the country's school system.

Well-run schools can effect a very significant improvement in the life chances of poor learners. For example, when controlling for learner and school SES, African language learners in historically white schools enjoy a considerable performance advantage over those in historically black schools, even when one considers their generally more advantaged home background (Taylor and Yu, 2009; Chapter 3, this volume). This difference is statistically significant and large, especially so in the case of numeracy. Van der Berg et al (2011) conclude that although achievement is strongly connected with learner SES, much of this connection has to do with the effectiveness of schools in which learners are located. Given that primary schooling forms the foundation both for all further education and training and for labour market opportunities, the overwhelming challenge for the entire system is to improve the quality of basic education provided to poor learners.

Civil service capacity

According to Crouch and Vinjevold (2006), some of the roots of the poor quality of South Africa's schools lie in the rapid expansion of the system. Thus, between 1970 and 1995, when enrolment increased from 30% of the population to over 90%, large numbers of institutions were established, while the training capacity of the higher education system and the management capability of the civil service both consistently remained below the levels required to deliver anything but very poor quality schooling to these burgeoning numbers. The effects were exacerbated as a result of the reorganisation of the teacher training system, the FET college sector, and the educational bureaucracy since 1994.

The NPC sounds a warning regarding these conditions, citing rising corruption and the weakening of state institutions as signals which have preceded the decline of empires in historical times (NPC, 2011). According to government's Special Investigating Unit, it is estimated that 20–25% of state procurement expenditure, amounting to roughly R30 billion a year, is wasted through overpayment or corruption (Report of Special Investigations Unit to Parliament, 30 March 2011). The following year the head of the Asset Forfeiture Unit stated publicly that government attempts to rein in corruption were woefully inadequate, with only five convictions obtained for civil service corruption in the last decade (*The Star*, 20 February 2012). In 2011 the provincial department of education in the Eastern Cape and Limpopo were placed under administration by central government in terms of Section 100 of the Constitution (Republic of South Africa, 1996).

Developments in the Eastern Cape are particularly apt in illustrating the importance of consequences of the breakdown in civil service discipline. Central government takeover of the Eastern Cape Education Dept was precipitated by an overspend of R1.2 billion in the province, in part the results of a shrinkage in learner numbers and consequent reduction in allocation to the province by the Treasury, without an accompanying reduction in teacher numbers. As a result, school feeding and learner transport systems collapsed, but some 7 000 excess teachers kept their jobs (*Business Day*, 20 February 2012). In response to the department's proposal to redeploy teachers away from under-utilised schools towards overcrowded schools and to terminate the contracts of 4 000 temporary teachers, SADTU, the largest teacher union, mounted a 'go-slow', which effectively turned into a three-week unregulated strike (*Business Day*, 8 February 2012). The matter was resolved when the leader of Congress of South African Trade Unions (COSATU), Zwelinzima Vavi, negotiated a 'compromise' according to which all temporary teachers would be re-employed (SA FM radio discussion 16h00–18h00, 8 February 2012). It seems that the union now effectively controls the provincial education budget.

Eastern Cape

The latter point illustrates the power of the unions in the public sector. The NPC Diagnostic Report notes that strike action consumes as much as ten days a year (5% of school time), while holding union meetings during school time is often the norm in township schools. Procedures for dismissing teachers for misconduct are complex and time-consuming – and dismissals are rare as a result. School districts and the Department of Education have not provided adequate means to address allegations of extreme misconduct involving teachers. (NPC, 2011). In 2011 SADTU membership stood at 246 947 and, although they comprise only 12% of organised workers affiliated to COSATU (figures supplied by COSATU head office), the high levels of organisation of SADTU and the location of branches in every corner of the country give the union power way beyond its numbers. Furthermore, the location of COSATU in a tripartite alliance with the ruling African National Congress and the SA Communist Party, makes the resolution of disputes such as the situation in the Eastern Cape described above very difficult. However, in Chapter 4 below, we return to this issue, where we conclude that it is not clear in many situations to what extent the union is exhibiting predatory behaviour and to what extent it is protecting teachers against bureaucratic incompetence.

The prognosis for the NPC is that, under these conditions, a coordinated effort is required to turn the civil service into an effective instrument of development:

> Addressing the uneven performance of the public service will not be achieved through multiple new initiatives but rather through a focused and coordinated approach. This will require addressing a set of interrelated issues including instability resulting from repeated changes in policy, under-staffing and skills shortages, obstacles to building a sense of professional common purpose in the public service, political interference, lack of accountability, and insufficient clarity in the division of roles and responsibilities. (NPC, 2011:26).

Teacher subject knowledge

The last few years has seen the accumulation of evidence to indicate that the majority of South African teachers know little more about the subjects which they teach than the curriculum expects of their learners, and that some teachers know considerably less than this (Taylor, N., 2009; Carnoy et al, 2011). In his analysis of the SACMEQ III results, Spaull (2011) notes that the subject tests given to teachers were comparable to those taken by the learners, but that the average teacher scores in both the reading and mathematics tests were mediocre. We analyse these tests and the scores of both learners and teachers in Chapter 8, and suffice to say at this stage that the subject knowledge of teachers

is too low to provide their learners with an adequate conceptual foundation in either literacy or mathematics.

Despite their poor subject knowledge, the large majority of South African educators are considered to be appropriately qualified, as indicated by possession of a Senior Certificate (Grade 12) and a minimum of three years of appropriate post-school training. Educator qualifications have increased dramatically in the last two decades: in 1990 only 53% of educators were appropriately qualified by these yardsticks, and by 2008 this had increased to 94.4% (DOE, 2009). This increase in the proportion of teachers reaching qualified status is in stark contrast to the absence of any discernible improvement in learner performance in the same period. In July 2010 the Department of Basic Education (DBE), in announcing the release of the Integrated Strategic Planning Framework (DBE & DHET, 2011), admitted that the R1.1 billion available annually for teacher in-service training was not optimally used (*Business Day*, 27 July 2010), but conceded that it had not yet decided how to design more effective training. The massive growth in teacher qualifications over the last decade has been fuelled by the part-time Accelerated Certificates of Education (ACE) offered by universities. The quality of many of these programmes has been questioned by the Council on Higher Education (CHE, 2010). Similarly, the impact on school performance of the uncertified training provided by donor funded NGO programmes and by provincial departments of education has been disappointing (Taylor, 2009). The two-week block release programme offered by the Cape Teaching and Leadership Institute is the only in-service initiative that has been shown to be associated with significant rises in learner scores in both reading and maths in the annual provincial tests (Dechaisemartin, 2010). The model of training offered by the CTLI is also used by Gauteng's SciBono Centre, and the Maths and Science Teacher Education College in Limpopo: an intensive residential course of relatively long duration (two weeks for CTLI and SciBono; nine weeks for MASTEC) focusing on subject content, with substitute teachers employed to release teachers for training. While research on these programmes is incomplete, the model does appear to hold some promise (Pereira, 2011).

Teachers

Ref?

It is unclear at this stage to what extent programmes in initial teacher training equip learners for teaching in South African schools, since the large majority of teachers currently in service were trained by the 120 largely rural teacher colleges which were closed or amalgamated with one of the 23 universities in 2003, resulting in a dramatic drop in the numbers of teachers trained. What can be said is that both the number and quality of learner teachers appear to have risen since the introduction of a state bursary scheme for the study of teaching in 2009 (DHET, 2011), although there is evidence to indicate that new graduates struggle to find jobs, despite persistent projections of teacher shortages (Deacon, 2011). The latter effect may be due to the tight control over employment exerted by the

unions, as illustrated in the case of the Eastern Cape described above. Research on both the flow of newly qualified teachers and the extent to which the curriculum better prepares learners in terms of subject and pedagogical knowledge are needed to illuminate these questions.

Time management

The inefficient use of time is a prominent feature of many South African schools, occurring at three levels: getting to school, getting to class, and covering the curriculum efficiently when in class. An analysis of data collected from principals and teachers during the SACMEQ II study revealed high levels of teacher absenteeism and late coming, as reported by principals (Van der Berg and Louw, 2006). This problem is particularly widespread in the four poorest quintiles of the system, where 97%–100% of principals reported it as a problem. A substantial proportion of schools (26%) in the most affluent quintile reported experiencing the same problem.

Leave, and in particular the abuse of sick leave by teachers, offers another gap for teachers to spend less time at school. Teachers are entitled to 36 days sick leave over a three year cycle, and it seems that many teachers have come to see this leave as an entitlement which must be taken, rather than as a generous service benefit in case of serious illness. A recent study by the Human Sciences Research Council (HSRC) (Reddy et al, 2010) found that the public school system has a leave rate somewhere between ten and 20%, the wide margin of error indicating poor data systems for monitoring teacher leave. This implies that teachers are on leave between 20 and 40 school days per year and is in contrast to a rate closer to 5–6% in developed countries. The HSRC study estimates that over three quarters of leave is of one or two days' duration and therefore does not require a doctor's certificate. The way in which this benefit is abused is clearly shown by the incidence of leave for Mondays and Fridays being twice that of Tuesdays and Thursdays, respectively.

Furthermore, when they are at school, it seems that many South African teachers spend less than half their time in class and teaching. This finding was identified by Chisholm et al (2005), who, through a national survey verified by case studies in ten schools, concluded that:

- Teachers self-reported that they worked an average of 41 hours per week, out of an expected minimum of 43.
- In all, 41% of this time was spent on teaching, which translated to 3.4 hours a day;
- 14% was devoted to planning and preparation, and
- 14% was spent on assessment, evaluation, writing reports and record keeping.

Ensuring the effective use of time in any institution is essentially a leadership responsibility, and it appears from the available evidence that it is a responsibility that the large majority of South African principals are unable to rise to.

Classroom practice

Many of the problems observed in South African classrooms are clearly rooted in the poor knowledge resources of teachers. These links are manifest in the judgment of teachers when assessing the performance of their learners. For example, van der Berg et al (2011) found that Foundation Phase teachers in the Western Cape province were in general very optimistic about whether their learners were at the right level: teachers interviewed indicated that around 80% of their learners could perform at the appropriate standard at the end of the grade, in both home language literacy and in numeracy. These optimistic expectations are in sharp contrast to the weak performance of their learners on the annual provincial assessment tasks, with only 22% of learners in the schools observed actually meeting the provincial standard for adequate performance. The poor knowledge judgment of teachers is accompanied by very slow pacing of curriculum delivery, and low levels of coverage and of cognitive demand relative to curriculum specifications (Reeves and Muller, 2005; Carnoy et al, 2011); a paucity of books in schools, and low levels of book use in class, even when they are available (see Chapter 7).

Instructional leadership

An important dimension of school leadership is the responsibility of the principal and her team to ensure not only that teachers are in class and teaching during school hours, but also that teachers cover the curriculum effectively when they are in class. The majority of South African principals apparently do not understand their responsibilities regarding this latter function: Hoadley and Ward (2009) surveyed 200 schools in the Eastern Cape and Western Cape to investigate school management practices. They found that the majority of principals described their main activities as administration and disciplining learners. This is in contrast to the conclusion of the international literature that school managers should focus on the task of 'instructional leadership', a set of systems that propel teaching and learning in the school (Leithwood et al, 2004; see Chapter 4).

Moves to systemic accountability

Following the general election in April 2009, the new cabinet adopted a set of 12 Outcomes which captured a comprehensive set of targets for government, and

which were included in the performance agreements signed by the President with each of his Ministers. The principal goal for the Department of Basic Education is captured by Outcome 1: 'Improved quality of basic education'. The following year the DBE published the first of its plans for achieving Outcome 1 in the form of *Schooling 2025*, described as a long term plan for the basic education sector which will allow for the monitoring of progress against a set of measurable indicators covering all aspects of basic education including enrolment and retention of learners, teachers, infrastructure, school funding, learner well-being and school safety, mass literacy and educational quality (DBE, 2010b). This was followed by the publication of the DBE's *Action plan to 2014: Towards the Realisation of Schooling 2025* (DBE, 2011b), which outlines 27 goals focused on raising learner test scores in Grades 1–9, increasing education and training opportunities beyond Grade 9, improving the quality of teaching, and school supervision and support. At the same time the Minister of Basic Education announced in Parliament that she intends to hold principals and deputies accountable for the performance of their schools through performance agreements, while a performance appraisal system for circuit managers and other 'office-based educators' would direct these officials to rigorously assess the work of principals (*Business Day*, 20 April 2011).

The first practical measure instituted in support of these accountability targets was the Annual National Assessment exercise, the first administration of which was done in 2010. These consist of literacy and numeracy tests in grades 1–6 which are administered and scored by teachers. The following year government distributed the first annual set of workbooks to all learners in grades 1–6 in mathematics and the 11 official languages, in support of implementation of a new curriculum.

Multivariate modelling research on schools

The state of public schools is accorded a high priority in most countries, but it seems that South Africa has more cause for concern than many, and a more urgent need to understand the reasons for underperformance of our schooling system. The National School Effectiveness Study (NSES), the results of which form the core of this book, is the first attempt to relate home-, school- and classroom-level factors to learner learning in South Africa, based on a longitudinal research design and a nationally representative sample of primary schools. In the English-speaking world, two traditions are discernible in work of this kind. On one hand, school effectiveness research (SER) has accumulated a body of literature which periodically and self-consciously examines its own theoretical orientations, research designs and policy legacies (see Levine and Lazotte, 1990; Sammons, Hillman and Mortimore, 1995; Reynolds and Teddlie,

2000; Marzano, 2003; Mujis, Harris, Chapman, Stoll and Russ, 2004; Luyten, Visscher and Witziers, 2005; Verspoor, 2005; Xu, 2007; Riddell, 2008; and Teddlie, 2010 for successive reviews of the field). Riddell (2008) distinguishes three waves of SER research. The first derived from the 1960s, 1970s and early 1980s and placed the emphasis on identifying individual variables that influence learning outcomes, and on distinguishing the effect of family background versus that of the school. According to Riddell the second wave, from the late 1980s, focused more on process variables and the classroom, and was more strongly based on education theory. The third wave, according to Riddell, also started in the late 1980s, but focused on the interrelatedness of factors using multi-level modelling. Multi-level modelling, for instance hierarchical linear modelling (HLM), is a technique of multivariate modelling that explicitly uses a nested design (e.g. of learners nested within classrooms, with modelling then at two levels, individual level and class level). There are debates about whether this offers a superior technique for dealing with nestedness (Osborne, 2000).

A second tradition more closely resembles individual studies that all happen to use production-function methods more than a coherent body of work (see Hanushek, 1986; 1989; Brown & Saks, 1986; Elberts & Stone, 1988 for early examples). In contrast to proponents of SER, who have been closely associated with the annual *International Congress for School Effectiveness and Improvement* since 1998 and the specialist journal *School Effectiveness and School Improvement,* analysts working in the second tradition are at least as likely to publish in journals of economics than in educational journals; for this reason we will refer to this approach as the economics of education (EE) tradition. Both perspectives use multivariate modelling as their central analytical rubric. Multivariate analysis, such as regression analysis, considers the joint effect of different factors on an outcome variable, such as cognitive learning. For instance, it is likely that more qualified teachers teach in more affluent schools, and to know whether teacher qualifications make a difference to learning outcomes, it is not enough to consider whether outcomes are higher where teachers are better qualified: other factors likely to produce higher learning outcomes should also be considered, such as the school's socio-economic status. This can best be done through regressions, where the joint and individual associations of all the factors affecting learning can be evaluated simultaneously. Then it is possible to consider the coefficient on any one variable to be its 'effect' on learning, given the values of all other variables.

Interestingly, while the two research traditions of school effectiveness research and economics of education research, or SER and EE, share the same objects of study and method and produce very similar findings, in general they do not reference each others' work. An exception in this regard is a meta-analysis by Glewwe et al. (2011), which attempts to summarise the major results of the past two decades of empirical research that has appeared in economics or education journals.

Although one of the earliest SER studies to raise the question of non-quantifiable sources of variance in student learning was located in Southern Africa (Fuller and Clarke, 1994), the region, and indeed much of Anglophone Africa, has been dominated by studies situated in the EE quadrant (Lockheed and Verspoor, 1991; Henneveld and Craig, 1996; Lee, Zuze and Ross, 2005; Howie and Plomp, 2010; Van der Berg et al, 2010).

Noting the diminishing returns produced by reviews of the field, Bogotch, Miròn and Biesta (2007) conclude that SER is at a conceptual crossroads. Sandoval-Hernandez (2008) asserts that the merit of a theoretical framework is that it leads to novel predictions or the confirmation of explanations. From this point of view, a theory both guides the search for data and links together information from various sources. Such a theory would be in contrast to what some regard as predominant practices by both SER and EE researchers of 'fishing for correlations' (Coe and Fitz-Gibbon, 1998) among a battery of items held together by little more than common sense (Lauder et al. 1998). A major problem with what some see as an unprincipled approach to data collection and analysis, followed by immersion in the wash of modelling in the hope that something shows up as significant, is that the indices and instruments adopted by different studies are generally very different. As a consequence, replication is seldom done and knowledge growth is in danger of remaining segmented and unsystematic.

One writer who has made a concerted effort within an SER perspective to develop a coherent model of educational effectiveness (which includes both school- and teaching-level effects) is Creemers. Starting with his comprehensive model (Creemers, 1994) and later expanded to a dynamic model (Creemers and Kyriakides, 2006) the lynchpin of this initiative is the assumption of the multilevel structure of schooling, where schools are nested in contexts, classrooms are nested in schools, and learners are nested in classrooms. This idea has become a standard feature of SER. According to Kyriakides (2008) such models serve a number of purposes, chief among which is that they explain previous empirical research parsimoniously, and provide a useful road map for practitioners. In testing the validity of Creemers' dynamic model in six separate research studies, Kyriakides (2008) has demonstrated that SES shows up as positively associated with learning in five of the studies (learner aptitude was also significant in five studies, while subject motivation, time on task and opportunity to learn were all significant in four). However, the model makes no attempt to explain why SES is important, what it is about poverty or affluence that affects learning so profoundly.

In contrast, the EE approach to education production functions is imbedded in economic theory, which assumes that individuals maximise their utility, and that the behaviour of social actors, such as teachers or principals, would thus be a response to the incentives they face. This explains the attention

paid in the EE literature to accountability, management and various forms of sanctions and other incentives (see for instance Hanushek and Woessmann, 2011). Whereas much of the literature emanating from the education field implicitly assumes that teachers do the best they can, sometimes under difficult circumstances, the EE literature assumes that teacher efforts would only be optimised if accountability structures and incentives were appropriately aligned with the outcomes society desires. These assumptions draw from the theory regarding the principal-agent problem, which arises from the question as to how one individual, the principal (say an employer), can design a compensation system (a contract) which motivates another individual, his agent (say the employee), to act in the principal's interests (Stiglitz, 2008). In education, the issue in terms of this perspective is what structures and rules to set in place to get teachers and school principals (the agents) to act in the best interests of learners (the real principals, in this context), though parents and policymakers are often assumed to act on their behalf. Precisely because of the problem of asymmetric information, parents or policymakers do not know whether teachers are really making an all-out effort in the interests of learners, and the education production function can illuminate to some extent whether and where performance is better or worse than expected, thus offering some guide to policy intervention. But the best remedy, in the eyes of proponents of EE, is that parents/learners should have as much information on learners' performance, and ways to put pressure on teachers/schools to perform: this is assumed to empower the clients of service delivery directly (Bruns, Filmer and Patrinos, 2011).

Qualitative perspectives

To date neither SER nor EE has been able to penetrate the black box of schooling to postulate a principled relationship between the input factors and the outcomes of learner knowledge, skills and values. On this point there is agreement between proponents of SER such as Teddlie and Reynolds (2001) and critics like Slee et al (2001). According to Sandoval-Hernandez (2008), building theory, which gives coherence to the field, involves the formulation of causal explanations. We agree, and would add that a good theory of schooling must begin by explaining the most commonly derived research results, and providing productive hypotheses for studying the enduring questions that continue to plague policy makers, parents, principals and teachers alike. In the first instance a theory of schooling must have a plausible explanation for the powerful association between social class, educational outcomes and labour market position, and for the tendency for schools to reproduce social divisions in general, while providing class mobility for only a minority of individuals.

A useful starting point in this quest is Bourdieu's view of schooling as the transmission of cultural capital, which represents 'long-lasting dispositions of the mind and body' (1986: 47). The acquisition of cultural capital is the process whereby external wealth – capital in the economic sense – is converted into an integral part of the acquirer, into what Bourdieu calls habitus, the shaping of character and way of thinking. This requires an investment of time on the part of the acquirer, of her family (and particularly from her mother) in the domestic situation, and of the school in the public sphere. Bourdieu notes that a feature of cultural capital is that its diffuse, continuous transmission within the family escapes observation so that the educational system seems to award its honours based on the natural qualities of the individual rather than the dispositions acquired from her family.

However, what exactly is passed on to the acquirer during this process? Can we identify the currency of cultural capital in order to make its transmission through the school more efficient, particularly for poor learners? Bernstein's (1990) answer to this question lies in his code theory, where a code is defined as a culturally determined positioning device. The code is what orients the child towards a particular way of classifying experience and creating meaning. Bernstein described two distinct patterns of sense making among children. All children make use of what Bernstein called a restricted code, which they use in colloquial situations with family, friends or peer groupings. Community or restricted codes make sense mainly in local contexts, and their use is learned largely tacitly.

A second kind of positioning, what Bernstein called the elaborated code, reflects a different perspective and a different set of classification principles, which transcend local contexts. The elaborated code is an orientation to meaning for finding commonalities across specific contexts, for understanding principles and operations, and their application to new situations. Where the restricted code provides rich access to the layers of cultural meaning in the child's home and social sphere, the elaborated code enables the child to make connections between particular and general classifications, and hence to link community to more general categories of meaning. In the restricted code meaning is context-dependent and generally takes a narrative form, while in the elaborated code meaning is context-independent and is more likely to assume an analytical structure.

The crucial point about these codes is that, while all children master a community code at home, middle-class children learn the basics of the elaborated code at home as well. Thus, middle-class learners generally come to school with two coding modalities, while working-class learners come to school mainly with one. From this perspective, the crucial question for any educational practice is: What needs to be done, under a particular set of circumstances, with a given child or group of children, to facilitate access to the processes and products of

elaborated meaning? This is the question we used to guide the construction of indicators shown in Table 2 below.

Schooling is the means by which any society, at whatever stage of its industrialisation, develops specialised skills and appropriate comportment in young citizens. Bernstein (1996) tells us this is much more than transferring knowledge and skills, but involves primarily a regulative discourse. By establishing the pedagogic relationship, framing time and space, and classifying knowledge, the regulative discourse creates order. This is primarily a moral order, which establishes the rules of social conduct and builds identity and character; as Bernstein says, it shapes consciousness. Or, put another way, spending 12 years in a well-functioning school in which academic excellence, fairness and rational debate are valued and in which time is efficiently used for intellectual work, children are socialised into internalising these characteristics as habits of mind. The regulative discourse in the school always dominates, in the sense that systematic instruction occurs best under conditions of a certain social, temporal and physical order.

From the perspective of Bernstein's code theory, reading assumes a particularly important role. Once a child can read, independent, solitary work is possible. S/he is introduced into non-oral forms of discourse, the rules of which are generally quite different to those of the oral forms through which restricted meanings are usually conveyed. The child becomes less dependent on the teacher and has access to alternative perspectives. Most important, the written word is the way of communicating knowledge across space and time and the child gains entry to the world of recreational reading, serious discussion in newspapers and journals, and the thoughts of great historical thinkers. Moore and Maton (2001) illustrate the latter point through the example of the three-century history of attempts to solve Fermat's Last Theorem, in which later mathematicians had the advantage of seeing the progress and dead ends produced by their predecessors.

Research design of the NSES

The National School Effectiveness Study was initiated in 2007 in response to three gaps in the terrain of large-scale research on the South African school system (see Taylor, Muller and Vinjevold, 2003, for a more detailed analysis of these issues). First, there is a paucity of research working on a representative national sample, rendering generalisations of the system questionable at best. Systemic test programmes, both national and international, have become relatively common over the last ten years but, important as these continue to be in elucidating the quality of learning in South African schools, they have not looked at management and teaching practices in any great detail, if at all. The latter two foci are the principal subjects of the NSES.

A second shortcoming in research on schools in the country is the absence of cohort or longitudinal studies: these are particularly important in relating specific teacher characteristics to learning. Learning outcomes for any particular learner depend most importantly on home characteristics and secondarily on all the teachers through whose hands the learner has passed. Therefore, cross sectional studies cannot adequately account for the practices of the teacher currently working with any particular learner. In order to address this problem, a cohort design was adopted for the NSES: this enables the gain scores exhibited by a learner over any one year to be related to the characteristics of the teacher for the same year, while controlling for school and home variables. Also, by studying the same learners over time, individual characteristics of the learners that are likely to remain largely unchanged (such as aptitudes, ability, motivation), can be implicitly taken into consideration. These factors would affect learners in one grade, but presumably also in the next; thus, their gain score from one year to the next would also control for such factors.

Third, school and classroom data was collected by means of interviews and direct observations, in contrast to questionnaires, which has generally been the method used by surveys conducted by studies such as SACMEQ, PIRLS and TIMSS. The study conducted by Carnoy et al (2011) in the North West province and Botswana is a second exception to this trend. Interviews and direct observation provide for the verification of data by experienced observers, greater consistency across schools and a finer grained data set. An important element of the NSES design was to include many common questions in the interview schedules for principals and at least two teachers per school, providing for data verification by triangulation.

The study is a collaboration between researchers working in the multivariate modelling tradition, and those who approach the study of schools from a qualitative perspective (in Fuller and Clarke's (1994) evocative terms, the 'policy mechanics' and the 'classroom culturalists', respectively). Regarding the modelling component, the NSES, with its focus on process variables and the classroom level, fits well into Riddell's (2008) Wave 2. However, the modelling approach, though not explicitly multi-level, uses interaction effects and takes into consideration clustering effects in classrooms in a way that makes it very similar to Riddell's Wave 3. Regarding the qualitative component, NSES utilises descriptive and case study designs to probe the associations revealed by its regression models.

Our research model is based on a number of assumptions about how schools work in effecting learning. At the end of the learning chain a set of outcome measures display what learners know and can do. We take the attainment score (or in some cases the gain score) as the dependent variable, and then take all the other measures as intervening variables that, with varying degrees of

independence and interdependence, impact on learner attainment. Learner attainment was assessed using the same Grade 3 literacy and mathematics instruments developed for the national Systemic Evaluation (SE) exercise conducted by the Department of Education in 2007, with one important difference. While SE tests were written in the home language of the learners at Grade 3 level, the NSES tests were written in English. The reason behind this decision was that the NSES followed the same cohort of learners for three years, administering the same test annually. Because most schools for African learners change their medium of instruction in Grade 4 from mother tongue to English, we wanted to have comparable scores for the same learners for each of the three years. Thus, while at Grade 3 level the learners would have been disadvantaged by writing in a language with which they were unfamiliar, this design enabled us to compare scores directly across the three years. Because the NSES schools were a subsample of the SE sample the design also provided a unique opportunity to compare scores by the same Grade 3 learners on the same test written first in their mother tongue and second in English. The latter results are described in Chapter 2, while a comparison of these two sets of scores are discussed in Chapter 5.

One minor deficiency of the design is that the Grade 3 test was used unchanged for the three years over which learners were tested. This may have placed a ceiling on the gain scores better learners could have achieved: Those who already started with close to top marks in Grade 3 could not show their progress fully over the duration of the study. Disappointingly, few learners were in this category, and this factor would not have affected findings in a major way. Due to the relatively limited frequency of this occurring, it was judged best to use this same Grade 3 test throughout.

The intervening variables are not all in the same place in the process chain. Outside of the school, the normally invisible time subsidies of the home are directly measured by reading and speaking English at home using a questionnaire administered to learners at the same time as the test. We used an asset-based method for assessing learner SES using the same questionnaire, which also collected learner attributes such as gender, age and family structure. Ideally we would have wanted information on family income and parental education, but measuring these factors by means of learner questionnaires has been found to be unreliable in South Africa for Grade 9 learners (Simkins and Patterson, 2005), and we surmised that the problem would be much greater for younger learners. Asset-based measures of SES using questions about books and electrical appliances in the home, have been widely used internationally as they provide reliable proxies for poverty (for a South African application, see Stephen Taylor (2010)).

Within the school, the level immediately before the learner-outcomes is occupied by indicators of opportunity to learn or pedagogically engaged

time. This set of variables is principally a direct effect of what the teacher does in the classroom and makes available to learners. In this regard, it was decided not to conduct classroom observations as part of the NSES design. This decision was motivated by the experience in earlier studies (for example, Taylor and Moyana, 2005) that in order to produce reliable estimates of teacher competence a number of observations of the teacher need to be conducted, an approach which would have placed a prohibitive financial burden on the study. As a result, classroom-level data is derived from interviews with the language and mathematics teachers (in many cases the same person at Grade 3 level); analyses of teachers' assessment records and planning documents, and an analysis of all the written work done by the best learner in each class (as nominated by the teacher) in each of the two subjects. Selecting the work of the best learner in each class provides a best-case scenario regarding the number of times in the year writing have been done, the quantity and quality of writing and the level of cognitive activity elicited by each writing episode.

We further assume that teacher subject knowledge is a teacher-level measure that is co-dependent with teacher competence. This factor was measured by administering a short test to the language and mathematics teachers, respectively. The tests proved to be too short to provide either a rich picture of teacher knowledge or satisfactory associations in the modelling exercise. As a result, Chapter 8 utilises the data from the SACMEQ tests administered to teachers in 2007, though modelling of learner performance did consider the NSES teacher tests as explanatory variable, as described in Chapter 3.

Then at the school level, we have a cluster of factors on which opportunity to learn depend. Collectively we call these leadership and management factors: resources (learner-teacher ratios, availability of textbooks, school assets), time maximisation indicators (time on task), and instructional leadership factors (school-level monitoring of teacher plans, assessment practices and the like). These factors were assessed by means of the same teacher interviews described above, interviews with the principal, or in her absence the deputy, and a school observation schedule that guided fieldworkers to assessing aspects of the school such as the design of and adherence to the timetable, or learners out of class during lessons. We also looked at the state of the book inventory and the teacher attendance register, if present, and recorded the number of teachers absent on the day of the visit.

At an even further remove from the chalk face, are the set of system-level policy directives and interventions aimed at improving the outputs of schools. We assume that those district- and higher-level interventions that align most closely with school-level instructional leadership indicators have an effect on learning, but in an indirect manner. Information on this factor was obtained through the interviews with the principal and teachers, where we asked about

the frequency of visits to the schools by district officials, and the kinds of activities undertaken during these visits.

The logic model showing the relationships between these levels is summarised in Figure 1.

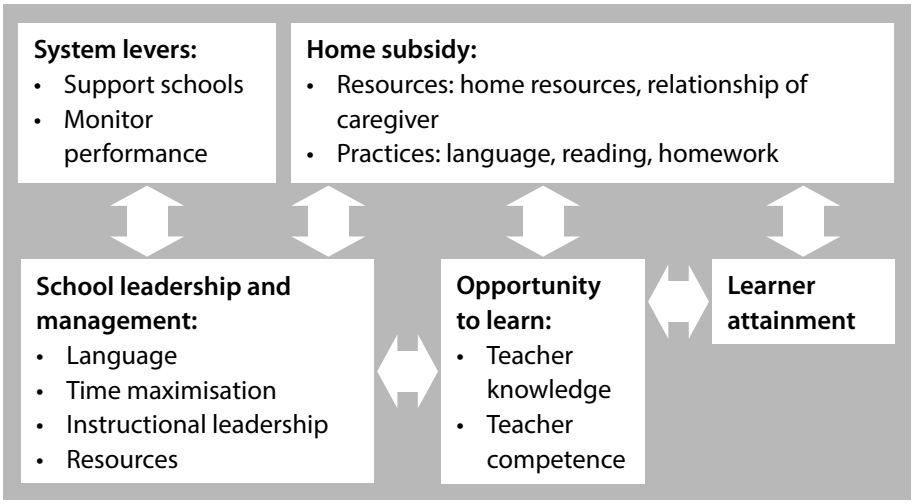

Figure 1.1: Logic model for the National School Effectiveness Study

As we have said, the NSES schools are a subsample of the 1 500 schools selected at random from the primary school population stratified by the nine provinces for the Department of Education's Systemic Evaluation (SE) exercise. In the end, the province of Gauteng was not included in the NSES sample, as it was discovered that the province was testing Grade 3 learners in all schools in the province at the time of the first round of NSES testing and it was important not to interfere unduly with learning in the classroom. We used the same probability procedure used by the SE exercise to select the 300 NSES schools, 268 of which ended up participating in all three years of the study. Around 16 000 learners participated in the study each year, with a cohort of 8 383 who were tracked over all three years, ending in Grade 5 in 2009. The teachers and learners in all classes within the respective grade level were included in the study.

NSES indicators

As explained above, we used a single question, derived from theoretical considerations of what values and competences it is that schools are intended to inculcate in learners, to derive a set of indicators for structuring our research instruments. In short, the argument starts with the question: which particular activities in homes, schools and classrooms augment or diminishes mastery of

abstract knowledge? The derivation of these indicators is shown in Taylor et al (2003), and we will not repeat the detail here. Table 2 shows the relationship between the indicators and the factors situated at different levels of the school system listed in Figure 1.

Table 1.2: Indicators guiding the NSES data search

Level	Factor	Indicator
Learner attainment	Competence in literacy and mathematics	Test performance in literacy and numeracy
System levers	Support schools Monitor performance	Frequency and nature of school visits
		Training
		Monitor learner attainment
		Monitor and support curriculum coverage
Home subsidy	Resources	Resources in home
		Family structure
	Practices	Exposure to language of the school at home
		Frequency of reading
		Frequency of and support with homework
Instructional leadership	Time maximisation	Teacher absenteeism and punctuality Timetable exists and is followed Efficient use of time in class
	Language	Promote proficiency in language of instruction
	Curriculum management	Plan curriculum delivery
		Monitor curriculum progress
		Moderate assessment
	Resources	Procure and manage books School resources: communicational and administrative
Opportunity to learn	Teacher knowledge	Subject knowledge
	Teacher competence	Curriculum coverage
		Frequency of reading
		Quantity and quality of writing
		Frequency and nature of assessment:

One may argue, with some justification, that the indicators listed in Table 2 are not yet indicators, but indicator categories, which more specific questions in the research instruments further illuminate. Whatever the terminology used, each item in the third column in the table was broken down into one or more questions, using the main theoretical question discussed above as a touchstone. It would be tedious to detail this process exhaustively here, so we will limit ourselves to one illustration of the procedure adopted in formulating the NSES instruments.

Let us take the issue of assessment. What kind of assessment practices would we expect system level officials, principals, teachers and parents to pursue so as to promote the learning of analytical thinking in children? Starting in the classroom, in discussing any curriculum topic with one or more learners, we would expect the teacher to ask carefully posed questions so as to make the learner utilise deductive or inductive reasoning, to explain or justify answers. We would expect the teacher to use each exchange to provide detailed feedback on the verbal knowledge displays of the learner, drawing attention to misconceptions and authorising appropriate responses. This is what Morais and Pires (2002) call 'explicating the evaluation criteria'. Not every exchange would look like this, but we would expect teachers to push the discussion to these levels frequently with all learners in the class, individually and collectively. We would expect the teacher to set frequent written exercises which stimulate the same cognitive processes, particularly through extended writing exercises in language and solving non-routine mathematical problems, and to respond in detail to learners' written knowledge displays. Class tests and examinations would follow the same pattern.

At school level, we would expect subject heads to set policy for each grade regarding the number and type of assessment exercises to be undertaken over the year; to moderate the content of written tests in order to ensure that an appropriate level of cognitive challenge is maintained across a range of tasks; to monitor the results for each class, and to provide the respective teachers with feedback on the results. We would expect principals and teachers to engage parents on the progress of their children, providing them with information through written reports and face-to-face meetings, and encouraging them to take an interest in their children's homework and test preparation. We would, furthermore, expect district level officials to undertake a parallel set of activities that mirror those of school management, and to arrange professional development activities for teachers on curriculum areas where test results indicate a need.

Method

The indicators shown in Table 1 were translated into structured instruments: interview schedules for principals, literacy and numeracy teachers, and observation schedules. The details are discussed in the respective chapters that follow. A team of two fieldworkers, experienced in school observations, visited each of the 300 schools in the sample for two days a year in 2007 (grade 3), 2008 (grade 4) and 2009 (grade 5). During this period they administered learner tests, interviewed principals and teachers, and examined learner books, teacher records (assessment schedules, planning documents) and school documents (attendance records, assessment schedules, book inventories). Moderation procedures and other quality controls during the scoring of test scripts were aimed at ensuring consistency of marking over the three waves of test administration. The most important variables derived from the questions and constructs used are discussed in Chapter 3.

Conclusion

The systematic study of schooling has long been plagued by acrimonious debates around theoretical foundations and research methods. Our starting point is that the existence of these debates is indicative of the enormous complexity of the field, and that, far from representing the most appropriate approach, each of the contending perspectives provides a partial view and limited but valuable insights into the terrain of schooling. Thus, research studies that utilise multilevel modelling techniques attempt to unravel the many variables that direct and shape teaching and learning, and to understand their relative importance and interactional effects. Within this broad church, the traditions of school effectiveness research and the economics of education bring complementary perspectives to bear. While the former assumes that individual actors, and in particular school principals and teachers, are motivated by altruism and the desire to do the best for the learners in their care, economists assume that actors are motivated largely by self interest. Taken together, these views sound like a good description of human behaviour.

However, large-scale statistical studies, from either the SER or EE approach, do not provide an adequate account of how the moral and technical contents of the school curriculum interact with the socio-economic and cultural contexts of learners to structure differential learning effects and life opportunities. Even more importantly, they are unable to explain how occasionally individual learners and even entire school cohorts are able to transcend these broad reproductive trends and assume life trajectories which defy aggregate prediction. It is here that a variety of qualitative perspectives finds their

greatest application. In particular, the sociological work of Bourdieu and Bernstein described above, the cognitive (Chapter 6) and semiotic (Chapters 2, 7 and 8) framing lenses elaborated on below, and the use of case studies (Chapter 4), assist in understanding the links between language, social class and consciousness; and in tracing the spark that links analytical thinking, written and verbal symbol systems and individual identity.

Some may dismiss our research approach as one of unprincipled eclecticism. Our reply to such a charge would be that the principle that drives our search is the desire to find those processes of schooling that optimises the acquisition of high levels of literacy and numeracy for those learners disadvantaged by social circumstance. Further, we assume that the use of multiple perspectives in pursuing this search is entirely appropriate, given the complex nature of schooling and the many factors, sometimes contradictory, which motivate human actors. We postulate that a unified science of schooling would not necessarily need to incorporate these perspectives directly, but would need to provide responses to the questions they raise that are at least as insightful as those reflected in accounts currently available.

We conclude this opening chapter with a brief synopsis of the remainder of the book.

Chapter 2 starts with a description of the architecture of the Grade 3 literacy and numeracy tests used in the NSES. Annual results are discussed in terms of changes in overall scores and outcomes on measures of different cognitive tasks. In general, learners show mastery of only the most basic skills in literacy and numeracy, and it is only in these areas that improvements over the years are noted in national aggregate scores. New evidence is produced concerning the achievement gap between two sets of schools in South Africa, with Grade 3 learners in suburban schools outperforming Grade 5 learners in rural and township schools.

The backbone of the NSES is a multivariate modelling exercise described in Chapter 3. The results highlight areas for the attention of policy makers and practitioners at four levels of schooling: policy and systems management, schools, classrooms and homes. Many lessons may be drawn from these findings. At the same time, some of the associations derived in Chapter 3 provide only blunt responses to questions like 'Is the monitoring of assessment practices by school management associated with improved learning, when controlling for SES?' In the case of the NSES the answer to this question is affirmative, but that tells us little about what is entailed in these monitoring activities: it seems likely that monitoring is one element in a constellation of activities undertaken by effective school leaders in order to maximise the impact of assessment on learning. And the really useful knowledge that principals and policy makers need to understand is what that constellation of practices consists of and how it ranges across schools that produce stronger and weaker test performances.

In order to investigate the last question, and a number of related issues concerning school leadership and management, a set of case studies was undertaken, the results of which are described in Chapter 4. A matched-pairs design was used to compare five well-performing primary schools with five schools that perform very poorly under the same conditions of culture and language, apartheid history, poverty and political economy. The leadership characteristics of successful principals and school management teams are described, and the beginnings of a stage theory of school improvement delineated.

Chapter 5 addresses the emotive and contentious issue of language, and in particular the language of instruction and the relationship between English and various African languages. New data contrasts the results on the tests administered to Grade 3 learners in 2007 by the DBE's Systemic Evaluation exercise (in mother tongue) with the same instruments administered to the same learners one month later by the NSES (in English). The results show a distinct advantage for mother tongue administration with respect to literacy, but the differences in maths scores for the same learners are generally not significant, whether they wrote the test in English or their mother tongue.

Chapters 6, 7 and 8 are about teaching practice and teacher knowledge. Since the NSES did not include lesson observations, the evidence consists of structured observations of learner books and teacher records for Chapters 6 and 7, and in Chapter 8 of learner and teacher scores on the SACMEQ Grade 6 tests. In addition, we used selected classroom vignettes to illustrate theoretical issues. These lesson descriptions were obtained during visits to the ten case study schools described in Chapter 4, and to 12 additional schools by the first author as part of two unrelated research programmes. These brief inserts are intended to be illustrative rather than predictive.

Chapter 6 looks at the frequency and quality of learner writing in literacy over the course of one academic year. The data is set against a discussion in the research literature on the role of writing in cognitive development. In Chapter 7 we undertake a similar analysis of learner writing in mathematics, within the context of a theoretical discussion on forms of representing mathematical entities and the function of writing in learning mathematics. It is clear from this evidence that the majority of South African classrooms are places in which oral and collective communication predominates and that poor learners are not being inducted into a literate culture.

Chapter 8 profiles teacher subject knowledge in language and mathematics. The NSES teacher test scores showed a significant but small association with improved learner outcomes for literacy, but an effect was only observed in maths in those cases where teachers answered all five items correctly. However, the tests were too short to provide an extensive picture of teacher knowledge resources. This information was therefore supplemented by data drawn from

the SACMEQ study conducted in 2007. The SACMEQ data is interesting in that the tests for teachers overlapped with those administered to learners in a significant number of items, allowing a direct comparison between teacher and learner scores on key topics in both math and language. The results provide the most detailed picture yet of teacher knowledge, and of the relationship between teacher knowledge and learner success.

Chapter 9 turns attention to the issue of learner age. Birthdates provided by the cohort of 8 000 NSES learners tracked over three years, together with the full sample of some 16 000 each year, give a clear picture of the extent of over-age enrolment in Grades 3 to 5. These patterns are structured according to poverty, gender, and learner achievement.

This book speaks to a policy audience: to policy makers (people taking decisions in the generation of government policies, projects, programmes and plans), those engaged in application of policy, and those involved in or with an interest in the policy debate. At the same time, the NSES findings hold many lessons for parents, teachers, school principals and system-level bureaucrats. Chapter 10 deals with the important and sometimes strained relationships between research and policy, and researchers and policy makers, before going on to discuss some policy recommendations. The NSES was undertaken with the express attention of informing policy making and policy thinking, and of providing practical guidelines for educational practices in homes, schools and classrooms. It could not have been undertaken without the expressed cooperation of national and provincial policy makers and many of those engaged in applying policy on the ground – administrators, principals and teachers.

The various chapters in this report are all aimed at interrogating the nature and adequacy of policy and practice and to asking how policy can be improved. Thus, all the chapters are relevant to the policy debate, although Chapter 10 is the only chapter that deals explicitly with policymaking, mainly at the broad system level. Chapter 10 begins by providing a South African perspective on the debate of how research and policymaking are linked, and ought to be linked. It then assesses the current policy trajectory of the South African schooling system in the light of the findings in the foregoing chapters, and the evidence from other developing country schooling systems.

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Chapter 2

Learner Performance in the NSES

Stephen Taylor and Nick Taylor

Introduction

The major objective of this book is to understand how various factors, such as learner age, language, the quality of school management and teacher content knowledge, influence learner achievement in South Africa. The main source of learner achievement data used is the numeracy and literacy testing that was administered in the NSES over a three-year period. This chapter provides crucial background information to the forthcoming chapters, describing the content of the tests, presenting analyses of how learners fared on specific types of items, reporting overall patterns in the total test scores and learning gains that occurred over the period.

The tests and testing process

Literacy

The same literacy and numeracy tests were administered in English in each of the three waves of the NSES. The literacy test consisted of 40 items. In order to understand learner reading and writing performance on specific skills, we classified the items in the NSES test according to the PIRLS framework. PIRLS recognises two purposes for reading (*reading for literary experience* and *reading for the use and acquisition of information*) and four processes of comprehension (*focus on and retrieve explicitly stated information*; *make straightforward inferences*; *interpret and integrate ideas and information*; and *examine and evaluate content, language, and textual elements*) (Howie et al, 2007).

Nses used PIRLS

Regarding the 'purposes of reading' axis, we further subdivided this category in order to characterise each of the five texts contained in the NSES test: visual cues, poster, bar graph, non-fiction narrative and fiction descriptive, as shown in Table 1.

Since the PIRLS instrument was a reading test whereas the NSES assesses both reading and writing, we expanded the PIRLS 'processes of comprehension' axis to include writing tasks, and renamed the axis 'literacy processes'. The assessment of writing was done in two ways. First, we included two writing tasks (sentences and paragraphs) in the analytical scheme shown in Table 1. Second, we distinguished between items posed in multiple-choice format (MC), and those which require the writing of words or phrases (FR or free response). It is well known that learners find it easier to recognise an appropriate answer when presented in MC format than to formulate an original response (FR) to the same question.

Finally, regarding the cognitive processes involved in reading and writing, experience tells us that large numbers of South African children exhibit proficiency levels two or three Grades below curriculum specifications (Moloi, 2005; Spaull, 2011). In order to ensure that scores for these learners were captured, the NSES test included items which the National Curriculum Statement (NCS) assumes are mastered at Grade 1 level. These items fall into two categories: matching a word to a picture and selecting the appropriate word to complete a simple sentence. These refinements supplement the four PIRLS 'processes of comprehension' (retrieve, infer, interpret and evaluate), which are included in our scheme. Table 1 shows the distribution of items in the literacy instrument according to this analytical scheme.

Although the four processes of comprehension generally show increasing complexity, from information retrieval, through inference and interpretation, to evaluation, such typologies never operate unidimensionally. A difficult retrieval question can be more difficult than an easy inference, for example, even within the same text. What is important is that these processes, together with our additions shown in Table 1, are frequently exercised, using different text types, which the NSES test does through the use of five very different texts. However, the instrument perhaps does not do as well in covering the various literacy processes, being skewed toward easier tasks. Thus, the majority of questions (17/40) require only that the reader retrieves information explicitly stated in the text. Further, most of these retrieval items (13) are posed in the easier MC format. Only four items require inferential reasoning, and only seven invoke interpretation. None requires evaluation. The test contains only three items requiring sentence construction and none demanding extended writing.

Table 2.1: Distribution of NSES literacy test items according to text type and literacy process

		Format	Purposes of reading (types of text)					Total no. items
			Visual cue	Poster	Bar graph	Non-fiction descriptive	Fiction narrative	
Literacy processes	Matching word to picture	MC	1, 2					2
	Fill in missing word (cloze)	MC	3, 4, 5, 6, 7, 8, 9					7
	Retrieve	MC		10, 11	14, 15	19, 20, 21, 22, 23, 24	30, 31, 32	13
		FR			12, 13	25, 26		4
	Infer	MC					33, 34	2
		FR				27, 28		2
	Interpret	MC					35, 36, 37	3
		FR				29	38, 39, 40	4
	Evaluate							0
	Write sentence	FR	16, 17, 18					3
	Write paragraph							0
Total no. of items			12	2	4	11	11	40

Key: MC – multiple choice; FR – free response

Numeracy

Our analysis of the items in the NSES math test takes account of the test structure, which provides for variation on four kinds of variables: the nature of the mathematical task, the difficulty level at which the item is specified according to the NCS, whether the item is posed in verbal or symbolic form, and whether the item requires selection from four options (MC or multiple choice) or the formulation of an original response (FR or free response). We discuss these variables in turn.

The distribution of the 53 items according to the first two variables is shown in Table 2. Regarding mathematical tasks, over 60% of the items cover four tasks: counting and ordering whole numbers, addition, multiplication and subtraction. With the possible exception of number patterns, the remaining tasks are represented by too few items to draw hypotheses regarding learner mastery of the skills in question. It can be said that the test includes too few, or none at all, of some of the most important knowledge strands in school mathematics, notably fractions, equivalence and ratio. On the other hand, by focussing on a few of the most basic number operations, the test is able to gain a fuller understanding of learner capacity in the fundamental building blocks of mathematics.

Table 2.2: Distribution of NSES math items by mathematical task and NCS specification

NCS specification	Mathematical task												
	Count & order	Add	Multiply	Subtract	Divide	Combination	Fraction	Decimal	Pattern	Bar graph	Shape	Measure	Total
Grade 1				28							13		2
Grade 2	1, 2, 3, 4, 10, 19	22	35, 36	29, 30,			14		16, 17				14
Grade 3	6, 7, 8, 9	20, 21, 23, 24, 25	37, 38, 39, 43	31, 32, 33	42		44		18, 49	51, 52, 53	11, 12, 15	45, 46, 47, 48	30
Grade 4	5	26		34		41, 40		27	50				7
Total	11	7	6	7	1	2	2	1	5	3	4	4	53

On the question of NCS specification, we give the following example to illustrate the point. In general, levels of difficulty increase within any skill set at successive grade levels. In Table 3, the items get more difficult as the number range increases on the operations of addition, subtraction and multiplication from Grade 1 through Grade 4.

Table 2.3: Curriculum standards, showing increasing levels of cognitive demand

LO 1: Numbers, operations and relationships				
AS: Can perform calculations, using appropriate symbols, to solve problems involving:	Grade 1	Grade 2	Grade 3	Grade 4
	• addition and subtraction with whole numbers and solutions to at least 34; • repeated addition with whole numbers and with solutions to at least 34	• addition and subtraction of whole numbers with at least 2 digits; • multiplication of whole 1-digit by 1-digit numbers with solutions to at least 50	• addition and subtraction of whole numbers with at least 3 digits; • multiplication of at least whole 2-digit by 1-digit numbers	• addition and subtraction of whole numbers with at least 4 digits; • multiplication of at least whole 2-digit by 2-digit numbers

Key: LO – Learning Outcome; AS – Assessment Standard
Source: Compiled from DOE, 2002: 22, 23, 42.

Regarding the third element in the structure of the NSES math test, item format, free response items are nearly four times more numerous (41) than multiple choice items (12). In this sense, the test is more challenging than tests that are posed entirely in MC format, since, as in the case of literacy, guessing from four alternatives is an easier task than generating an original response.

Finally, the degree of difficulty of items may vary depending on whether they are articulated entirely in symbolic form (e.g. 16 – 7 = ____), or whether they contain significant verbal and/or iconic features. We discuss in Chapter 7 these different forms of representation of mathematical entities and their role in learning. Suffice at this stage to say that questions that are posed in verbal or mixed forms are generally more difficult than those posed entirely symbolically. The reason for this is that the former first require translation into a mathematical function before the answer can be computed, and therefore invoke conceptual understanding and logical reasoning in their solution. In contrast, in questions posed symbolically, the mathematical function required to solve the problem is already given, and the answer may be computed by purely procedural means.

And translation into HL

Here, too, the NSES test is perhaps more challenging than many systemic tests in that items posed symbolically are in the minority (32:21).

The 4 variables in our scheme (mathematical task, NCS level, form of representation, and MC vs. FR format) vary independently, so that, as Table 6 shows, a Grade 4 addition item (26) may be easier than a Grade 3 division problem (42).

Scores by item in each year

Literacy

Figure 1 shows the mean score on each item in the literacy test, across the three years of the NSES. Most items were multiple-choice questions (27 of 40) in which learners either scored zero or one. However, items 12, 13, 16, 17, 18, 25, 26, 27, 28, 29, 38, 39 and 40 in the literacy test required longer answers (free response) in which up to five marks were allocated. In the multiple-choice questions the mean item score can be regarded as the percentage of learners that got the item correct.

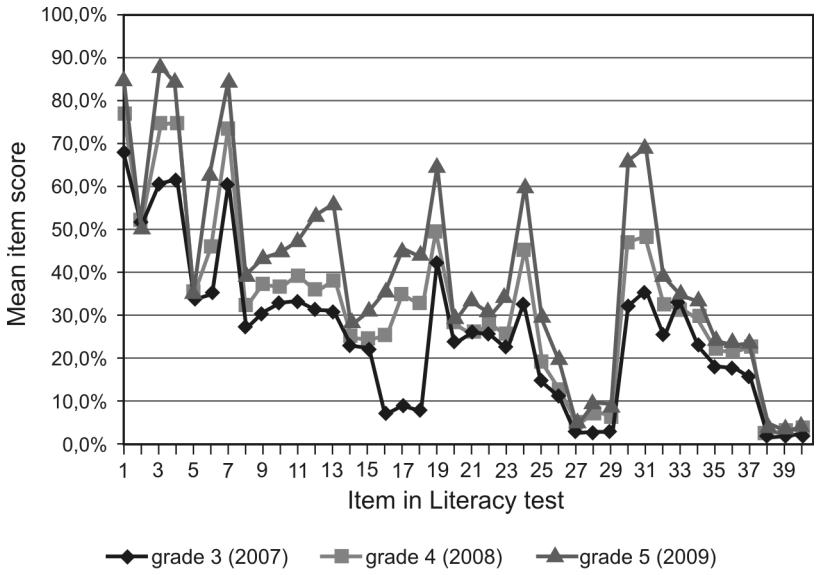


Figure 2.1: Mean item score in the literacy test for each year

One encouraging feature of the item score graph is that a close correlation is shown between the scores on each item from one year to the next. There were no items which were amongst the harder items in one year and then amongst

the easier items in the next year, or vice versa. This affords reliability to the overall test scores.

It is also encouraging that in certain items learner performance improved considerably over the three-year period. Conversely, it is a matter for concern that for many items there was hardly any observed improvement. In the case of literacy, most of those items with an improvement in the average score of more than 20 percentage points were items fitting into the 'cloze' and 'retrieve' categories in Table 1. Question 4 from the test is shown below as an example of a 'cloze' item.

4. Look at the picture. complete the sentence by drawing a circle around the letter of the correct answer:

   The dog was so tired, it climbed on the chair and went to…

   a. eat.
   b. play.
   c. sleep.
   d. run.

None of the items requiring inferential reasoning or interpretation saw substantial improvement from Grade 3 to 5. The average score on items 27, 28 and 29 was below 10% in all years. These items required writing in full sentences and the application of inferential and interpretive reasoning to a non-fiction text. Clearly, the combination of writing and these higher order cognitive skills is beyond most South African Grade 5 learners. Question 29 is shown below as an example of a question requiring both interpretation of a non-fiction text (not shown below) and sentence writing.

Question 29: Why do your bones stop growing? Explain in your own words.

It is nevertheless somewhat consoling that the performance on items 16, 17 and 18 (which required sentence writing to describe activities depicted in a simple picture) was considerably better in 2008 and 2009 than in 2007. The fact that the main improvement in these three items occurred between Grade 3 and Grade 4 might reflect that in Grade 3 most learners would not have been exposed to English as the LOLT whereas by Grade 4 most learners would have been. Question 16 is shown below as an example of those questions which required sentence writing but little interpretation.

Do diff-in-diff by item category, inferential reading etc.

Look at the picture in question 16. Write a complete sentence about what the children are doing in the picture.

_____

_____

_____

Numeracy

Figure 2 shows the mean score on each item in the numeracy test.

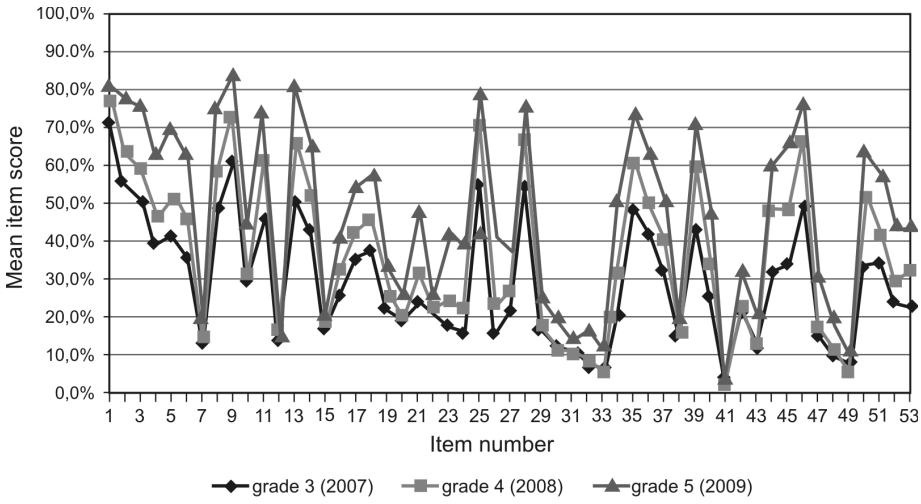
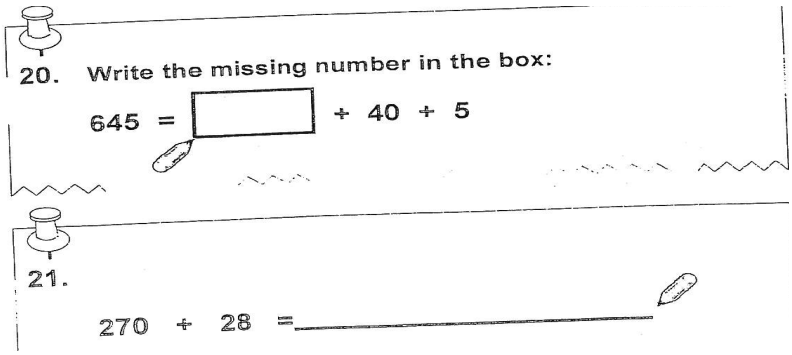


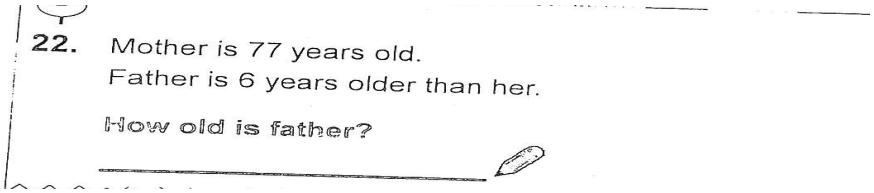
Figure 2.2: Mean item score in the numeracy test for each year

As in the case of literacy, a close correlation is shown between the scores on each item from one year to the next. The items in which most improvement occurred were typically the easier items. It is interesting that there were several items involving addition that were poorly answered in Grade 3 but in which considerable improvement occurred through to Grade 5, and that there were also several other addition items that were poorly answered in Grade 3 and in which virtually no improvement took place. An inspection of these items

Try and answer whether or not the improvement from gr3 to gr5 is due to learning in maths or language proficiency

revealed that the difference between these two groups of items was that those in which improvement occurred were not language-intensive, whereas those in which learner performance did not improve were language-intensive. Items 20, 21 and 22 are shown below as examples. Although the mathematical computation required in item 21 is arguably more complex than those required in items 20 and 22, learner performance was considerably better on item 21. The most plausible explanation for this apparent anomaly is that the language-intensive nature of items 20 and 22 makes them more difficult to interpret than 21, which is posed entirely in symbolic form.





Rasch analysis of item difficulty

This section reports on a Rasch analysis (undertaken using the Conquest software) of the Grade 5 scores in literacy and in numeracy. The Rasch methodology uses an iterative procedure to generate both ability scores for each learner and difficulty scores for each item on the same scale. The origin of the scale is set arbitrarily at zero and learner abilities are then distributed across this scale. The learner ability score indicates the level at which one would expect learners to score 50% on the question located at that level. An item with a difficulty score of zero is one where learners with an ability of zero (in other words the average learner) would be expected to score 50%. The important thing to remember when interpreting the following figures and tables is that

the difficulty scores calculated using Rasch are more negative for easy items and more positive for harder items.

Literacy

Table 4 shows an item difficulty map for all the literacy items. The left side of the map depicts the distribution of learners and the right side depicts the distribution of items. Learners with ability scores on a par with difficulty scores of particular items would be expected to achieve 50% on those items. The items at the high end of the map were so difficult that virtually no learners would have been expected to achieve 50%, while there were also several items at the bottom of the map for which virtually all learners would be expected to achieve 50%. The items have been colour coded to indicate how they are classified in terms of the characterisation set out in Table 4.

Table 2.4: Rasch item difficulty map for literacy

HIGH ABILITY	DIFFICULT ITEM	
	|	39
	|	
3	|	38 40
	|	
	|	
	|	
	|	27 29
	|	28
	X|	
2	X|	
	X|	
	X|	
	X|	
	X|	
	X|	
1	X|	26
	X|	
	XXX|	35 36 37
	X|	
	XX|	14 20 25

Key to colour coding
Matching a word to picture, cloze, retrieval – MC
Matching a word to picture, cloze, retrieval – FR
Infer – MC
Infer – FC
Interpret – MC
Interpret – FR
Write a sentence – FR

	XX|	15 22
	XX|	21 34
0	XXXXX|	5 16 23 33
	XXX|	8 32
	XXX|	
	XXXXXXX|	9 10 17 18
	XXXX|	11
	XXXXXXXXXX|	
	|XXXXXXXXXX|	2
	XXXXX|	12
–1	XXXXXXXXX|	13
	XXXXX|	24
	XXXXXXXX|	
	XXXXXXXX|	6
	XXXXXXX|	19 30
	XXX|	
	XXX|	31
	XXXXX|	
–2	XX|	
	XX|	
	X|	
	X|	
	|	
	|	1 4 7
	|	
–3	|	3
	|	
	|	
LOW ABILITY		**EASY ITEM**

Caution needs to be exercised in interpreting the distribution of items in Table 4, because there are too few items in some of the categories to draw generalisations, and also because of interactions between the various factors which contribute to the difficulty of any item. Nevertheless, there are some clear patterns in Table 4. Items requiring no more than the matching of words to pictures, the completion of sentences or the retrieval of information stated in the text are generally the easiest. When inferential reasoning is required to

answer a question, learners struggle (items 33 and 34), especially when a free response is called for (27, 28). Finally, when the reader is asked to interpret information in order to arrive at an appropriate answer, learners struggle the most (items 35, 36, 37), particularly when called to produce an original answer (FR) (items 29, 38, 39, 40).

When read in conjunction with Table 1, Table 4 confirms that free-response items were considerably harder than multiple-choice items, and that, within the free-response category, longer response items were more difficult than short response items. The fact that learners did so poorly on items requiring longer responses raises questions about how much written work is covered in South African classrooms, an issue we take up in detail in Chapter 6.

Numeracy

According to the specifications of the NCS, items in the numeracy test were pitched at levels suitable for Grades 1 through to Grade 4, with the majority of items at the level of either Grade 2 or Grade 3. Table 5 confirms that items considered to be of a Grade 1 or 2 level were indeed easier on average than Grade 3 or 4 level items. Interestingly, however, there were some Grade 1 and 2 items that learners found very hard and some Grade 3 and 4 items that learners found fairly easy. This may point to specific learning areas that are being weakly taught in many schools. However, as argued earlier, four variables go into determining the relative difficulty of an item and it should not be unexpected for learners to experience a Grade 2 division item as more difficult than a Grade 3 addition question, particularly if the latter is represented entirely symbolically while the former is phrased as a 'word problem'.

Table 2.5: Difficulty scores by Grade level of item

Grade level	Mean difficulty	Hardest item	Easiest item	Number of items
1	–1.17	0.44	–2.15	3
2	–0.42	1.71	–2.24	14
3	0.27	2.95	–2.43	30
4	0.24	4.03	–1.41	6

Table 6 depicts the item difficulty map for the numeracy items. The items have been colour coded according to the type of mathematical task being assessed.

Table 2.6: Rasch item difficulty map for numeracy

HIGH ABILITY		DIFFICULT ITEM
4	|	41
	|	
	|	
	X |	
	X |	
3	XX |	49
	XX |	
	XX |	33
	XX |	
	XX |	12 31
2	XX |	32
	XXXX |	48
	XX |	7 30 38 43
	XXXX |	15
	XX |	20 22 29
1	XXXXX |	
	XX |	42 47
	XXXXXX |	19
	XXXXXXX |	27
	XXXXXXXX |	16 24 26
0	XXXX |	10 23 52 53
	XXXXXXXXX |	21 40
	XXXXXXXXX |	34 37
	XXXXXXXXXX |	17
	XXXXXXXXXX |	18 51
	XXXXX |	4 6 44
–1	XXXXXXXXX |	14 36 45 50
	XXXXXXXXXX |	
	XXXXXXXX |	5 39
	XXX |	3 8 11 35

Key to colour coding
Addition
Bar graphs
Counting & ordering
Multiplication
Number patterns
Shape recognition
Subtraction
Other

	XXXXXX	2 28 46
–2	XX	13 25
	XX	1
	X	9
	XX	
	X	
–3	X	
LOW ABILITY		**EASY ITEM**

The numeracy-item difficulty map does not present as clear a pattern by item categorisation as was the case with the literacy items. Therefore, to depict the relative difficulty more clearly amongst the various types of items Figure 3 shows the mean item difficulties for each category.

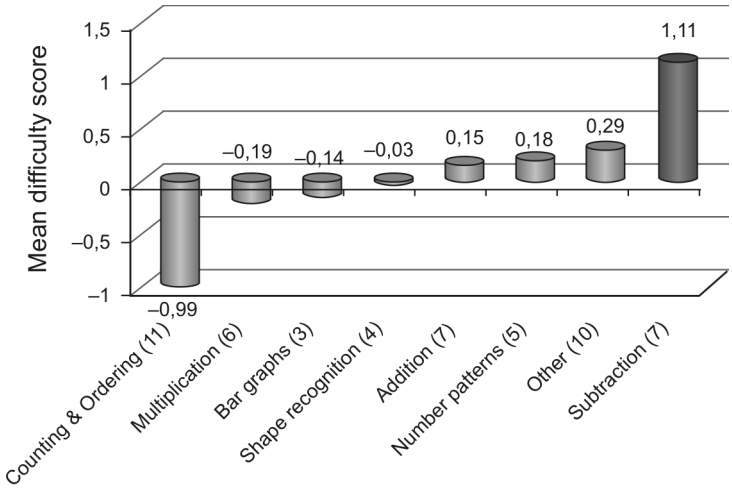


Figure 2.3: Numeracy item difficulty by skill description

Note: The number of items within each skill category is shown in parentheses.

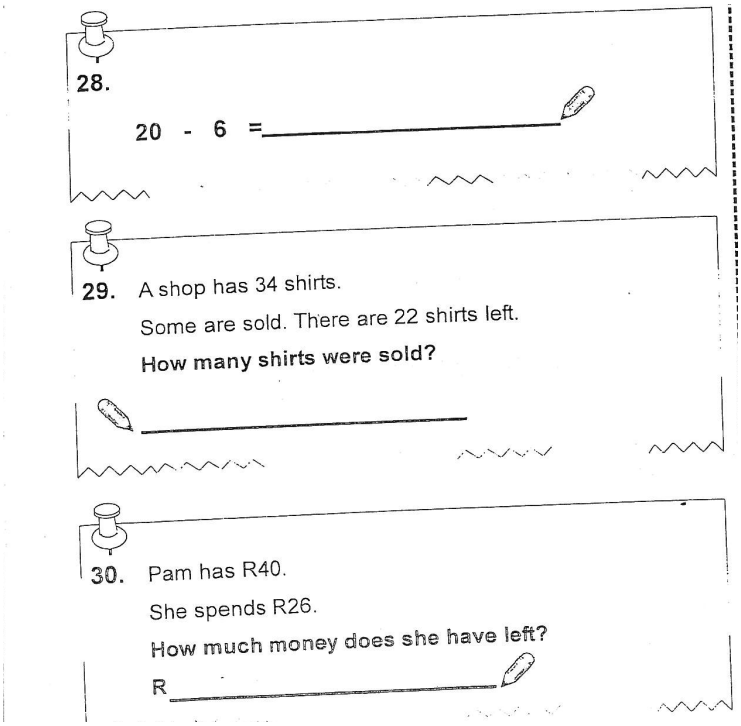
The easiest group of items according to these descriptions was those that simply required counting. It is perhaps surprising that children found the multiplication items easier than the addition items and considerably easier than the subtraction items, which were the most difficult on average. It turns out that the multiplication items were mainly simple times tables, such as 8 x 10, with very few items having any words. In contrast, the addition and subtraction items were more complex, involving larger numbers and word or story questions. A closer inspection of the subtraction items illustrates what

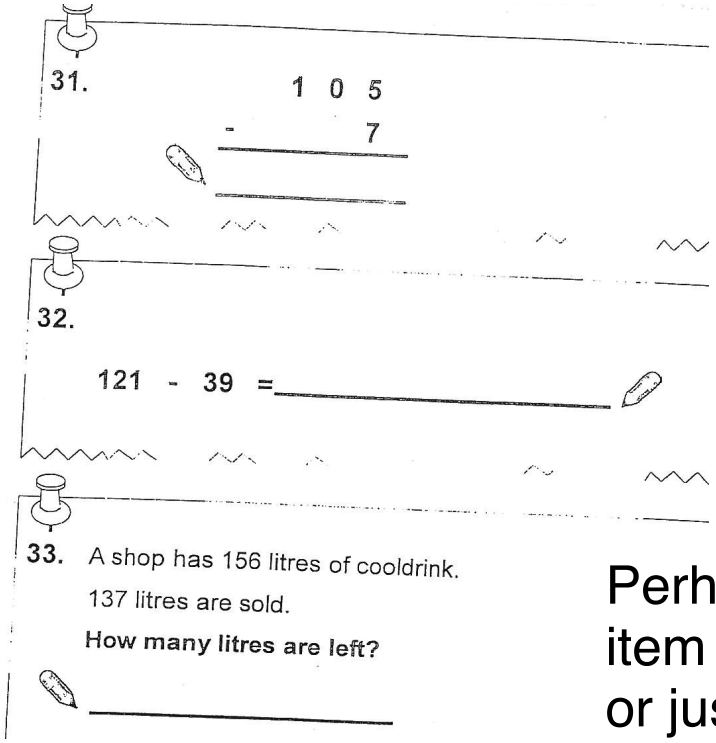
children found especially difficult. Table 7 reports the difficulty score for each of the seven items that involved subtraction.

Table 2.7: Difficulty scores for each subtraction item

Item	Difficulty score
Item 28	–1.81
Item 29	1.35
Item 30	1.71
Item 31	2.22
Item 32	2.02
Item 33	2.54
Item 34	–0.26

Item 28 was a particularly easy item and item 34 was of fairly average difficulty, while the remaining five subtraction items were all amongst the most difficult in the test. By inspecting these items one can begin to understand why learners found them difficult, and gain an insight into the nature of the problems inherent to classroom practice in South Africa. Items 28 to 33 are portrayed below.





Perhaps include item level dummys or just a table?

Item 28, which was the easiest subtraction item by a large margin, is different from the other items in two significant ways. Firstly, it does not involve words and therefore eliminates any language related obstacles, although it does mean the learners have mastered the elementary symbolic language in which the question is posed. Items 29 and 30 were classified as Grade 2 level questions, yet fewer than 20% of Grade 5 learners could provide the correct answer. This indicates the extent of the challenge when items are posed verbally, indicating the very significant role of language in mathematics learning. However, items 31 and 32 did not involve words. A second difference, then, between item 28 and the more difficult subtraction items was that the harder items involved numbers that were too large for children to obtain an answer by simply counting. Both Hoadley (2007) and Schollar (2008) have demonstrated that children answering a question such as item 32 (121 – 39) very often will make 121 marks on a piece of paper, cross off 39 of the marks, and the count the remainder to get the answer. With such large numbers there is obviously much room for error, which explains why the item was poorly answered. But the real problem that this highlights is that mathematics teaching in South African classrooms is failing to enable children to progress beyond concrete approaches to problem solving to algorithmic methods, a subject we return to in Chapter 7.

The Rasch item analysis confirms that, in general, questions posed in verbal or mixed forms of representation were more difficult than those posed entirely in symbolic form. As Chapters 6 and 7 will show very clearly, most South African primary school children are not well practiced in extended writing in their language classes, nor are they exposed to written calculation of any kind in mathematics classes; in particular they lack practice in undertaking relatively complex calculations, which we define as those requiring more than one step. Under these conditions, it is not surprising that item 33, which is both posed in verbal format and involves relatively large numbers, turns out to be the most difficult.

Overall learner performance in the NSES tests

The overall scores are presented as percentage scores. In the case of numeracy, all 53 items counted for 1 mark. For literacy, however, there were several questions that were longer, for example requiring a substantiated answer, and these items therefore counted for several marks. Table 8 reports several outcome measures of learner achievement that can be calculated from the data. The mean percentage scores for literacy and numeracy in each wave of the survey are shown. The gain scores (in percentage points) are also shown from one year to the next and for the overall two-year gain. Note that the numbers in Table 8 are calculated using the sample of 8 383 learners that participated in all three waves of the survey.

Table 2.8: Mean scores and gain scores in literacy and numeracy for all 3 waves (per cent correct)

	Literacy	Numeracy
Grade 3 (2007)	20.15	29.38
Grade 4 (2008)	29.59	35.50
Grade 5 (2009)	37.73	47.04
Gain 2007 - 2008	9.43	6.12
Gain 2008 - 2009	8.14	11.54
2-year gain	17.57	17.66

Note: In all analysis, the sampling weights were applied to ensure that reported statistics are representative of the eight provinces in the survey.

As Table 8 shows, the average achievement in both literacy and numeracy was low, especially considering that the tests were comprised of items ranging from Grade 1 to Grade 4 levels. Nevertheless, there was clear improvement from one year to the next, with gains of about 17.5 percentage points for both literacy and numeracy over the two-year period.

Figures 4 and 5 show the overall results by province for literacy and numeracy respectively. The lines show the percentage scores when calculated using the sample of 8383 learners that participated in all three waves (the panel sample). The columns show the percentage scores when calculated using the full cohort of learners that participated in each year. The fact that the average scores were slightly higher for the panel sample than for the full cohorts indicates that those who remained in the sample throughout the period were a slightly stronger pool of learners than those who for some reason participated in only one or two waves. This selection effect, however, does not appear strong enough to warrant suspicion that analysis based on only those captured in all three waves will be particularly biased.

Selection effect

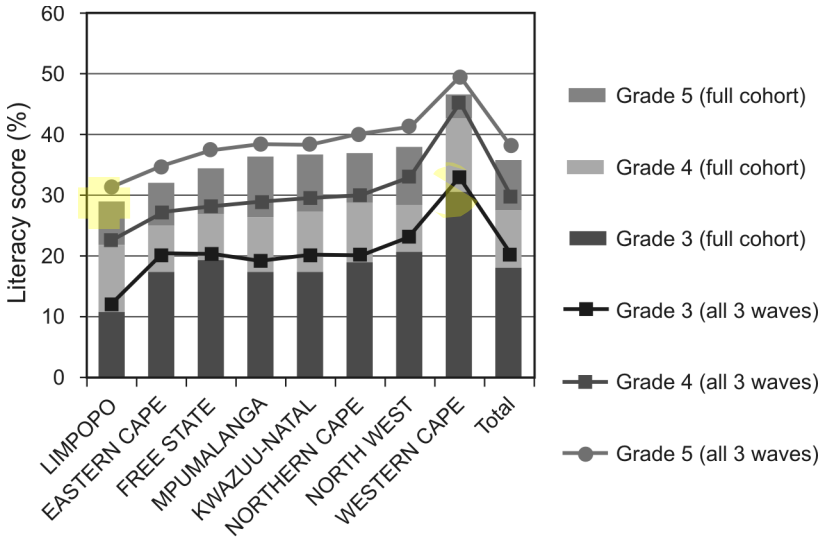


Figure 2.4: Mean literacy scores in each year for the full cohorts and for the sample that was captured in all three years, by province

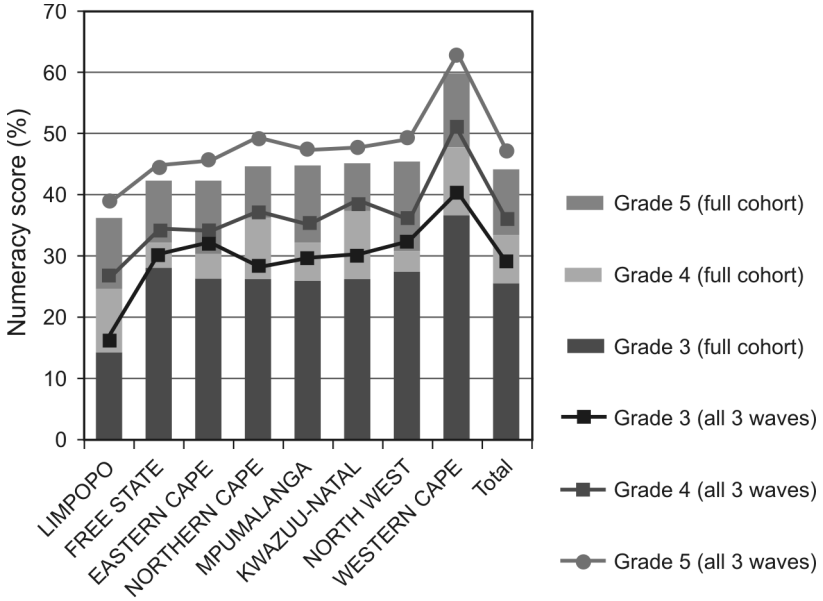


Figure 2.5: Mean numeracy scores in each year for the full cohorts and for the sample that was captured in all three years, by province

Figures 4 and 5 also show that Limpopo was the worst performing province in both literacy and numeracy, while the Western Cape was the best performing province. The substantial gain scores evident in the figures, even in low performing provinces, are an encouraging sign indicating that despite the low levels of achievement, some learning did occur over the two-year period and that this was true for all provinces.

Figure 6 presents another way to view the gains, using kernel density curves. The distributions depict the proportion of learners (along the vertical axis) achieving various 2-year gain scores (along the horizontal axis), for literacy and for numeracy. Additionally, vertical lines have been superimposed to indicate the position of the 25th and 75th percentiles within each distribution of gains. Several features of the graphs in Figure 6 are striking. The gain score at the 75th percentile was 26.7 percentage points in literacy and 30.2 percentage points in numeracy – fairly large gains indeed. The figure also draws attention to the large error component often present within gain scores due to measurement error at both the baseline test score and the post-test score. The very large positive gains and, especially, the large negative gains most likely represent measurement error rather than exceptional learning, or unlearning. Although measurement error may be a factor at the bottom end of the distribution of gains, it is still cause for concern that so many children exhibited very low or negative gains. 25% of the sample recorded gains of less than 8.3 percentage points in literacy or even losses, while the same proportion recorded gains of less than 5.7 percentage points in numeracy.

Why so normal??

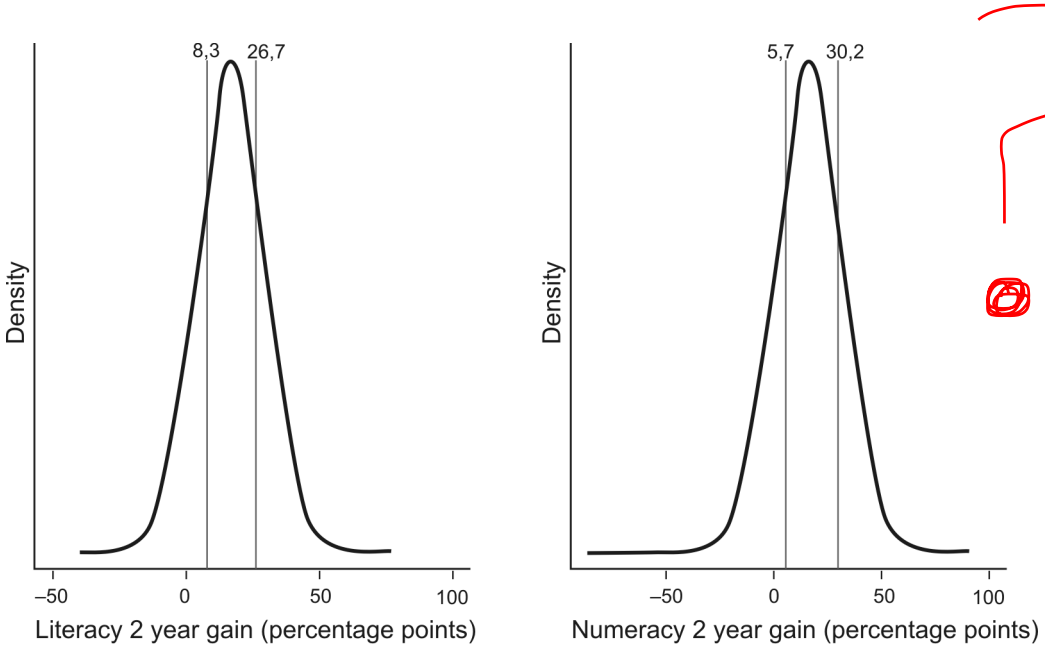


Figure 2.6: Kernel density curves of literacy and numeracy gains

Note: The red lines represent the 25th and 75th percentiles within each distribution of gain scores.

Performance by socio-economic status and former education department

It is well known that educational achievement amongst South African children is strongly associated with socio-economic status (SES). The NSES offers an opportunity to add to what is known about this and, in particular, to investigate whether the inequalities in cognitive ability that children of varying SES enter school with are reduced or exacerbated over time as schooling takes place.

Large surveys of educational achievement such as PIRLS, TIMSS, SACMEQ and the NSES typically do not contain information about household income or expenditure, as learners cannot be expected to provide reliable income or expenditure information. It is therefore increasingly common to construct asset-based measures of household SES. Filmer and Pritchett (2001) argue that asset-based classifications of households correspond sufficiently well to classifications by expenditure, and that asset-based indices are in fact better at predicting educational attainment than are expenditure data. One reason for this is that the presence of household assets is a more stable indicator than

income or expenditure and therefore a better proxy for SES, which is fairly unresponsive to short-term fluctuations in household income.

The learner questionnaire in the NSES asked learners about the presence of a number of household items at their homes. Learners were asked about the presence of a fridge, tap water, a toilet, electricity, a car, a computer, a newspaper and a washing machine. A statistical technique called Principal Component Analysis (PCA) was applied to these eight variables in order to derive a composite index for SES. This method does not give equal weight to each variable when deriving the SES index, but allocates the weight to each variable according to how much information about SES each variable provides. For a detailed explanation of Principal Components Analysis and its application to deriving asset-based indices for SES see Taylor and Yu (2009). The index was set to have a minimum value of zero, a mean value of 2 and a standard deviation of 1. The average SES within each school was also derived in order to examine the impact of the combined SES of each school on learner achievement.

Figure 7 shows kernel density curves of Grade 5 literacy and numeracy scores, respectively, by quintile of school-mean SES. These 'quintiles' were calculated by ranking schools by the average learner SES within each school and then dividing the distribution into five equal groups, so that Quintile 1 represents the 20% of schools with the poorest composition of learners and Quintile 5 represents the 20% of schools with the least poor composition of learners. The kernel density curves show the proportion of the sample (along the vertical axis) that attained specific literacy scores (along the horizontal axis). For both literacy and numeracy, the distributions for the bottom four quintiles are remarkably similar, while the distribution for those in the most affluent 20% of schools lies considerably to the right, indicating superior performance. This pattern is consistent with other research that has found similar levels of performance within the bottom four quintiles of South African schools and substantially higher achievement within the top quintile (Van der Berg, 2008, Taylor and Yu, 2009).

Disconcerting!

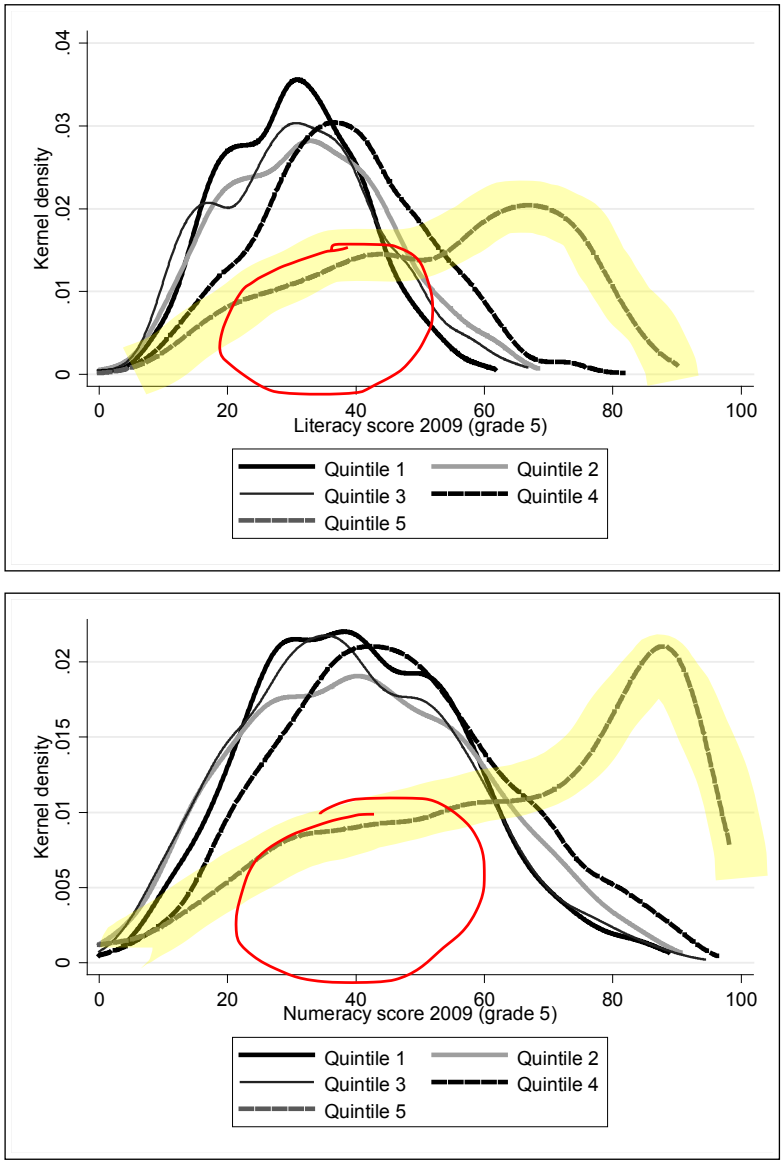


Figure 2.7: Kernel density curves of Grade 5 literacy (weighted) and Grade 5 numeracy by quintile of school-mean SES

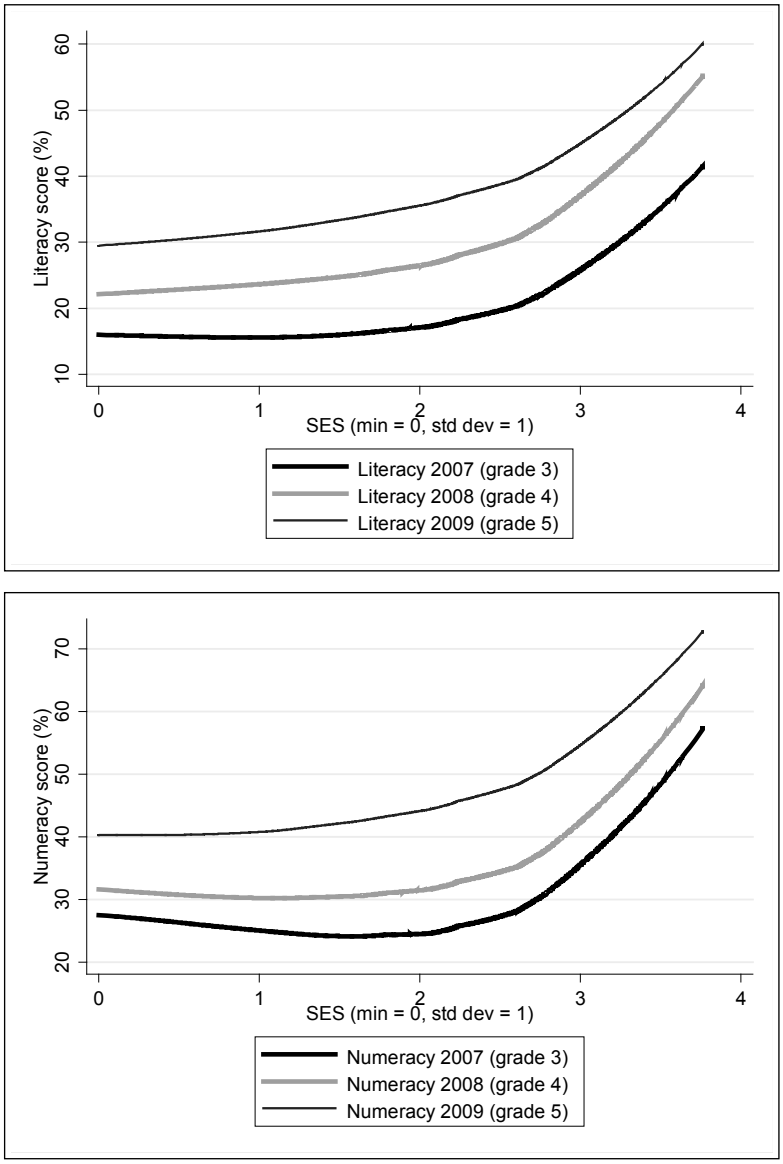


Figure 2.8: Lowess-type socio-economic gradients for literacy and numeracy over the three years

Figure 8 depicts socio-economic gradients across the three years of the survey for literacy and numeracy, respectively. A socio-economic gradient is the graphical representation of the relationship between SES and an outcome

of interest, such as health or education. In this case, the technique of Lowess regression was used to estimate the relationship and smooth the curves.

Figure 8 shows that across the lower to middle range of SES, changes in SES are not associated with significant improvements in achievement, while at higher levels of SES there are large improvements in achievement associated with changes in SES, as indicated by the steepness of the curves. It is disconcerting that this pattern is evident as early as the third Grade and remains fairly constant through to Grade 5, albeit at a somewhat higher overall level of achievement. In fact, the basic shape of these socio-economic gradients is consistent with other similar estimations based on data from higher grades, such as that done by Van der Berg (2007) using Grade 6 data and by Taylor *et al* (2011) based on Grade 8 and matric data. This suggests that the harmful impact of low SES is established early on in primary school and that no evidence can be found to suggest that primary schooling is able to reverse this. An implication of this for policy is that interventions should be made as early as possible in the educational process, including at the pre-school level and during the phase of Early Childhood Development (ECD).

Another perspective on how the gaps in achievement between high and low SES children changed over the two-year period during which the NSES was conducted is provided in Table 9. The distributions of literacy scores in each year were divided into percentiles of achievement, such that the first percentile was the worst-performing 1% of learners and the 100th percentile was the best-performing 1% of learners. At the same time, learners were divided into quintiles according to their SES, so that the first quintile represents the poorest 20% of learners and the 5th quintile represents the least poor 20% of learners. Table 9 shows the average position in the literacy percentile distribution within each quintile of learner SES in each year. Importantly, the SES index used for the calculation of the quintiles was based on three years of information about household assets. Therefore, the same learners remained in the same quintiles across the three years. What the numbers mean is that, for example, in Grade 3 the average learner within the poorest 20% of learners would have

been ranked 42 out of 100 in terms of literacy performance. Table 9 shows that the average percentile position for the poorest quintile of learners decreased fairly substantially from 42.0 in Grade 3 to 36.5 in Grade 5. This means that poor learners became more concentrated at the low end of the performance distribution over time. At the other end of the spectrum, the average position of the richest quintile improved slightly from an initial position considerably higher than any of the other quintiles and the average position of the fourth quintile (second richest) improved noticeably over the period. This provides tentative evidence regarding an important issue: as learners progress through the early phases of the school system it would seem that educational inequalities are widening rather than being reduced.

Table 2.9: Average position in percentile distribution of literacy achievement by SES quintile

	Grade 3 (2007)	Grade 4 (2008)	Grade 5 (2009)
Quintile 1	42.0	38.2	36.5
Quintile 2	39.9	40.3	41.0
Quintile 3	42.6	44.8	45.7
Quintile 4	46.6	49.1	51.3
Quintile 5	67.2	70.4	69.5

Conf Int?

One reason for this divergence is that there were some schools serving poor learners in which performance was very low and hardly improved at all over the three-year period. There were 28 schools in which the mean literacy score remained below 25% in all three years. Similarly, there were 28 schools in which the mean numeracy score remained below 32% in all three years. 16 schools were common to both these sets of 28 schools. Of these 16 schools, 15 were historically black schools and one was historically coloured and 11 of the 16 historically black schools were in former homeland areas, indicating that the problem of severe underperformance and negligible learning during primary school is most pervasive in rural areas.

Another preliminary way to analyse the influence of SES is to run an Ordinary Least Squares (OLS) regression predicting achievement based only on learner SES and the mean SES in each school. Including both learner and school SES allows one to assess the relative importance of these two factors. Table 10 reports the statistics for such a regression predicting literacy achievement in Grade 4 (2008). Note that the inclusion of the squared and cubed versions of mean school SES was motivated by the sharp increase in the association of SES with achievement at higher levels of SES that was evident in

Figure 8, and was justified by this third order specification providing a better model fit than either a linear or quadratic specification.

Table 2.10: The effect of SES on literacy scores: learner level and school level combined

Dependent variable: Grade 4 literacy score (unweighted)	
Mean School SES	13.44***
	(1.46)
Mean school SES squared	–10.81***
	(0.75)
Mean school SES cubed	2.47***
	(0.11)
Learner SES	1.51***
	(0.17)
Constant	16.03***
	(0.81)
R-squared	0.38
N	11813

* p<0.05, ** p<0.01, *** p<0.001
(Standard errors in parenthesis)

Due to the third order specification of school-mean SES the coefficients reported in Table 10 are easier to interpret when graphically represented. Figure 10 depicts the predicted literacy score in Grade 4 according to the regression in Table 10. Movements along the horizontal axis represent changes in school-mean SES, while the vertical width of the band of predicted values is due to variation in learner SES at given levels of school-mean SES. It is evident that variation in learner SES at given levels of school-mean SES was generally associated with fairly small changes in the predicted literacy achievement, whereas a movement to the top end of the school SES spectrum was associated with a substantial increase in the predicted literacy score. Therefore, the combined SES of learners within the school appears to have a more decisive impact on learner achievement than the home SES of learners, although the latter may well determine what type of school learners are able to attend. One might think of the impact of SES on learner achievement in South Africa as a two-step process, in which the first step is the crucial one. Learner SES is in the first place a major determinant of the quality of schooling to which learners gain access; thereafter, home SES has less of an impact on educational

achievement than school effects, which we assume has as much to do with peer influence, as with aspects of school quality.

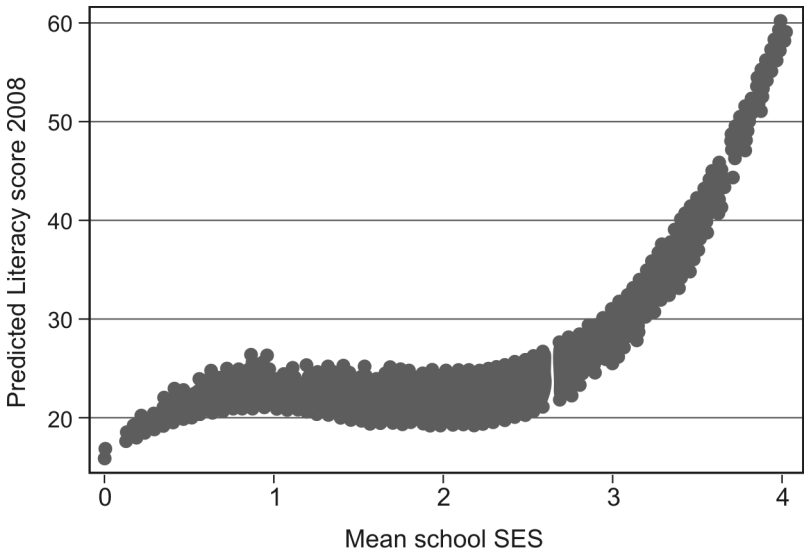


Figure 2.10: SES gradient for Grade 4 literacy: Learner and school SES combined (based on Table 10)

Differential performance between the two historically different 'sub-systems'

Many authors, social commentators and politicians have now used the idea of 'two economies' or 'two South Africas' to describe the divided nature of various aspects of South African society. The education system in South Africa can similarly be characterized as consisting of two 'sub-systems' that have very different historical backgrounds and continue to perform at different levels of effectiveness. The majority of South African children are located in the historically disadvantaged system, which continues to be disadvantaged through poverty and all the educationally detrimental factors that are associated with poverty. On average, children in these schools demonstrate low proficiency in reading, writing and numeracy. The second sub-system consists

Fees

mainly of schools that historically served white, Indian and some coloured children and produces educational achievement that is closer to the standards achieved in developed countries. This second system has increasingly become racially integrated to the point where white and Indian children may no longer be in the majority. However, SES has to a large extent replaced race as the major determinant of who attends schools in this second system.

As considered earlier, the influence of SES on achievement in South Africa is intertwined with the historical divisions amongst schools on the basis of race. Under apartheid schools were administered by separate departments of education according to race group. Table 11 reports the mean literacy achievement (calculated as the average over three years) as well as the mean SES by institutional history. The table confirms that schools which prior to 1994 would have served black children are still achieving at lower levels than historically white and Indian schools, with historically coloured schools somewhere in between. The table also demonstrates how those in the historically black part of the system are poorer than those in the rest of the system. Note that only four historically Indian schools were surveyed in the NSES, making this group too small to warrant meaningful analysis.

Table 2.11: Mean literacy scores (3-year average) and mean SES by institutional history of schools

Institutional history of schools	Mean literacy over 3 years	Mean SES	Observations
African	25.19	1.70	6 776
Coloured	39.12	2.97	880
Indian	43.86	2.81	108
White	58.78	3.35	619
Total	29.16	1.95	8 383

It is revealing to compare the distributions of achievement within each year of the NSES for historically African schools with those for formerly white schools. Figures 11 and 12 depict these distributions for literacy and numeracy, respectively. The three solid lines are for historically African schools and the three broken lines for historically white schools. For both groups of schools,

the distribution of achievement improved with each year (shifting to the right). It is alarming, however, that the distribution for Grade 5 learners in historically African schools was still a considerably weaker distribution than that of Grade 3 learners in historically white schools. One can therefore conclude that by the fifth Grade the educational backlog experienced in historically African schools is already equivalent to well over two years worth of learning.

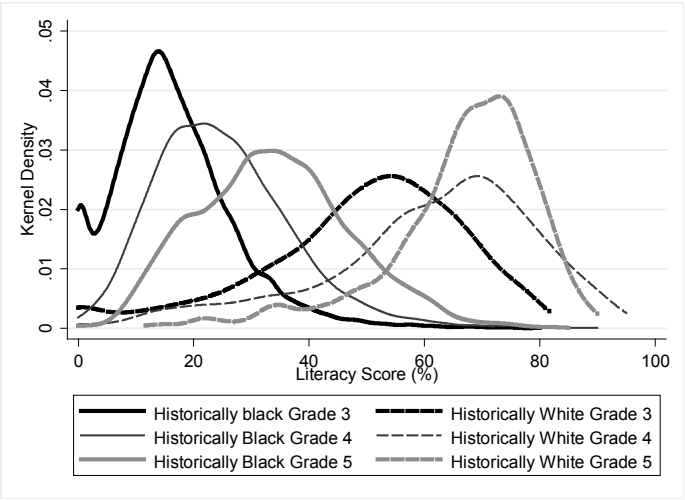


Figure 2.11: Kernel Density curves of Grades 3, 4 and 5 literacy by institutional history

The picture for numeracy is similar. Figure 12 differs from the figure for literacy in that the distributions for historically black schools are more spread and the distributions for historically white schools are more concentrated at the top end, evidently with little room for improvement with scores in 2007 already concentrated at the high end of the spectrum. This merely reflects that the numeracy test was generally experienced as easier than the literacy test. The difference between the Grade 5 distribution for historically black schools and the Grade 3 distribution for historically white schools is even greater for numeracy than for literacy. This deficit despite more years of schooling may at least partly explain why black South Africans still earn less than white South Africans with similar amounts of education. Several studies suggest that the most probable explanation for this racial wage gap is that the quality of each year of education within the schools that black people typically attend is lower than that within schools typically attended by white South Africans (e.g. Burger and Jafta, 2006, Burger and Van der Berg, 2011). This is indeed what is observed in Figures 11 and 12. Thus, schooling is increasingly stratified by the possession of cultural capital and access to the country's good schools, and decreasingly by race alone.

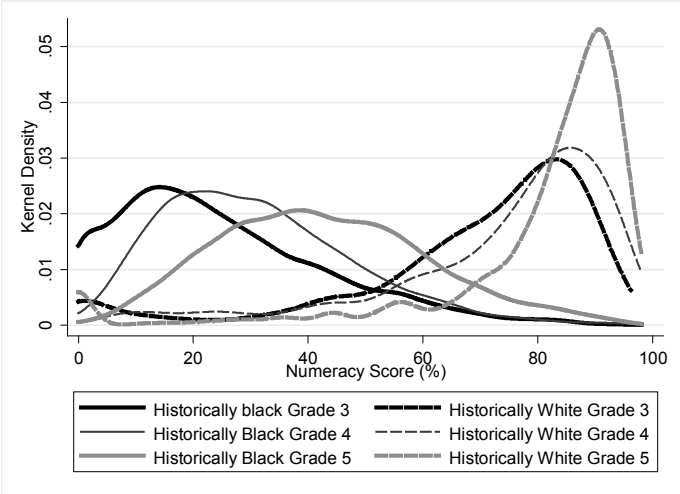


Figure 2.12: Kernel Density curves of Grades 3, 4 and 5 numeracy by institutional history

The key point here is not that achievement differs between individual children of different race groups but between those located in the different parts of the school system. When one compares African language children (a proxy for race) in historically black schools with other African language children attending historically white schools this becomes clear. The average literacy score amongst African language children in historically black schools in grade 5 was 33.8% compared with an average score of 45.3% amongst other African language children in historically white schools in grade 3. Although differences in socio-economic status accounts for some of this gap in performance, to a great extent this points to systematic differences in school functionality.

Conclusion

This chapter has served to introduce the structure of the NSES literacy and numeracy tests and to highlight several key results. The analysis of individual items in the tests provides the reader with a feel for what exactly is being measured by the various outcome variables that will be used in the coming chapters. The item analysis also provides an indication of what children are learning and what they are not learning. Improvement from Grade 3 to Grade 5 was mainly observed on items which tested low level skills. In literacy, most learners struggled with free response questions requiring inferential reasoning, interpretation and writing full sentences. Weak literacy skills clearly spill over into numeracy so that performance on word problems is particularly

low. Numeracy items involving calculations with large numbers (so that simple counting techniques become insufficient) were also poorly answered. These observations point to some of the weaknesses in teaching practice in South Africa, such as an insufficient focus on extended writing or complex calculations in mathematics.

Encouragingly, the overall results of the NSES provide evidence that learning did take place over the two year period, and that this applied in all provinces and across the historically different parts of the system. On the other hand, there are also too many cases of schools in which little if any learning appears to have taken place. It is these schools, in which achievement was at a low level and in which little progress was made off those low levels, that require closer investigation to establish what the binding constraints to learning are and that may require the most fundamental interventions to create an environment that is conducive to learning. The chapter also demonstrates that most of these underperforming schools form part of the historically disadvantaged part of the school system, in which low quality education serves to further disadvantage the majority of South Africa's poor children.

The rest of the book is concerned with investigating which factors are most likely to improve the quality of schooling for all South Africans, but particularly for poor children. Chapter 3 uses statistical modelling techniques to assess the relationship between learner performance and various learner, teacher and school characteristics as they occur in combination. This serves to highlight some of the most important factors determining learner performance. Thereafter, subsequent chapters zoom in on certain of these factors that affect learner performance, such as instructional leadership, language, reading and writing in language and mathematics, and learner age.

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Chapter 3

Modelling educational achievement in the NSES

Stephen Taylor

Overview

In addition to testing learners in literacy and numeracy over three years, the NSES collected considerable information about the learners, their home backgrounds, the schools they attended and the teachers who taught them. Using this rich collection of information, this chapter introduces some of the important factors that influence learning in South African primary schools. The chapter begins by discussing several methodological issues that arise when analysing factors that influence educational achievement, then describes key indicators of effective school management and teaching that the NSES shows to be important, and finally reports on a multi-variable statistical analysis of the factors associated with learning.

Some of the analysis presented in this chapter is based on only the first two waves of data from 2007 and 2008, allowing a larger sample of 11 813 students. There is also some analysis based on the dataset containing all three waves that, due to attrition, comprises only 8 383 students who were surveyed in all three years.

There is also a slight difference in the way percentage scores for literacy were derived in these two datasets. In the sample of 11 813 (waves 1 and 2) each item was given the same weight in the overall score. However, in the dataset with all three waves the literacy percentage scores have been calculated to weight up longer items. This is probably the preferable method, as it makes sense that an item involving an answer as well as a sentence to substantiate the answer will provide more information about learner competence than, say, a multiple-choice question. This kind of answer should then have the mark allocation categories of 0, 1, 2 rather than 0, 0.5, 1, as was the case in the unweighted derivation of the scores.

Advantages of the NSES data for analysing educational achievement

The panel nature of the NSES data is distinctly advantageous as it allows one to observe the amount of learning that occurs over time rather than a simple cross-sectional snapshot of achievement. A single cross-sectional snapshot of educational achievement reflects both observed influences on achievement, such as various characteristics of teachers in that year, as well as unobserved factors, such as the innate ability of learners and the influence of previous teachers. This leads to a problem of omitted variable bias when estimating the importance of various influences – if, for example, learners with well-qualified teachers in the year of observation also had been exposed to good teaching in earlier years one might wrongly or over-attribute better performance amongst these children to the well-qualified teachers. Using gain scores as the outcome of analysis, means that omitted variable bias can, to some extent, be avoided. This is because prior influences and unobserved learner characteristics are already reflected in the baseline score and remain largely unchanged during a year or two.

A second advantage of the NSES is the extensiveness with which it covered school-management, teacher-knowledge and teacher-practice issues. Previously, much of the South African 'education production function' literature has found that learner socio-economic status, and to some extent school resources, account for much of the variation in learner achievement, but that a large unexplained amount of variation remained (For example, Crouch and Mabogoane, 1998, and Van der Berg and Burger, 2002). Some researchers have speculated that school management and the 'hard-to-observe' aspects of teaching must account for most of this unexplained variation, but have been unable to demonstrate these effects due to data limitations. The NSES, however, covered a variety of school-management and teacher practices with remarkably fine detail for a large-scale sample survey. For example, an extensive document review was carried out, which included a thorough perusal of learner workbooks to establish how often various types of exercises were undertaken throughout the year. In addition, English teachers were given a short literacy test and mathematics teachers a short numeracy test, allowing the effects of teacher knowledge on learner achievement to be investigated.

These unique features of the NSES allow the modelling exercise presented in this chapter to go somewhat further than was previously possible in unpacking the so-called 'black box' of how school and classroom practice impacts on learning.

The need to analyse the two 'sub-systems' separately

Not only is the distinction between schools that historically catered for different race groups useful for describing broad patterns of educational achievement in South Africa, as the previous chapter has shown, but there are important statistical and methodological reasons to analyse the two 'sub-systems' separately when investigating what drives educational achievement in South Africa. Particular school inputs, teacher practices or other characteristics may affect learner achievement differently across the two sub-systems. It is possible, for example, that an advanced-media technology may be effective in the well-functioning part of the system but ineffective in the historically disadvantaged sub-system where schools may not have the expertise to implement the technology or the security to protect the equipment from theft and vandalism. In this way, important dynamics in one segment of the school system can be glossed over by estimating a single model for the entire school system. Alternatively, a single model may indicate that a relationship exists between learner performance and a particular characteristic, when in fact this pattern is being driven by differences between the two sub-systems.

During the years since the historically different parts of the school system were brought under a single administration, there has been some migration of black learners into historically white, coloured and Indian schools, although not in the opposite direction (Soudien, 2004). Figure 1 shows that when one controls for race (by restricting the sample to only learners whose home language is one of the 9 'African' languages) and household socio-economic status, learners attending historically white schools perform considerably better than their counterparts in historically black schools. The graph shows that at given levels of socio-economic status African-language learners located in historically white schools achieved better literacy scores than African-language learners in historically black schools. Admittedly, unmeasured aspects of socio-economic status or motivation may account for some of the observed performance gap. It is also likely that peer effects benefit African-language learners in Afrikaans/English schools. Nevertheless, it is likely that this pattern is also reflective of systematic differences in school efficiency between the historically different parts of the school system.

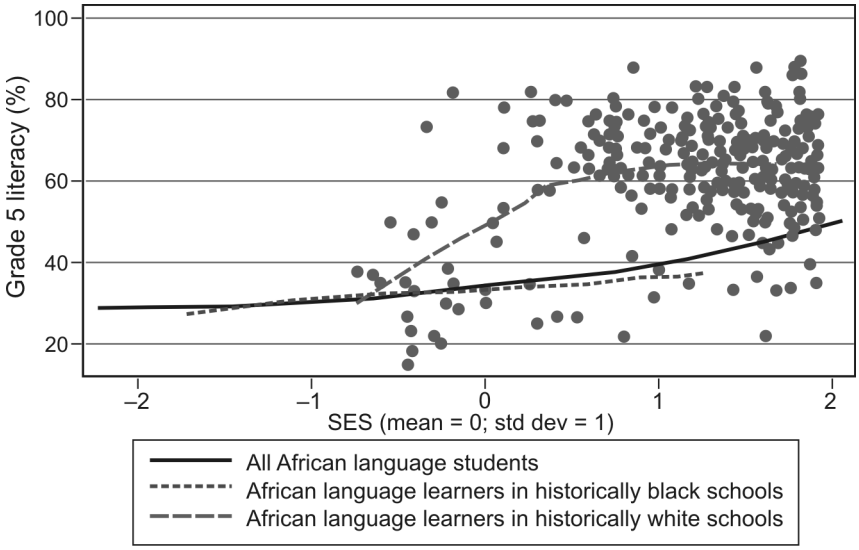

Figure 3.1: Lowess-type socio-economic gradients for African language children in historically different sections of the school system, NSES 2009

Note: Lowess smoothing lines are used to depict the relationship between socio-economic status and Grade 5 literacy achievement. In addition, a scatterplot is shown only for those African-language learners in historically white schools.

This shows that although achievement is strongly connected with learner socio-economic status, much of this connection has to do with the effectiveness of schools in which learners are located. This confirms what was suggested in Chapter 2, that learner socio-economic status exerts its impact on achievement in two steps: Its decisive influence is through selection into schools of varying quality; thereafter, a learner's socio-economic background has a limited further influence on achievement.

This argument that systematic school inefficiency must be contributing to low achievement over and above the influence of poverty is supported by another key finding in the literature: Poor South African children are performing worse than equally poor children in our neighbouring countries are. Van der Berg (2007) has demonstrated this using SACMEQ 2000 data and Spaull (2011) has shown this using SACMEQ 2007 data. This implies that factors other than poverty must be inhibiting learning in the schools that poor South African children attend. In time, one might expect the institutional weaknesses within historically black schools to subside and that educational performance will differ by socio-economic status but not by race or by historical institution. It will be important for future research to revisit this issue and investigate whether

the differences in learner performance between these groups of schools can be fully attributed to socio-economic differences. However, it may prove difficult to disentangle these effects given the ongoing residential segregation by socio-economic status and the role that socio-economic status plays in selection into differently functioning schools.

Although it is clear that the historically disadvantaged and poorer parts of the school system are operating at a low level of efficiency, and that this is not completely attributable to socio-economic status, it is less clear what teaching and management practices underlie this low performance. The next section describes several school and teacher characteristics captured in the NSES that can be considered indicators of quality.

Descriptive analysis of indicators of effective school management and teaching

Chapter 4 argues that one of the most important aspects of well-managed schools is effective instructional leadership. The notion of instructional leadership asserts that the primary task of the school principal, together with senior management, is to oversee the delivery of the curriculum. Other studies promoting the notion of instructional leadership have suggested that many school principals in South Africa do not understand their role as instructional leaders and that their division of time to various tasks reflects this neglect.

The document review conducted in the NSES, particularly the learner workbook review, sheds further light on the extent to which instructional leadership is lacking in South African schools. Insufficient coverage of the curriculum emerges as a clear sign of weak instructional leadership and inadequate teaching, and can be seen to impact negatively on learner achievement. Evidence on curriculum coverage was obtained through recording the number of various types of exercises that were observed in learner workbooks. In order to improve comparability across classes, each teacher was asked to present the 'best' learner's workbook for inspection. This also means that the records can be considered a 'best-scenario' picture of classroom activity. Table 1 describes what information was obtained in the learner workbook review.

Table 3.1: Information recorded in the review of learner workbooks

Description of record	Year
Mathematics workbooks	
Total no. of topics (Assessment Standards in the Curriculum) covered so far	2008, 2009
Completion of short examples (5 or fewer per day)	2008, 2009
Completion of short examples (more than 5)	2008, 2009
Completion of complex calculations or word problem	2008
Total number of numeracy exercises	2009
Number of complex exercises (excluding word problems)	2009
Number of word problems	2009
Reading workbooks	
Writing consisting of paragraphs or longer	2008*, 2009*
Exercises consisting of isolated words only	2008*, 2009
Exercises consisting of sentences	2008*, 2009
Non-verbal forms of text (tables, graphs, mindmaps, diagrams)	2008*
Total number of literacy exercises	2009
Transcription	2009

*It was also recorded whether the length of exercises marked with an asterisk was less than half a page or longer than half a page.

It is worth describing the extent to which several of the above indicators were observed in learner workbooks. The books were examined to identify the number of mathematics topics (learning outcomes specified in the curriculum) that had been covered up until that point in the year. Fieldworkers were instructed to recognise the 84 topics for Grade 4 (in 2008) and the 89 topics for Grade 5 (in 2009) that were specified in the National Curriculum Statements. It would truly be exceptional if all topics were observable in one learner's workbook, given that the year was not completed at the time of the survey and that even the very best teachers would probably not have administered written exercises in each of the topics. Nevertheless, one might expect a good teacher to have covered well over half the curriculum by September of the school year. Figure 2 shows the extent to which the curriculum topics were indeed observable in learner workbooks. The picture was very similar for Grade 4 classrooms as it was for Grade 5 classrooms a year later. Less than 10 percent of topics were covered in roughly 20% of classrooms. Less than 30% of workbooks showed evidence of at least 30% curriculum coverage.

The recording of various types of exercises revealed that the cognitive demand of exercises is typically low. As described in Chapter 2, many

workbooks contained no complex exercises (those consisting of more than one step) and a small proportion of workbooks indicated that complex exercises were regularly undertaken. In Chapter 7, writing in mathematics and the frequency with which various types of mathematics exercises are undertaken, are discussed in detail.

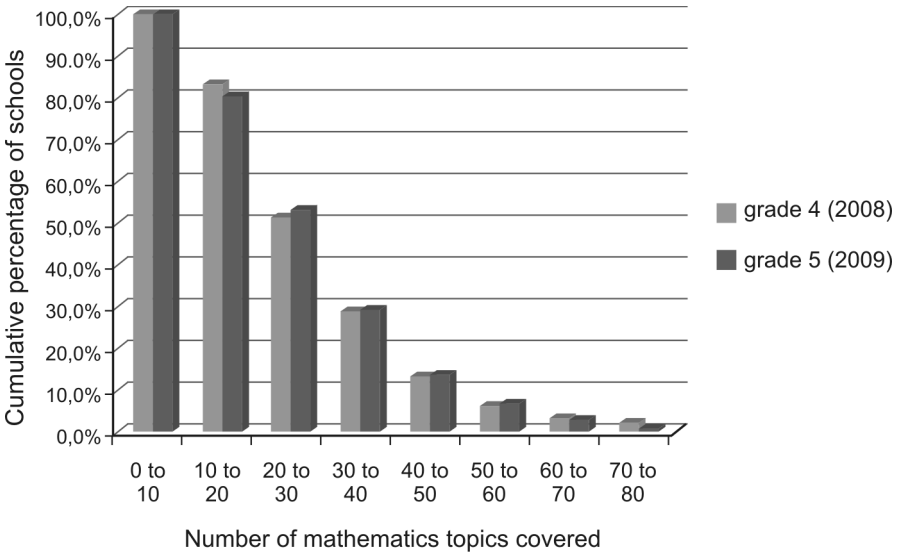

Figure 3.2: Coverage of mathematics topics

When one compares indicators of curriculum coverage across the historically different parts of the school system, one gains some insight into the weak instructional leadership and classroom practices that must contribute to the low performance within the historically disadvantaged part of the system. Table 2 reports the percentage of learners located in schools where evidence was found of more than 25 mathematics topics being covered. This is broken down by the institutional history of schools. Within the historically white part of the sample, 75% of learners were in schools where evidence was found of more than 25 topics being covered, compared with just 26% of learners in the historically black schools. Of course, the historical roots of these differences are well known, and we do not wish to minimise them here. What is of particular interest to our study is the variation *within* each sub-system and how these differences are systematically related to differences in school leadership and classroom teaching.

Table 2: Percentage of learners in schools where more than 25 mathematics topics were covered in Grade 4 (2008)

Institutional history	Percentage > 25 topics	Number of learners	Proportion of learners
Black	26%	6 306	81.0%
Coloured	25%	849	10.5%
Indian	38%	86	1.3%
White	75%	591	7.3%
Total	29%	7 832	100%

Table 3 shows the mean number of literacy exercises identified in learner workbooks by institutional history. This demonstrates that considerably more exercises were undertaken by learners within the historically advantaged parts of the system over the course of the year. Tables 2 and 3 offer some perspective on the large learner achievement deficits being carried within historically black schools, as referred to earlier. If the curriculum is not being covered and learners are not frequently engaged in exercises, it is hardly surprising that learning deficits will accumulate. On the other hand, there may be an element of bidirectional causality underlying the relationship between low curriculum coverage and low achievement within historically black schools: If teachers take on learners with prior learning deficits, it may be justifiable to adopt a slower pace of curriculum coverage. However, the observed level of curriculum coverage is so low within historically black schools that it seems safe to conclude that this is an aspect of school quality in need of attention.

Table 3: Mean number of literacy exercises found in the 'best' learner's book (2009)

Institutional history	Mean number of exercises	Number of learners
Black	33.43	6 478
Coloured	62.40	837
Indian	72.44	102
White	75.21	580
Total	39.58	7 997

Figure 3 provides an indication of the amount of extended writing (as measured by the number of exercises involving written paragraphs observed in learner workbooks) that was undertaken by Grade 5 learners. In 85 out of 285 classes it would appear that no paragraph writing had taken place. In only 19 classes could it be observed that learners had written a paragraph at least ten times in the year.

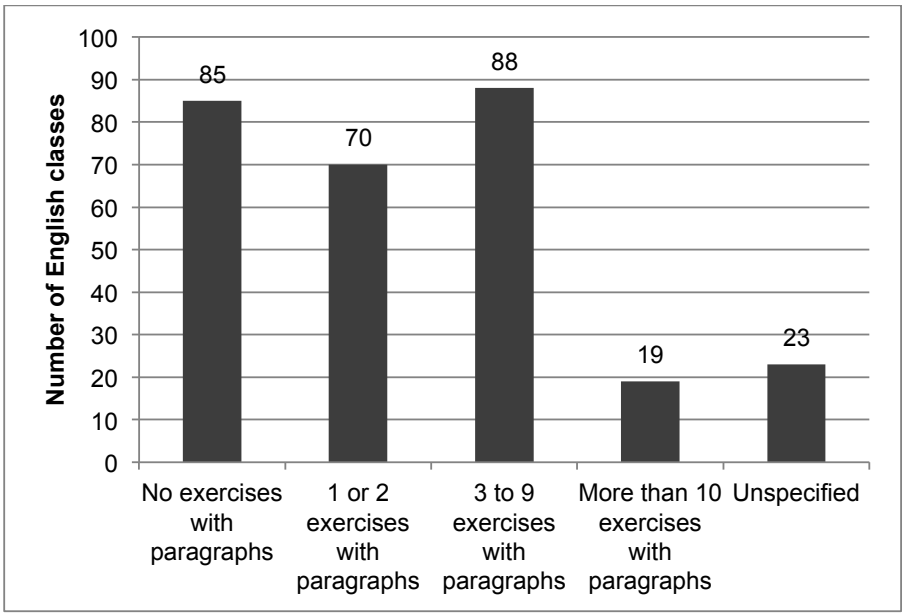

Figure 3.3: Frequency of paragraph length writing (Grade 5)

Subject knowledge amongst teachers has rarely been measured in large-scale sample surveys of learner achievement in South Africa. Two sources of information on teacher knowledge have recently become available and both are used for analysis in this book. Firstly, the SACMEQ survey of 2007 (only released in 2011) included comprehensive teacher testing. (A thorough analysis of the performance of South African teachers in the SACMEQ tests is provided in Chapter 8.)

Secondly, the NSES administered a comprehension test with seven questions to English teachers and a five-item test to mathematics teachers. The shortness of these tests means that they provide only limited measures of teacher knowledge, but this feature does at least allow for some measure of teacher knowledge to be included in the modelling analysis, something that has hitherto rarely been possible with South African data. Figure 4 shows a histogram of scores on the English teacher test. The histogram is skewed to the right indicating that most of the scores were concentrated at the higher end. Although there were few extremely low scores, there was still a lot of variation in teacher knowledge and only 16% of teachers scored 100%.

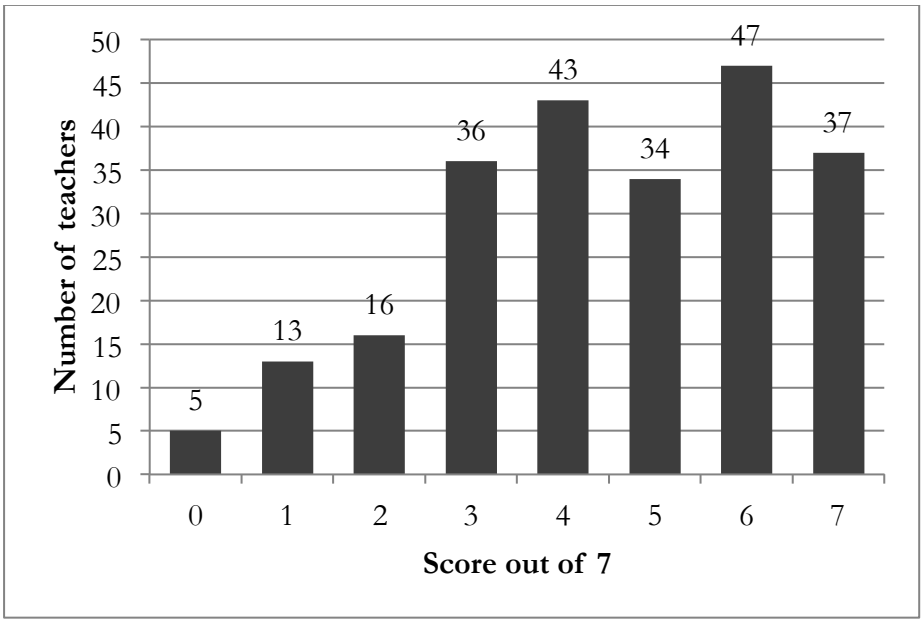

Figure 3.4: Histogram of English teacher test scores (2008)

Figure 5 shows the number of teachers achieving each score out of five on the mathematics test. Most of the scores are in the middle range with only 29 teachers scoring 100%. The significance of this is better realised by looking at the distribution of mathematics teacher knowledge at the level of learners, i.e. the numbers of learners taught by teachers with each test score. Table 4 presents this breakdown. The table reveals that more than half of the learners in this survey were taught by teachers who scored 40% or less on the simple mathematics test. Just over 12% of learners were taught by teachers who scored 100%. Although the relationship between teacher knowledge and learner achievement is a complex one, as Chapter 8 describes, if teacher knowledge is this deficient, it is perhaps not surprising that learner achievement in South Africa is so low. The far right column of Table 4 shows the mean numeracy achievement in 2008 (Grade 4) for learners in each category of teacher test score. For teachers who scored anything less than 100% the mean achievement of learners was very similar. However, those learners taught by teachers who scored 100% performed noticeably better than the rest. This suggests that more effective teachers have sound knowledge, or at least knowledge that is sound enough to achieve 100% on this short test. In contrast, any score less than 100% is an indicator of lower teacher quality and is linked to low learner achievement. This hypothesis that, at least in the case of mathematics, a threshold of sound teacher content knowledge is required before learner achievement is responsive will be discussed further in Chapter 8 and is tested

in the multivariate analysis in this chapter. An example of the questions in the mathematics teacher test is provided below.

Example

'10 days 75 hours can be written as ... days ... hours'

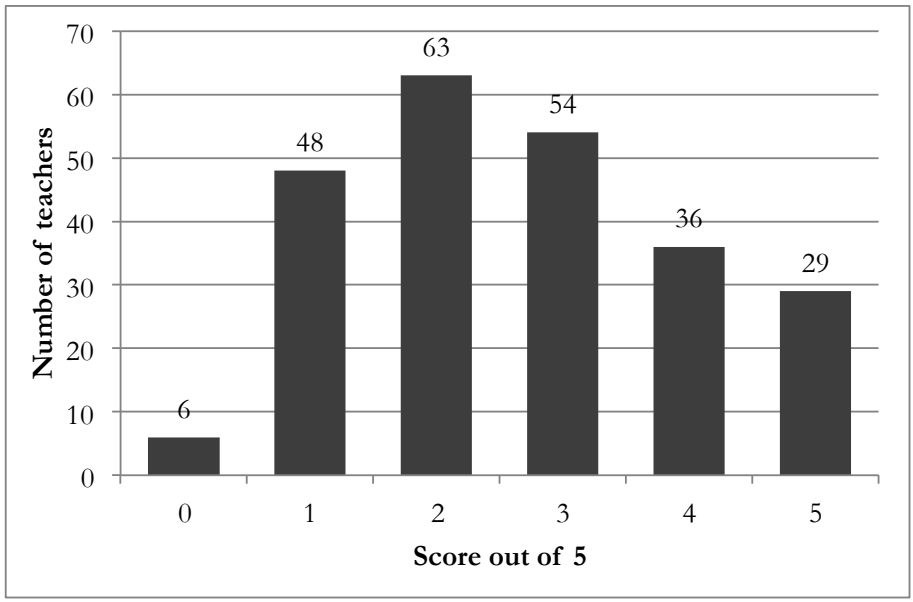

Figure 3.5: Histogram of mathematics teacher test scores (2008)

Table 3.4: The number and performance of learners by teacher knowledge (Grade 4 – 2008)

Teacher score	Number of learners	%	Cumulative %	Mean Learner Numeracy (Grade 4)
0	210	2.1	2.1	37.3
1	2 130	21.5	23.6	33.0
2	2 774	28.0	51.7	33.5
3	2 168	21.9	73.6	34.1
4	1 408	14.2	87.8	34.8
5	1 209	12.2	100.0	46.9
Total	9 899	100	100	35.4

Another teacher characteristic captured in the NSES was the self-reported number of hours spent on actual teaching per week. This variable itself was not strongly correlated with learner outcomes, although an interesting interaction between the time spent on teaching and teacher knowledge was noted. As Table 5 shows, those taught by teachers who scored less than 100% in the mathematics test and who taught for less than 18 hours per week had lower numeracy achievement in Grade 4 on average than learners with any other combination of these two teacher characteristics. Learners taught by teachers with either better knowledge or more time spent teaching but not both of these characteristics performed somewhat better than the poorest performing group. However, those whose teachers scored 100% and reportedly spent more than 18 hours teaching performed substantially better on average than the other learners. Table 6 demonstrates that not only did this category of learners perform at a higher level, but also showed the greatest improvement from one year to the next. This is an exciting finding as it suggests that it is only when teacher knowledge is combined with time on task that substantial learner learning can be expected to occur.

Table 3.5: Mean Grade 4 numeracy score by teacher knowledge and time spent teaching

	Teacher score <100%	Teacher score 100%	Total
Less than 18 hours spent teaching	30.1 (3 274)	34.8 (446)	30.6 (3 720)
More than 18 hours spent teaching	36.1 (5 416)	54.0 (763)	38.3 (6 179)
Total	33.8 (8 690)	46.9 (1 209)	35.4 (9 899)

Table 3.6: Mean numeracy gain (Grade 3 to 4) by teacher knowledge and time spent teaching

	Teacher score <100%	Teacher score 100%	Total
Less than 18 hours spent teaching	5.7 (3 274)	5.0 (446)	5.6 (3 720)
More than 18 hours spent teaching	7.1 (5 416)	10.6 (763)	7.5 (6 179)
Total	6.5 (8 690)	8.6 (1 209)	6.8 (9 899)

Note: Number of observations is shown in parentheses.

Again, a word of caution regarding the interpretation of Tables 5 and 6 is necessary. It is likely that most of the more affluent schools are located in the cell for 'teacher score 100%' and 'more than 18 hours spent teaching'. Therefore, a multivariate analysis conditional upon socio-economic status is needed to test whether these teacher characteristics directly affect learning or whether they should rather be interpreted as representative of a constellation of features and practices that characterise the better-functioning part of the school system. The difference is subtle but the two interpretations have divergent policy implications. This point will be expanded upon later in this chapter and in Chapter 10.

Another issue that receives a lot of attention anecdotally and in the media is teacher absenteeism. Very little research, however, has found a demonstrable link between teacher absenteeism and learner achievement in South African schools. One reason for this is that most surveys rely on self-reports of absenteeism, which are unlikely to be accurate amongst teachers who are frequently absent. The NSES used a different approach by recording the number of teachers absent on the day of the survey. Taking this value as a proportion of the total number of teachers at each school it was possible to derive the percentage of teachers absent on the day of the visit. This is not necessarily a fair reflection of typical teacher absenteeism in any particular school, but it is at least a hard measure and, when averages across the full sample of schools are used, provides an interesting picture. Table 7 shows an interaction between the proportion of teachers absent on the day of the visit and the state of teacher attendance registers. The state of attendance registers says something about the organisational efficiency within schools and reflects how seriously teacher attendance is taken by the school management. The table demonstrates that teacher absenteeism was approximately twice as high in schools where the teacher attendance register was not up-to-date. This demonstrates that teacher absenteeism reflects more than merely the commitment of individual teachers themselves but is also reflective of the quality of school leadership and organisation.

Absenteeism

Table 3.7: Teacher absenteeism by state of teacher attendance register

	Percentage absent	Number of schools
Register not up-to-date	20.5	51
Register up-to-date	10.2	191

The documentary review also assessed the quality of inventories for textbooks and other learning support materials in schools. This provides another indicator of the organisational efficiency within schools. Table 8

shows how learner performance was associated with both the presence and completeness of book inventories. It is evident that learners in schools where inventories were both available and up-to-date performed better and achieved the highest gains from Grade 3 to Grade 4. This could arise because good management of school resources positively *affects* learning or because efficient management of learning materials is a *sign* of a good school. It is likely that a combination of these possibilities underlies the association evident in Table 8. For this variable, as for many others discussed in this section, a better assessment of its impact is achievable through multivariate analysis. This is the focus of the next section.

Table 3.8: Student performance by state of school book inventories

	Mean numeracy (Grade 4)	Mean numeracy gain (Grade 3 to 4)	Mean literacy (Grade 4)	Mean literacy gain (Grade 3 to 4)	Number of schools
No inventory available	33.1	5.0	25.3	7.2	126
Inventory incomplete	33.4	6.7	24.7	6.9	60
Inventory up-to-date	41.4	7.3	31.6	7.7	69

Multivariate analysis

The descriptive analysis presented above is useful to highlight broad trends in the data. However, the limitation of this descriptive analysis is that other factors not shown could be driving the observed patterns. For example, an observed pattern of better learner achievement in schools with well-organised inventories of books might be caused by the fact that school socio-economic status is correlated with the quality of inventories and that socio-economic status is the important determinant of achievement. The need for a multivariate analysis to isolate the impacts of such factors is clear.

Multivariate analyses of the determinants of learner achievement, usually in the form of regression analysis of one sort or another, are typically referred to as 'Education production functions'. The term is appropriated from economic models of industrial production, in which various inputs such as capital and labour are related to output. Although this analogy has connotations suggesting an overly simplistic link between inputs and outputs, the education

production function remains a useful statistical method for analysing the relative importance of various learner, school and teacher characteristics and practices in determining learner achievement. Education production functions predict cognitive skills based on individual characteristics, such as home background, measures of school quality, which can include resources, organisational practices, pedagogical methods and teacher characteristics, amongst others. This holds potential for addressing an important policy question: After accounting for the influence of socio-economic status, what school and teacher characteristics are associated with learner achievement? Or, put differently, what distinguishes better- and worse-performing schools within communities that are similarly poor or wealthy?

The results of education production functions should be interpreted with caution, as there are numerous potential sources of bias, as Paul Glewwe (2002) discusses. He therefore recommends an approach that sets out to gather as much evidence as possible and then make overall judgements based on various estimations of production functions. Several models, using different techniques and exclusion restrictions, are presented in this chapter.[1] The first models presented are cross-section models explaining achievement at one point in time in Grade 4 literacy and Grade 4 numeracy respectively. Separate models in which the sample was restricted to learners in historically black schools are also presented. Thereafter, the learning gains from Grade 3 to Grade 5 are modelled using slightly more complex methods. A description of all explanatory variables that were used in this analysis is presented in an Appendix.

Three categories of explanatory variables were included: Student characteristics were obtained from the learner questionnaires; school characteristics were obtained from the questionnaire completed by the school principal, and teacher characteristics were obtained from the teacher questionnaire. In arriving at the final models presented here, an iterative process was followed in which numerous other variables were included, but only those that proved to be importantly related to learning achievement were retained.

Table 9 reports the results of two Ordinary Least Squares (OLS) regression models that predict literacy achievement in Grade 4 (2008).[2] The first model is for the full sample of learners while the second model is restricted to include only learners attending historically black schools. The way to interpret each coefficient reported in the Table depends on whether the explanatory variable under consideration is a continuous variable or a binary (or 'dummy') variable. This information is provided in the Appendix. For example, Student SES is a continuous variable with a standard deviation of one. In the full model reported in Table 10 the coefficient on 'Student SES' is 0.39. This means that, after controlling for all the other explanatory variables in the model, a one

standard deviation increase in Student SES is associated with an improvement of 0.39 percentage points in Grade 4 literacy achievement. 'Household size: large' on the other hand is a dummy variable taking a value of either one (the student comes from a large household) or zero (the student comes from a small household). Under the full model in Table 10, the coefficient of -1.89 indicates that being in a large household is associated with Grade 4 literacy achievement that is 1.89 percentage points less than that for students coming from small households.

The set of learner characteristics that was associated with literacy and numeracy achievement was remarkably consistent across the various models shown in this chapter. One exception was the number of books at home, which was sensitive to model specification and was only a significant predictor of achievement in some models. However, learner socio-economic status, age, household size, frequency of reading on one's own at home, home language and exposure to English were consistently important learner characteristics to include in the models.

Table 3.9: Education Production Function for Grade 4 literacy scores (2008)

Explanatory variables	All schools	Historically black
Student characteristics		
Student SES	0.39*	0.28
Male	–2.48***	–2.30***
Young	–0.40	–0.49
Old	–2.84***	–2.73***
Household size: large	–1.89***	–1.11**
Read 1 to 3 times a week	1.37**	1.21**
Read more than 3 times	2.39***	1.96**
Books at home: 1 to 10	0.60	
Books at home > 10	1.17*	
Home language English	8.42***	
Speak English 1–3 times	1.75***	1.95***
Speak English 4+	1.86**	1.55~
English on TV 1–3 times	0.85*	0.92*
English on TV 4+	3.35***	3.04***
School characteristics		
Mean School SES	–9.13***	–5.11*
Mean School SES squared	3.35***	2.09**
Pupil-teacher ratio	–0.18**	–0.01

Students per Grade 4 classroom		–0.04*
Teacher absenteeism zero	1.93*	2.10*
Book Inventory good	1.66*	
Problems with learners index	–0.96*	
No timetable available		–3.04*
Curriculum planned using year schedule	1.46~	
Teacher characteristics		
Full year learning programme	1.55~	
Time spent on assessment: low		1.15
Time spent on assessment: high		3.59**
Time spent on assessment: very high		0.08
Constant	29.69***	27.77***
R-squared statistic	0.4591	0.1869
N	10 860	8868

Note: ~ p<0.10, * p<0.05, ** p<0.01, *** p<0.001.
P < 0.10 means that the chance of the estimated effect actually being effectively equal to zero is less than 10%. When this is true, one says that the estimated coefficient is statistically significant at the 10% level of confidence.

Note: The regressions included dummy variables for the provinces but the coefficients on these are not reported in the table. Also, dummy variables controlling for non-response were included for the following characteristics: household size, frequency of reading at home on one's own, frequency of speaking English at home, frequency of hearing English on television, teacher absenteeism, whether the teacher has a learning programme for the full year and the time spent on assessment.

It is interesting to note which aspects of home background were not associated with achievement under the models in this section. Family structure, as measured by the number of parents present at home, was not significantly associated with achievement in any of the models that were estimated. This does not necessarily mean that it does not matter, as the effect of family

structure may be contained within the effect of learner socio-economic status. Another variable that one might have expected to influence achievement was the availability of help with homework from an adult at home. However, this variable also was not significantly associated with achievement in the multivariate analysis. Similarly, there was no significant effect of reading with an adult at home. Yet, children who reported reading on their own at home performed better than those who did not, conditional upon all the other characteristics. As Table 9 shows, this positive effect was greatest for those who read on their own at home at least four times a week. This effect was also observed in the model restricted to learners attending historically black schools. This points to the importance of early reading activities in providing a foundation for learning within this part of the school system.

Male learners performed worse than females and this effect was consistent in all the models. Students who were older than the norm also performed worse in all the models. Students whose home language was English had a performance advantage over other learners, which is unsurprising given that the tests were in English and that those speaking English as a home language tend to be more affluent than average. A consistent pattern that emerged was that greater exposure to English through speaking and hearing English on the television was associated with higher achievement even after controlling for home language. Apart from the obvious language proficiency effect, the possibility exists that this result may be picking up a further effect of socio-economic status: those who have televisions at home and frequently speak English outside school may also be more affluent. Nevertheless, even when the model was restricted to historically black schools a positive effect of greater exposure to English was obtained.

Student socio-economic status was itself significantly associated with literacy achievement in 2008, although a more substantial impact was attributable to the mean of school socio-economic status (and the square thereof). The positive coefficient on the squared term indicates that school socio-economic status has a stronger effect on achievement at higher levels of school socio-economic status. As suggested in Chapter 2, the major impact of learner socio-economic status may therefore be through determining selection into schools of differential socio-economic status (and associated quality). This is consistent with the fact that in the models for historically black schools only learner socio-economic status was not significantly associated with achievement after controlling for the other characteristics. Once children are enrolled in the historically black part of the system, their own socio-economic status has little further effect on their achievement.

The learner-teacher ratio was statistically significant in both the full sample models for literacy and numeracy (Table 11) with small to moderate effect sizes. This ratio of learners to teachers in a school is essentially a resource measure.

However, an arguably more important factor for learning is the actual number of learners in a class at any point in time, which is dependent on both the learner-teacher ratio and the way teachers are managed within the timetable. Research has demonstrated that excessively large classes in South Africa are largely a result of poor school management rather than resource shortages (Gustafsson and Patel, 2009). Unfortunately the NSES did not capture class size in this way. Another factor that may contribute to large classes despite acceptable learner-teacher ratios is a shortage of physical classrooms. It is interesting that the learner-teacher ratio was not significantly associated with either literacy or numeracy achievement within the historically black models but that the ratio of Grade 4 learners to classrooms was related to achievement within this sub-sample (at least in the case of literacy). Having made these observations, the information on class size in the NSES is too limited for any strong conclusions to be drawn based on this analysis.

In both the literacy and numeracy models a positive effect was obtained for schools in which no teachers were absent on the day of the survey. Although this once-off measurement may not reflect teacher absenteeism accurately over a longer period, it avoids the response bias and subjectivity often present when teachers and school principals are asked about the severity of teacher absenteeism. Moreover, the fact that this variable is significantly associated with achievement in these models indicates that it is probably capturing teacher absenteeism, and perhaps even school organisation and professional work ethic more generally, although with a certain degree of measurement error.

The coefficient on the dummy variable for schools having an inventory for books that is present and up-to-date was positive and significant in the model for literacy. This is a good indicator of how well resources are managed and used by schools. An index derived from a number of questions about problems with learner behaviour was negatively associated with literacy achievement. However, this variable was not consistently associated with achievement in most other models – both those reported in this chapter and those reported elsewhere (Taylor, 2010, Taylor, 2011).

A positive effect was obtained for schools in which curriculum planning was reportedly done using a year schedule. School principals were read a list of ways in which curriculum planning might be undertaken and asked to identify which of those were practised in their schools. The options were not mutually exclusive. The variables for the quality of book inventories and for curriculum planning with a year schedule did not emerge as significant predictors of achievement when the sample was restricted to historically black schools. The fact that these variables come through in the full sample model but not in the restricted model may mean that these variables are indicative of the sort of planning and organisation that distinguishes more effective schools from less

effective ones, but that these variables themselves are not levers that guarantee better learner achievement.

Only one variable from the teacher instrument was associated with literacy achievement in the model for the full sample: a dummy variable indicating that a full-year learning programme was seen by the fieldworker. It would be unwise to conclude from this result that learner achievement will improve by the size of the coefficient if teachers planned the learning programme for the full year. Rather, this variable should be regarded as a proxy for teacher organisation and preparation in general.

It is noteworthy that many other teacher characteristics did not warrant inclusion in the model for literacy achievement. In particular, teacher knowledge as measured by the short comprehension test was not significantly associated with learner achievement after controlling for all the other variables in the model. This may be simply a consequence of the short test not adequately differentiating between teachers with varying degrees of subject knowledge. One variable that warranted inclusion in the literacy model for historically black schools was the time spent by teachers on assessment. Those teachers who reportedly spent between three and five hours a week on assessment related tasks produced better learner achievement than those who spent less time or more time (probably a counterproductive or unrealistic amount of time) on assessment. This finding should be considered in the light of other research that has revealed that assessment practices in many historically black schools are weak (Van der Berg and Shepherd, 2010; Lam, Ardington and Leibbrandt, 2010).

One albeit crude way of translating these regression results into something more tangible is to consider what effects various improvements in school and teacher characteristics could have on the national average of literacy achievement. The mean literacy score in 2008 for the sample of learners that was included in the full sample literacy model was 26.57%. Table 10 shows the predicted changes to this sample mean associated with changing the entire sample of schools to have the positive value of the school and teacher characteristics that emerged as important in the literacy model. The largest effect on the sample mean was predicted for changing schools in which some teachers were absent (on the day of the survey) to having no teachers absent. Of course, it is unrealistic always to maintain zero absenteeism. This calculation should rather be interpreted as the predicted change in the national average associated with improving teacher attendance in general (and improving whatever organisational characteristics for which this variable is acting as a proxy) in the 'some teachers absent' group of schools to the level at which it is in the 'zero teacher absenteeism' group. The combined effect of improving these characteristics under the model parameters would be to raise the mean

sample average by 3.29 percentage points, a relatively large increase given the generally low scores on the test.

The combined effect of these characteristics is the more relevant figure as none of the individual characteristics should be conceived of as inputs that will yield the exact outcomes predicted by the models, but rather as indicators of the underlying concepts of school and teacher effectiveness. A further technical caveat regarding the estimates in Table 10 is that regression coefficients represent the predicted effect holding all other variables in the model constant. Therefore, strictly speaking one cannot estimate the combined effect as is done in Table 10 because changing one variable would alter the estimated coefficients for all the others. However, the exercise seems useful not for the sake of technical exactness but rather for extracting a rough sense of magnitude from the regression results.

Table 3.10: Estimated effects of improving selected management characteristics on the literacy national average (Original sample mean = 26.57%)

	Predicted new mean	Gain
Teacher absenteeism zero	27.84	1.27
Book Inventory good	27.36	0.79
Curriculum planned using year schedule	27.18	0.61
Full year learning programme	27.18	0.61
Combined effect of improved characteristics	29.85	3.29

The estimated effects of learner characteristics in the model for Grade 4 numeracy achievement (Table 11) were very similar to those in the literacy model, although the number of books at home was not associated with numeracy achievement. Otherwise, conditional upon all other factors in the models, those who reported having more than two siblings did worse than those in smaller households; those who read frequently at home on their own did better; and those who were more frequently exposed to English also did better. Interestingly, the coefficient on learner socio-economic status was not significantly different from zero in the numeracy model. This is further evidence of the weak influence of home socio-economic status after school mean socio-economic status has been accounted for.

Table 3.11: Education Production Function for Grade 4 numeracy scores (2008)

Explanatory variables	All schools	Historically black
Student characteristics		
Student SES	0.26	0.13
Male	–1.13**	–1.07**
Young	–0.07	–0.36
Old	–3.99***	–3.64***
Household size: large	–2.37***	–1.05
Read 1 to 3 times a week	3.49***	3.21***
Read more than 3 times	4.97***	4.32***
Home language English	9.87***	
Speak English 1-3 times	2.43***	2.19**
Speak English 4+	2.01~	0.69
English on TV 1-3 times	0.66	0.54
English on TV 4+	4.50***	3.77***
School characteristics		
Mean School SES	–16.89***	–8.91~
Mean School SES squared	4.88***	2.46~
Pupil-teacher ratio	–0.38***	–0.16
Media and Communication facilities index	2.45*	2.17*
Assessment record keeping good	0.25	0.34
Assessment record keeping poor	–2.79	–2.29
Assessment record keeping very poor	–4.87*	–4.88*
No timetable available	–4.87*	
Teacher absenteeism zero	2.74*	3.03~
Teacher characteristics		
Maths teacher test score: 100%	2.99~	
Maths topics covered: 25 plus	4.69**	5.81***
Constant	50.05***	35.10***
R-squared statistic	0.4223	0.1691
N	11383	8838

Note: ~ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Note: The regressions included dummy variables for the provinces but the coefficients on these are not reported in the table. Also, dummy variables controlling for non-response were included for the following characteristics: Household size, frequency of reading at home on one's own, frequency of speaking English at home, frequency of hearing English on television, teacher absenteeism, teacher mathematics test result and the number of mathematics topics covered.

As in the literacy models, variables reflecting the availability of school resources did not emerge as important drivers of achievement. Nevertheless, a composite index for the availability and quality of various media and communication facilities, such as projectors and copying facilities, was significantly associated with numeracy achievement. The evidence for this effect was, however, mixed and was sensitive to model specification.

In all of these models, school resource variables were less consistently related to achievement than were variables that can be thought of as indicators of effective school management. For example, in 15 schools no timetable was available for the fieldworker to observe, and learners in these schools indeed performed worse controlling for other factors in the numeracy model. A school timetable is supposed to be a crucial and ever-present feature in the daily running of a school. It is therefore reasonable to regard not having an easily accessible timetable as a flag for a dysfunctional school. The dummy variable for zero teacher absenteeism on the day of the survey also came through strongly in the numeracy model. Although the book inventory dummy did not warrant inclusion in this model, another indicator of school organisation did emerge as significant: the quality of assessment records. Students in schools where the quality of assessment records was very poor, did worse than those in schools where these were both present and up-to-date.

In contrast to the literacy model, a significant effect of teacher knowledge was obtained in the model for numeracy. A learner achievement advantage of slightly less than three percentage points was associated with a score on the teacher mathematics test of 100%. No significant differences in achievement were associated with variations in teacher knowledge below 100%. Sound teacher knowledge therefore seems necessary before any noticeable impact on learner achievement accrues. There was also a reasonably large, positive and significant effect associated with having covered more than 25 curriculum topics, as identified in learner workbooks. The number of topics can therefore be considered a good indicator of curriculum coverage and, more fundamentally, of the amount of work that is being undertaken in classes. This aspect of classroom practice clearly has an important impact on learner achievement. From a policy perspective, this is perhaps also a measure that should be monitored by curriculum advisors, especially with the recently introduced

colour-printed DBE workbooks that should allow for easier monitoring and greater comparability across schools.

The predicted effects of improvements in the school and teacher characteristics on the national average were greater for numeracy than for literacy. As Table 12 shows, the national average could be expected to improve most substantially in response to raising teacher knowledge and curriculum coverage across the system. The combined effect of a universal attainment of positive values on the indicators of school and teacher quality in the model would be to raise the Grade 4 numeracy national average from 34.21% to 42.29%.

Table 3.12: Estimated effects of improving selected characteristics on the numeracy national average (Original sample mean = 34.21%)

	Predicted new mean	Gain
Assessment record keeping	35.08	0.87
No timetable available	34.45	0.24
Teacher absenteeism zero	36.01	1.80
Maths teacher test score: 100%	36.38	2.17
Maths topics covered: 25 plus	37.20	3.00
Combined effect of improved characteristics	42.29	8.08

The remainder of this section presents education production functions for literacy and numeracy using the gain score from Grade 3 to Grade 5 as the outcome variable. These models make use of learner, school and teacher information from the 2008 and 2009 questionnaires, seeing as the outcome variable is a reflection of what happened in these two years.

Using gain scores has the advantage over single cross-sections of achievement because unobservable influences such as innate ability and prior influences such as an excellent pre-school exposure should now, to a large extent, be reflected in the baseline score (in this case Grade 3 achievement). The amount of learning during a given time interval can be explained by observable influences, such as school practices, during that time interval. However, gain scores can also suffer certain weaknesses, especially when the pre- and post-test were not far apart in time.

In the NSES there is a tendency for especially low or high learner scores in 2007 to be followed by scores of the same individuals that are closer to the sample mean in subsequent tests. This happens because with each individual test score there is a degree of random error around a hypothetical true

mean, which would accurately reflect the individual's true proficiency. If an individual were tested a sufficient number of times this true mean would become evident. A large proportion of the NSES tests were multiple-choice questions. This means that the measurement error at the bottom end of test scores would be particularly prevalent. It is therefore likely that a very low score represents an underestimation of that individual's hypothetical true mean, and that a repeat test would yield a higher score even if no learning has taken place in the interim. This phenomenon of regression to the mean would result in overestimation of gain scores at the low end of initial test scores and underestimation of gain scores amongst the initially high achieving learners. There is also a 'ceiling effect' contributing to the underestimation of learning amongst high-performing learners. A learner scoring 80% in Grade 3 has less room to improve than a learner scoring 30%.

The data confirm that to some extent regression to the mean and the so-called 'ceiling effect' did affect NSES gain scores. Amongst the worst-performing 10% of learners in Grade 3 numeracy, the average gain over two years was 34.3 percentage points. Amongst the top-performing 10% of learners in Grade 3 numeracy, the average gain over two years was only 2.8 percentage points. It would be foolish to interpret this as evidence that those who were performing well in Grade 3 did not learn much in the next two years but that those who were performing poorly learnt a lot. Instead, the combination of regression to the mean and the ceiling effect creates a bias that needs somehow to be dealt with.

The model design begins with the assumption that learning between Grade 3 and Grade 5 depends on a learner's proficiency to learn (which reflects innate ability as well as all influences prior to the pre-test) and all environmental influences during the period (which include observed home, school and teacher characteristics). Therefore, in the model for literacy gains the learner's Grade 3 numeracy score is included as a proxy for proficiency to learn. In addition, the Grade 3 literacy score is included in the model to control for regression to the mean and the ceiling effect. The way these two variables are expected to interact is as follows: if two learners of identical ability were to score differently on the pre-test, one would expect a lower gain for the learner who had initially scored higher. In an estimated regression one would therefore expect a negative coefficient on the control for regression to the mean. Similarly, for two learners with the same Grade 3 literacy score one would expect the gain to be higher for learners of greater proficiency and in an estimated regression one would therefore expect a positive coefficient on the Grade 3 numeracy score.

Table 13 reports the results of an education production model for the two-year literacy gain. The coefficients on the proficiency control and the control for regression to the mean are exactly as expected. With these two variables

controlled for, the likelihood is reduced of those characteristics associated with effective schools appearing to influence gain scores negatively due to lower gain scores at the high end of achievement.

The learner characteristics that were associated with literacy gains were largely consistent with those that were important in the earlier models. Student socio-economic status, although not significantly related to gains, was included as this is a standard control in education production functions. Gender, age and exposure to English through speaking at home and through television once again emerged as important predictors of learning.

As in the earlier models, resource variables were not strongly related to learning gains. Only a facilities index capturing the presence of functionality of various school facilities was significantly associated with literacy gains, and the magnitude of the effect was fairly small. Class size (measured as the number of learners enrolled in the school divided by the number of register classes) was significantly associated with learning. The coefficient on the squared term was positive indicating that marginal changes in class size are associated with smaller changes in predicted gains at higher levels of class size. It should be mentioned that the estimated effect of reducing class size is fairly small relative to the budgetary implications of doing so. For example, reducing the class size from 42 learners to 30 learners is associated with an increase in the predicted gain score of only about one percentage point.

Five variables that can be considered as indicators of management and teaching practice were significantly related to literacy gains: teacher punctuality, whether the principal was absent on the day of the survey, teacher assessment records showing more than two English marks, paragraph writing and the number of literacy exercises observed in learner workbooks. Teacher punctuality and principal absenteeism reflect the quality of management and leadership present within a school, while ensuring that paragraph writing and other written exercises are undertaken is a reflection of teacher practice, but also of the instructional leadership within the school.

Although teacher performance in the comprehension test was not significantly associated with learning gains in the above model, another model (not reported here) in which the sample was restricted to learners in historically black schools did suggest a significant relationship. The association of teacher content knowledge with learning for each historically different part of the school system is described in Figure 6. In this case the measure of teacher content knowledge is calculated as a combination of the test performance of both mathematics and English teachers that taught each learner in both 2008 and 2009. This measure therefore reflects the content knowledge of teachers in each school rather than that of an individual teacher. The maximum score on this derived measure is therefore 24 marks. Arguably, this is a more informative measure than any of the short teacher tests provide in isolation. The figure

shows the mean literacy gain (as well as 95% confidence intervals) for learners with teacher knowledge at least 18 out of 24 (good knowledge) versus those with weaker teachers. This is shown separately by institutional history. Teacher content knowledge appears to be related to literacy gains within the historically black schools but not within the rest of the system. This result requires further investigation as it is not immediately clear why this should be the case.

Table 3.13: Education Production Function for literacy gains (2007 TO 2009)

Explanatory variables	Coefficients
Student characteristics	
Grade 3 numeracy score (proficiency control)	0.18***
Grade 3 literacy score (rtm control)	–0.69***
Student SES	0.31
Male	–2.80***
Young	–1.42
Old	–3.77***
Speak English 1-3 times a week	1.55***
Speak English 4+	4.70***
English on TV 4+	3.90***
School characteristics	
Mean school SES	1.80***
Facilities index (2008)	0.24*
Class size	–0.25**
Class size squared	0.0023**
Principal absent	–1.97*
Teacher punctuality good	2.52***
More than 2 English mark records	2.13**
Teacher characteristics	
Paragraph writing: none	–3.62***
Literacy exercises: more than 27	3.33***
Constant	22.09***
R-squared	0.3336
Number of Observations	8282

Note: ~ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Note: The regression included dummy variables controlling for non-response for the following characteristics: gender, age, frequency of speaking English at home, frequency of hearing English on television, paragraph writing and the number of literacy exercises.

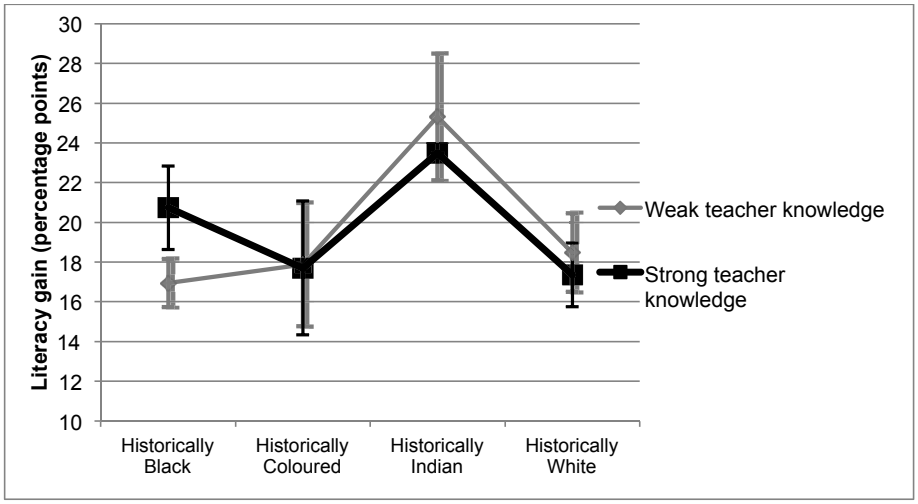

Figure 3.6: Mean literacy gain and 95% Confidence Intervals by combined teacher knowledge index (standard errors adjusted for clustering in schools & sampling weights)

The results of the numeracy gains model are presented in Table 14. Although the familiar demographic and home variables had similar effects as in earlier models, this model points to several factors that may have specific importance in numeracy. Students who reportedly received mathematics homework more than three times a week gained more than other learners. Learners in schools where there was a shortage of mathematics textbooks learned less than those in schools with good availability of textbooks. These two variables were not associated with literacy achievement or literacy gains and may therefore be specifically important for mathematics learning.

Three indicators of school management were significantly associated with numeracy gains. Learners in schools in which a timetable was readily available achieved considerably higher gains than those in schools where a timetable was not available. Teacher punctuality was also associated with more learning. Combining classes when the teachers are absent was associated with less learning. If schools do not arrange a replacement teacher or ensure that teachers with free periods fill in for the absent teacher this may be a sign of poor instructional leadership.

The coverage of various types of exercises as observed in learner workbooks was strongly associated with numeracy gains. The model presented here includes the frequency with which more than five short exercises were conducted in one day and the total number of exercises observed. However, when these variables were replaced with others such as the number of complex exercises or the proportion of learning outcomes covered these other variables also were significantly associated with learning. The point is that simply doing sufficient exercises and covering curriculum in class is very important for mathematics learning.

Table 3.14: Education Production Function for numeracy gains (2007 TO 2009)

Explanatory variables	Coefficients
Student Characteristics	
Grade 3 literacy score (proficiency control)	0.12***
Grade 3 numeracy score (rtm control)	–0.58***
Student SES	–0.10
Student SES squared	–0.05
Male	–0.29
Young	–1.36
Old	–5.21***
Homework: more than 3 times a week	0.93*
Speak English 1-3 times a week	2.12***
Speak English 4+	1.86*
English on TV 1-3 times a week	–0.2
English on TV 4+	3.45***
School characteristics	
Mean school SES	–2.63
Mean school SES squared	0.86
Timetable available (2009)	6.85***
Class size	–0.28*
Class size squared	0.0027*
Teacher punctuality good	2.07~
Availability of textbooks: very poor	–2.61~
Teacher sick: combine classes	–2.00*
Teacher characteristics	
Teacher content knowledge: bad	–3.46*
Time spent on assessment: 1-2 hours	1.44

Time spent on assessment: 2-5 hours	3.84*
Time spent on assessment: 5-7.5 hours	1.55
Time spent on assessment: more than 7.5 hours	0.18
Short exercises 2008 (>5 per day): 5 - 13	2.61
Short exercises 2008 (>5 per day): 14 - 23	3.08
Short exercises 2008 (>5 per day): 24 - 45	2.55
Short exercises 2008 (>5 per day): 46 or more	5.43*
Number of all mathematics exercises 2009: 36 - 45	–3.02
Number of all mathematics exercises 2009: 46 – 58	–0.41
Number of all mathematics exercises 2009: 59 – 75	3.05
Number of all mathematics exercises 2009: 76 – 155	5.15*
Number of all mathematics exercises 2009: 156+	7.93**
Number of class tests 2009: 1 or 2	2.86
Number of class tests 2009: 3 or 4	1.64
Number of class tests 2009: 5 – 9	2.95
Number of class tests 2009: more than 9	7.36**
Constant	24.61***
R-squared	0.4017
Number of Observations	8282

Note: ~ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Note: The regression included dummy variables controlling for non-response for the following characteristics: gender, age, frequency of homework, frequency of speaking English at home, frequency of hearing English on television, the presence of a timetable, teacher knowledge, time spent on assessment, the number of short exercises, the number of all mathematics exercises and the number of class tests.

Assessment practices also appear to have a more prominent effect on numeracy than on literacy. Teachers who spent a reasonable amount of time on assessment and who frequently administered class tests produced greater numeracy gains. This all confirms what seems intuitively obvious but what has been sadly lacking in many South African classrooms: frequent practice is crucial in learning mathematics.

In the numeracy gains model very poor teacher content knowledge was associated with less learning. Whereas the cross-sectional model of Grade 4 numeracy achievement suggested that only sound teacher knowledge is

linked to better achievement and that variations in teacher knowledge at lower levels are not associated with differences in learner achievement, evidence from the gains model shown in Table 14 indicates that there is a difference in the numeracy gains between those taught by teachers with ordinary content knowledge and those taught by teachers with very weak content knowledge.

Tables 15 and 16 shed further light on the impact of teacher content knowledge. Table 15 shows the average numeracy gains for each decile of Grade 3 numeracy scores. The table clearly demonstrates the effects of regression to the mean and the 'ceiling effect' – the gains become smaller at higher levels of Grade 3 achievement. Table 16 shows, for each quartile of teacher content knowledge, the average learner baseline-numeracy achievement and the average learner 2-year gain. It is evident that those taught by teachers with better content knowledge had higher baseline scores on average. Interestingly, the average gain was lowest for those taught by the bottom-performing 25% of teachers despite the fact that their low baseline scores leave more room for improvement than those in the other categories. The average baseline achievement for those taught by the top-performing 25% of teachers was similar to that of the ninth decile of Grade 3 achievement. Whereas the average gain was 5.7 percentage points for those in the ninth decile of Grade 3 achievement those taught by teachers with good content knowledge gained 17.9 percentage points from similar levels of baseline achievement. This is remarkably high given the ceiling effect faced by those with initially high achievement.

Table 3.15: Initial numeracy achievement and numeracy gains

Deciles of Grade 3 numeracy	Average Grade 3 numeracy	Average 2 year numeracy gain (percentage points)
1	1.3	34.3
2	7.7	25.3
3	12.2	22.6
4	16.9	21.7
5	22.5	20.8
6	28.1	17.3
7	34.6	15.7
8	43.1	11.4
9	55.9	5.7
10	78.0	2.8

Table 3.16: Initial numeracy achievement and numeracy gains by teacher knowledge

Quartiles of teacher knowledge	Average Grade 3 numeracy	Average 2 year numeracy gain (percentage points)
1	23.1	16.4
2	26.0	18.6
3	29.7	21.3
4	50.4	17.9

Conclusion

This chapter has used several modelling strategies in order to build an understanding of how the numerous factors influencing learner achievement in South Africa operate together. There have been models for literacy and models for numeracy; models for the full sample of South African learners and models for the historically black sub-system; models for achievement at one point in time and models for learning over time. Consequently, a lot of results have been presented. It is therefore worth summarising some of the major conclusions that these various models have converged upon.

One learner characteristic that is consistently related to achievement is age. Those who are over-aged for their grade performed worse and learnt less over the two-year period of observation. This result has not been dwelt on in this chapter because it is not clear what this means. It could mean that entering school late leads to worse outcomes, or that repetition leads to worse outcomes, or that those with worse outcomes tend to repeat and thus become over-aged. Chapter 9 teases out these issues at greater length.

Age

The context of multiple languages in South Africa creates a disadvantage for many learners, and a situation in which the right policies around language of instruction are not immediately obvious. What this chapter has demonstrated, though, is that frequent exposure to English outside of school for those whose home language is not English or Afrikaans is beneficial for both their literacy and numeracy.

Socio-economic status remains the most important determinant of educational outcomes in South Africa. The models presented here indicated that the mean socio-economic status within the school attended by a child is more important for learning than the child's own home background. One interpretation of this is that socio-economic status impacts on educational outcomes in South Africa through a two-step process, in which the first step is the decisive one: Learner socio-economic status largely determines the quality

of school to which learners gain access; thereafter a learner's socio-economic background has a limited further influence on achievement compared with that of the school mean socio-economic status.

School resource variables were typically not important determinants of achievement. Rather, indicators of effective school management were consistently related to learning outcomes. This is in line with other research suggesting that the impact of school resources is conditional upon those resources being well managed (Van der Berg, 2008). The models provide evidence that good assessment practices, teacher commitment and planning, teacher knowledge and effective curriculum coverage vary substantially across South African schools and are strongly linked to educational achievement. The specific indicators of effective management and teaching identified here should, however, not be interpreted as more than exactly that: *indicators* that point to the characteristics typically exhibited by good managers and teachers, rather than levers to be manipulated by policy to achieve improved learner outcomes. Command and control measures aimed at forcing teachers to follow best practices may well empty such practices of their value through introducing the perverse incentive to window-dress those practices at the expense of focusing on the central task of teaching. A better and indeed more ambitious route for policy would be to explore ways to attract, train and support better teachers and principals, and to create an environment of accountability and support in order to encourage and empower better teaching and school leadership.

Form & subs

The next chapters examine in more detail some of the factors demonstrated by the multivariate modelling to be important drivers of educational achievement, beginning with school management which creates an enabling environment for teaching and learning.

[1]It should be noted that the statistical methods employed here do not prove causality. Instead, the strictly correct way to interpret the results of the multivariate models is that certain variables are 'associated' with learning outcomes. However, the assumption is made that if, after controlling for other important covariates, one consistently observes associations that can be supported by a plausible theory of change, then these observed associations are likely to be broadly representative of a causal relationship.

[2]In all the OLS regressions in this chapter the method of survey regression was used to account for complex sample design. The stratum variable was province (of which there were eight due to the non-participation of Gauteng in the NSES), the Primary Sampling Unit (PSU) was the school (of which there were 266) and a person weight for each student, which differed only by province, was specified.

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Appendix: Description of variables used in multivariate analysis

Table 3.17: Student level variables (Student questionnaires of 2007, 2008 and 2009)

Variable name	Description
Student SES	Z-score index of socio-economic status: Min = 0, std dev = 1
Male	Dummy variable: gender is male; reference category is female
Young	Dummy variable: Younger than 10 years
Age 10	Dummy variable: Expected age at Grade 4: 10 years
Old	Dummy variable: Older than 10 years
Household size: large	Dummy variable: Learner has 4 or more siblings
Read 1 to 3 times a week	Dummy variable: Learner reads 1 – 3 times a week on his/her own
Read more than 3 times a week	Dummy variable: Learner reads more than 3 times a week on his/her own
Books at home: 1 to 10	Dummy variable: Between 1 and 10 books at learner's home
Books at home > 10	Dummy variable: More than 10 books at learner's home
Home language English	Dummy variable: Learner's home language is English
Speak English 1-3 times	Dummy variable: Student speaks English at home 1 to 3 times a week (reference category is never)
Speak English 4+	Dummy variable: Student speaks English at home more than 3 times a week (reference category is never)
English on TV 1–3 times	Dummy variable: Student hears English on TV 1 to 3 times a week
English on TV 4+	Dummy variable: Student hears English on TV more than 3 times a week
Homework: more than 3 times a week	Dummy variable: Learner reports receiving homework more than 3 times a week

Table 3.18: School level variables (Principal questionnaires of 2007, 2008 and 2009)

Variable name	Description
Mean School SES	Mean of learner SES within each school: Min = 0, std dev = 1
Facilities index	Summative index capturing the presence and functionality of the following school facilities: running water, electricity, storerooms, toilets, administrative offices, box libraries and science kits.
Pupil-teacher ratio	Ratio of learners to teachers in the entire school in 2008
Class size	The average number of learners per register class in each school according to school list
Students per Grade 4 classroom	Ratio of all Grade 4 learners to the number of classrooms for Grade 4
LTSM Inventory good	Dummy variable: LTSM inventory complete and up to date
Teacher absenteeism zero	Dummy variable: No teachers were absent on the day of the survey in 2008
Principal absent	Dummy variable: The principal was absent in either 2008 or 2009 on the day of the survey.
Teacher punctuality good	Dummy variable: in all three years the principal maintained that teacher punctuality was not a serious problem in the school
More than 2 English mark records	Dummy variable: More than 2 mark records observed during the Principal instrument document review.
No timetable available	Dummy variable: Timetable could not be presented to the fieldworker in 2008
Timetable available (2009)	Dummy variable: Timetable was presented to the fieldworker in 2009
Problems with learners index	Z-scored index combining several evaluations of the extent of problems with learner discipline and work ethic in the school in 2008 (mean = 0, std. dev = 1)
Curriculum planned using year schedule	Dummy variable: Principal reported that curriculum planning occurs using a year schedule (in 2008)

Media and Communication facilities index	Z-scored index for the presence and functionality of the following: phone, fax, internet/email, copying facility, computer for administration, computer for staff, computers for learners, TV/video and overhead projector (in 2008)
Assessment record keeping good	Dummy variable derived from a summative index combining a number of questions regarding the presence and completeness of assessment records
Assessment record keeping poor	Dummy variable derived from a summative index combining a number of questions regarding the presence and completeness of assessment records
Assessment record keeping very poor	Dummy variable derived from a summative index combining a number of questions regarding the presence and completeness of assessment records

Table 3.19: Teacher level variables (Teacher questionnaires of 2008 and 2009)

Variable name	Description
Paragraph writing: none	Dummy variable: No evidence could be found in learner workbooks of written exercises comprising paragraphs.
Literacy exercises: more than 27	Dummy variable: More than 27 exercises were counted in the 'best' learner's English workbook.
Maths teacher test score: 100%	Dummy variable: Maths teacher scored 5 out of 5 in the content knowledge test
Maths topics covered: 25 plus	Dummy variable: More than 25 mathematics topics covered according to fieldworker review of learner workbooks
Full year learning programme	Dummy variable: Fieldworker was shown a learning programme for the full year
Time spent on assessment: low	Dummy variable: English Teacher reported spending between one and three hours per week on assessment
Time spent on assessment: high	Dummy variable: English Teacher reported spending between three and five hours per week on assessment
Time spent on assessment: high	Dummy variable: English Teacher reported spending 5 hours or more per week on assessment
Availability of textbooks: very poor	Dummy variable derived from several questions about the availability of textbooks within the school

Teacher sick: combine classes	Dummy variable: Principal stated that classes are combined when a teacher is absent
Teacher content knowledge: bad	Dummy variable: Combining teacher test scores for mathematics and English teachers within the school in 2008 and 2009, teachers scored less than 11 out of 24 possible marks.
Time spent on assessment: 1–2 hours	Dummy variable: Maths Teacher reported spending between one and two hours per week on assessment
Time spent on assessment: 2–5 hours	Dummy variable: Maths Teacher reported spending between two and five hours per week on assessment
Time spent on assessment: 5-7.5 hours	Dummy variable: Maths Teacher reported spending between five and 7.5 hours per week on assessment
Time spent on assessment: more than 7.5 hours	Dummy variable: Maths Teacher reported spending more than 7.5 hours per week on assessment
Short exercises 2008 (>5 per day): 5 - 13	Dummy variable: Between 5 and 13 cases of short exercises (at least 5 in one day) were observed in learner mathematics workbooks
Short exercises 2008 (>5 per day): 14 - 23	Dummy variable: Between 14 and 23 cases of short exercises (at least 5 in one day) were observed in learner mathematics workbooks
Short exercises 2008 (>5 per day): 24 - 45	Dummy variable: Between 24 and 45 cases of short exercises (at least 5 in one day) were observed in learner mathematics workbooks
Short exercises 2008 (>5 per day): 46 or more	Dummy variable: More than 45 cases of short exercises (at least 5 in one day) were observed in learner mathematics workbooks
Number of all mathematics exercises 2009: 36 – 45	Dummy variable: Between 36 and 45 mathematics exercises were observed in learner mathematics workbooks in 2009
Number of all mathematics exercises 2009: 46 – 58	Dummy variable: Between 46 and 58 mathematics exercises were observed in learner mathematics workbooks in 2009

Number of all mathematics exercises 2009: 59 – 75	Dummy variable: Between 59 and 75 mathematics exercises were observed in learner mathematics workbooks in 2009
Number of all mathematics exercises 2009: 76 – 155	Dummy variable: Between 76 and 155 mathematics exercises were observed in learner mathematics workbooks in 2009
Number of all mathematics exercises 2009: 156+	Dummy variable: More than 155 mathematics exercises were observed in learner mathematics workbooks in 2009
Number of class tests 2009: 1 or 2	Dummy variable: Maths teacher produced evidence of between 1 and 2 class tests having occurred in the year
Number of class tests 2009: 3 or 4	Dummy variable: Maths teacher produced evidence of between 3 and 4 class tests having occurred in the year
Number of class tests 2009: 5 – 9	Dummy variable: Maths teacher produced evidence of between 5 and 9 class tests having occurred in the year
Number of class tests 2009: more than 9	Dummy variable: Maths teacher produced evidence of more than 9 class tests having occurred in the year

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Chapter 4

School leadership and management

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NSES results

The correlations revealed by our modelling exercises in the previous chapter in many instances provide only very blunt responses to questions like 'Is the presence of an annual curriculum plan associated with better learner test scores?' In the case of the NSES, the answer to this question is affirmative, but that tells us little about what is entailed in these planning practices: it seems likely that curriculum planning is one element in a constellation of activities undertaken by effective school leaders to lead, direct, monitor, and support learning. The useful knowledge that principals, system-level managers and policy makers need to understand is what that ensemble of practices consists of, and how it ranges across schools that produce stronger and weaker learning outcomes.

Large-scale surveys such as the NSES cannot capture the details of the school-level systems that drive curriculum delivery, nor of the relationships between staff that characterise effective schools. In order to investigate these important elements of school life and to gain a deeper understanding of those school leadership and management (SLM) practices that have the greatest effect on learning, we undertook a set of case studies in five matched pairs of schools. This study adopted a deductive approach, first visiting the SLM literature to identify the kinds of practices we might expect to find in better performing schools. Through these readings, we derived a set of hypotheses to provide theoretical coherence to the study and to guide the fieldwork. We look first at research conducted through large-scale surveys, and then examine the findings of case studies of school leadership.

Large scale quantitative studies of SLM

Mixed results

Although the literature on SLM has reached very significant proportions, efforts to establish links between leadership and learning through quantitative methods are, first, relatively rare (Leithwood and Wahlstrom, 2008). Second, the findings of such quantitative studies have generally found only weak to moderate effects (Hallinger and Heck, 1996; Witziers, Bosker, & Krüger, 2003; Marzano, Waters, & McNulty, 2005; Evers and Katyal, 2007; Robinson, 2008; Hallinger, 2011). Such mixed and sometimes contradictory findings are disappointing after decades of research into what is universally regarded as a key element of good schooling.

One possible explanation for the difficulties involved in establishing statistically significant relationships between SLM practices and learning outcomes is the proliferation of theories or models of leadership. For example, Bush (2007) has described nine such models (Managerial, Participative, Transformational, Interpersonal, Transactional, Post-modern, Contingency, Moral and Instructional). These different conceptions of leadership prioritise and characterise the elements of SLM in different and generally non-comparable ways. Even where a common instrument is used by researchers, it may be framed in different ways. Thus, in his review of 130 doctoral dissertations that utilised the Principal Instructional Management Rating Scale (PIMRS) to investigate the practices of school managers, Hallinger (2011) concludes that the conceptual frameworks and methodologies used by these doctoral students were, on the whole, inadequate to the task of contributing to either the theoretical or the practical knowledge base in this field. In response to this problem, Robinson et al (2008) observe that the impact of different leadership dimensions are better investigated by looking at specific leadership practices rather than adopting broad theories as the unit of analysis. This is the approach we adopt in the new case studies we describe below.

A second major contributor to the difficulty of establishing statistically significant relationships between SLM practices and learning outcomes, may lie in the fact that different schools have different needs, depending on their state of development and on local economic and political conditions at any particular time (Hopkins et al, 1997; Marzano et al, 2005; Robinson et al, 2008; Day et al, 2010). Thus, factors that are significant in one environment may not stand out in another. For example, Leithwood et al (2010) review research on the strength of association between learning outcomes and various uses of time in schools and found very different results. However, in the South African context, given the very poor time management practices in many schools (Taylor and Vinjevold, 1999; Chisholm et al, 2005; Reddy et al, 2010), one

might expect that significant improvement in this area would have a noticeable impact on learning.

An activity-focused framework

Because of the two kinds of difficulties outlined above, our literature review is a purposive one, directed towards identifying those SLM practices that are likely to influence learning under South African conditions. We start with the framework constructed by Robinson and colleagues. In their review of 27 published studies examining the relationship between leadership and student outcomes Robinson et al (2008) identify five dimensions of successful leadership. We discuss these dimensions below, rearranging the order somewhat, renaming some, adding a sixth, and elaborating each to take account of South African circumstances and the broader international literature. From this discussion, we derive 15 hypotheses that frame the case studies we undertook.

1. Setting and communicating learning goals

Early work by Heck and various collaborators concluded that leaders in higher performing schools emphasise the communication of goals and expectations (Heck, Larsen, & Marcoulides, 1990), recognising achievement and informing the community of performance (Heck, Marcoulides & Lang, 1991). This set of activities has much in common with the notion of 'academic press' (for example, Leithwood et al, 2010) – setting high but achievable learning goals – and what is known in the school effectiveness (SESI) literature as 'high academic expectations'. Long tradition of SESI research concludes that high expectations are consistently associated with improved student performance (Brookover et al, 1979; Edmonds, 1979; Rutter et al, 1979).

Parental involvement in the schooling of their children is generally regarded as a good thing. The accountability measures currently being introduced by the South African Department of Basic Education will see schools circulating the results of the Annual National Assessment (ANA) exercise to parents. The assumption is that these scores will provide parents the information necessary to monitor school performance, and to exert pressure on schools to improve their performance (Department of Basic Education, 2010; 2011). This assumption has its theoretical roots in the Economics of Education literature: for example, Bruns, Filmer and Patrinos (2011) postulate that information-for-accountability programmes provide the clients of education (learners and parents in the case of schooling) with the information necessary to hold providers (schools) accountable for results. However, the EGRA study

conducted in Liberia indicates that a combination of teacher development and information on learning achievement provided to parents, school leaders and teachers has a far bigger impact on learning outcomes than information on its own (Piper and Korda, 2010). The Liberian example poses the hypothesis that information is only of use in promoting achievement if teachers have the capacity to effect higher levels of learning.

Leithwood et al (2010) make the useful distinction between family related factors that are alterable and those that are not amenable to the influence of the school. These authors found that learners' access to adult support in the home for school work was negatively associated with learner learning, a finding which flies in the face of both the conclusions of Dumont et al (forthcoming) that parental competence to help with homework is positively related to academic outcomes, and of the strong association found in the NSES between test scores and the extent to which children read and have access to English at home (see Chapter 3). Since both reading and access to English are amenable to parental influence, we decided to include a measure of the school/home relationship in our set of indicators for measuring the quality of SLM.

In conclusion, on the first of Robinson et al's (2008) dimensions of effective SLM – setting and communicating learning goals – we derive two hypotheses for investigation in our set of case studies:

Hypothesis 1.1: Setting and communicating learning goals across the school: a coherent focus on teaching and learning is the hallmark of an effective school, and is shared by managers, teachers, learners and their parents.

Hypothesis 1.2: Parental involvement: learning is improved when parents play a part in encouraging reading, supporting homework and test preparation, and promoting the language of instruction.

2. Ensuring an orderly and supportive environment

For Robinson and her colleagues an important component of instructional leadership is creating an environment for both staff and learners that makes it possible for academic and social goals to be achieved. An examination of eight studies revealed a mean effect size for this construct of a small 0.27, but these authors nevertheless conclude that the leadership of effective schools is distinguished by emphasis on and success in establishing a safe and supportive environment through clear and consistently enforced social expectations and discipline codes (Robinson et al, 2008; Heck et all, 1991). Viewing these considerations from a South African perspective, we incorporated four factors into our analytical frame for assessing the extent to which conditions conducive to learning exist in a school:

School governance

The South African Schools Act (SASA) (Republic of South Africa, 1996) confers significant authority on school governing bodies (SGBs) in matters such as admissions policy, language of instruction, school fees and staff appointments. While the law insists that parents constitute a majority on the SGB, and while these members are elected by the parent body, a lack of capacity in poor communities to fulfil these functions adequately, and an inequitable balance of power between educated teachers and illiterate or working class parents effectively delegates many of these responsibilities to the principal. Conflict among parents or between the SGB and school leadership is not uncommon (JET, 2003). However, Bush (2005) noted that, eight years after the promulgation of SASA, misunderstandings continued to occur, often leading to conflict between parents and educators.

Predatory behaviour

Teachers in South Africa are strongly unionised and conflict between the unions and departments of education have been common over the last decade. Violent strikes not infrequently accompany annual salary negotiations (Fleisch and Christie, 2004; Christie, 2010). The specific issue which precipitated the illegal Soweto strike of 2009 – the promotion of teachers and other officials (Fleisch, 2010) – fuels widespread public perception that union activity is primarily about advancing the authority and benefit of its members. In interviews with teachers and union officials in Gauteng, Zengele (2009) reveals that principal posts in schools are considered as 'open for deployment' by the South African Democratic Teachers Union (SADTU), by far the largest and most militant teacher organisation. Levy (2011) calls this phenomenon predation, where predators are individuals or groups who seek to capture collectively created or managed rents for private purposes; such groups often use channels of political support external to the specific arena of co-operation to override with impunity the formal and informal rules of the game associated with collaborative governance arrangements (Levy, 2011). With its dominance within the Congress of South African Trade Unions (COSATU), and with the latter's alliance with the governing party (see Chapter 1), SADTU possesses a number of predator group characteristics. One of the research questions of the present chapter is to investigate the extent to which predatory behaviour exists in South African schools, and the extent to which what Levy calls 'collaborative governance' is able to trump predator raids on public resources. Levy (2011) hypothesises that the strength of collaborative governance is promoted by factors such as: the quality of participation of parents and other stakeholders in school governance; leadership either from within the school or through external facilitation; shared social norms such as the primacy of law, religious and other ethical values; and the availability of information on performance.

Regulatory environment: work-directed relations among SMT, staff and learners

The third component of a school environment conducive to teaching and learning is assumed to consist of elements such as a well-defined set of school norms and procedures for dealing with their transgression. We would further hypothesise that where schools perform above demographic expectations, not only are these practices present, but that they are coordinated and monitored by the school leadership team, under the direction of the principal.

Time management: optimal use of time for teaching and learning

As we have noted above, from the South African perspective, improvement in this dimension might be expected to have profound effects on learning outcomes, given the very disorganised climate which pertains in large parts of the system: for example, teaching time in the majority of schools averages around 3.5 hours a day, compared with an average of more than 6 hours in well functioning schools (Chisholm et al, 2005).

Following this discussion, we derive four hypotheses concerning Robinson et al's second dimension of school leadership practices – ensuring an orderly and supportive environment:

Hypothesis 2.1 Governance: A productive working relationship between school leadership and the governing body is associated with better school performance.

Hypothesis 2.2 Unions: A productive working relationship between school leadership and the unions contributes to conditions conductive to teaching and learning.

Hypothesis 2.3 Regulatory environment: clear norms of behaviour and disciplinary procedures in the school are positively associated with improved learning.

Hypothesis 2.4 Time management: improved use of time for teaching and learning results in better performance.

3. Instructional leadership

The notion of instructional leadership (Southworth, 2002) sits at the heart of Robinson et al's (2008) third dimension of effective SLM, which they call Planning, coordinating, and evaluating teaching and the curriculum. In our framework, we revert to the commonly used and more succinct term 'instructional leadership'. The centrality of this set of activities to school life is well captured by Robinson and her colleagues, who assert that: '... the more leaders focus their relationships, their work, and their learning on the core business of teaching and learning, the greater their influence on student

outcomes' (Robinson et al, 2008:636). Hallinger constructed an instrument to measure principals' instructional leadership capacity, the PIMRS discussed earlier, where the central concept refers to those mental and physical actions of the principal which drive others to perform tasks in such a way that the school goals in terms of learner performance are achieved (Hallinger, 2011).

For Robinson et al (2008) educational leadership entails not only building collegial teams, a loyal and cohesive staff, and sharing an inspirational vision, but also involves focusing such relationships on very specific pedagogical work. These authors tracked 80 indicators of this dimension (planning, coordinating, and evaluating teaching and the curriculum) across nine studies and, finding a mean effect size of 0.42, concluded that this type of leadership has a moderate impact on learner outcomes (Robinson et al, 2008).

In the South African context, Bush and Heystek's (2006) baseline research on SLM practices in Gauteng schools showed that the majority of these principals do not conceptualise their role as instructional leaders, and are much more concerned with financial management, human resource management, and policy issues. The 'management of teaching and learning' was ranked only seventh of ten leadership activities in a survey of more than 500 Gauteng principals (Bush and Heystek, 2006). In support of these findings, Hoadley and Ward (2009) found that the majority of principals in a stratified sample of 142 high schools in the Eastern Cape and Western Cape provinces described their main activities as administration and disciplining learners, and were seemingly unaware of the importance of exerting leadership over curriculum matters. This study found a moderate association between improved performance and monitoring curriculum coverage. Similarly, Carnoy et al (2011) found that in their sample of 60 primary schools in the North West province, 57% of principals reported that administration and departmental reporting took up the majority of their time, while only 27% felt oversight of teaching and curriculum was their most time-consuming task.

While Richard Elmore's work (2003; 2008) cannot be classified as 'large-scale quantitative studies of SLM', his observations on school leadership strike a strong chord with the above discussion. For Elmore, a school which exhibits high levels of internal accountability has a well developed approach to curriculum and pedagogy, characterised by routine grade-level and content-focused discussions of instructional practice, and structured occasions to discuss learner performance. In such schools, instructional practice is monitored more or less continuously, through organisational structures, processes and norms that make instruction transparent. In the same vein, Raudenbush distinguishes between two forms of instructional practice: *isolated idiosyncratic practice*, which is rarely open to public inspection, and shared *systematic practice*, characterised by common aims, assessment tools,

and instructional strategies, active collaboration, routine public inspection of practice and accountability to peers (2009).

In the light of the foregoing discussion, we postulate four hypotheses regarding instructional leadership:

Hypothesis 3.1 Leadership roles: clear definition and distribution of roles among staff facilitates teaching and promotes learning.

Hypothesis 3.2 Leadership directly involved in the learning programme: learning is optimised when school leadership directs and monitors curriculum delivery.

Hypothesis 3.3 Collegial practice on curriculum delivery: in schools which exhibit improved performance teachers conduct routine grade-level and content-focused discussions of curriculum matters.

Hypothesis 3.4 Collegial practice on assessment: learning is enhanced by regular structured occasions to discuss learner performance.

4. Resourcing strategically

Robinson et al (2008) are clear that their fourth dimension of effective school leadership does not refer to activities such as fundraising, grant writing, or partnering with business, but points specifically to resources that are aligned with instructional purposes such as books and related curriculum materials. In the South African context, Crouch and Mabogoane (2001) are equally adamant that it is 'cognitive resources' (books, media-centre materials, media-centres, computers for instructional support and assistance) which are strongly associated with improved learning, rather than resources such as teacher qualifications, bricks and mortar and teacher/learner ratios. Given the very low incidence of book use in South African classrooms (see Chapters 7 and 8), and given the significant association found in the NSES between improved learning and whether or not the school has an operational book inventory system (Chapter 3), we propose the following hypothesis:

Hypothesis 4.1 Books: learning is enhanced when a school has working systems for the procurement, management and use of books for teaching and learning.

5. Promoting professionalism

The fifth dimension of SLM activity described by Robinson et al (2008), they call 'promoting and participating in teacher learning'. The contexts for such learning are both formal (staff meetings and professional development) and informal (discussions about specific teaching problems). An average effect size of 0.84 on this factor was found in Robinson et al's (2008) meta-analysis, a

large effect by any measure. To some extent these considerations are catered for by our hypotheses under instructional leadership in section 3 above, and more specifically to indicators 3.2 (Collegial practice on curriculum delivery) and 3.3 (Collegial practice on assessment). But there are additional aspects of teacher learning which we examine under the present heading, which we rename *Promoting professionalism in order to reflect our redistribution of the components of this dimension of leadership.*

Leithwood et al's (2010) notion of collective teacher efficacy (CTE) is relevant here. CTE is defined as the level of confidence a group of teachers feels about its ability to organise and implement whatever educational initiatives are required for learners to reach high standards of achievement. These authors claim that its effects on learner learning exceed those of learner SES, which would make it very large indeed. We would propose that the emergence of CTE in any school would be associated with a strong sense of individual agency held by teachers. Our assumption here is that if individual teachers do not believe they can make a difference to the lives of their learners, whatever the conditions under which they work, then they are unlikely to believe that they can do so collectively. The majority of South African teachers appear to lack the belief that they are able to make a difference to their circumstances. In particular, Bush and Glover (2009) noted the tendency for teachers to blame poor performance on external factors such as the behaviour of learners, socio-economic conditions, lack of accommodation and a paucity of books; some heads of departments (HoDs) also criticise their educators for weak skills or motivation but do not appear to recognise their responsibility for addressing such problems, while teachers in turn blame the HoDs for lack of support (Bush et al, 2009).

We return to the subject of teacher professional knowledge at some length in Chapter 8, and at this point confine ourselves to postulating a tripartite hypothesis regarding the fifth dimension of leadership.

Hypothesis 5: Learner performance is enhanced when the following are present in a school:

5.1 Professional attitudes: teachers exhibit the following characteristics:
- Ethical comportment
- Recognise the importance of subject and pedagogical knowledge for their practice
- Show intrinsic motivation, particularly regarding the development of their own knowledge

5.2 Induction: the school has a well-defined process of inducting and mentoring new teachers into the school.

5.3 Professional development and support: district expertise is used to train and support teachers.

6. Language of instruction

As we shall see in more detail in Chapter 5, some 80% of South African children receive instruction in their mother tongue to the end of Grade 3, after which they switch to English. Under conditions where teachers themselves are not proficient in English and where the language is not spoken much, if at all, in the community, this situation poses a significant disadvantage on these learners. Not surprisingly, Chapter 3 tells us that in the NSES sample children perform above the norm when they are exposed to English at home. We presume that the same would apply at school, and therefore propose the addition of a sixth dimension of school leadership framed by the following hypothesis:

Hypothesis 6.1 Language: schools that promote proficiency in the language of instruction exhibit improved performance.

Robinson et al (2008:669) concede that their five dimensions of SLM are '... still expressed at a level of abstraction that does not fully explain the processes responsible for their particular effects'. Following this line of thinking, the primary focus of the present study is to describe how these leadership dimensions are manifest in South African schools serving poor children under a variety of conditions.

Case studies of SLM practices

Case studies of SLM practices are generally conducted in a sample of schools that perform well under difficult circumstances, on the assumption that it is exemplary leadership that enables them to transcend their circumstances and to bring out the best in their socio-economically disadvantaged learners. Such studies are not uncommon, both in South Africa (Malcolm et al, 2000; Christie, 2001; Christie et al, 2007; Prew, 2007; Bush et al, 2009; Taylor et al, 2009) and internationally (Edmonds, 1979; Maden, 1996; 2001; Scheurich, 1998).

One of the most influential of these case studies was the work described in the report of the Britain's National Commission on Education entitled *Success against the odds: Effective schools in disadvantaged areas* (Maden, 1996). A study conducted in 11 schools spread across the United Kingdom representing a spectrum of types (primary, secondary and a special school), situated in a range of social and geographical circumstances (city, suburban, rural), and reflecting a variety of learner populations (Asian, white, ethnically mixed). Two factors which the schools shared was that they served economically disadvantaged learners, and they added significantly greater value to the learning performance of their learners compared to schools with similar intakes. The theoretical starting point for *Success against the odds* was a set of ten postulated features of success which resonate strongly with the 15 hypotheses

derived above, including: strong positive leadership; high expectations of learners; a clear focus on teaching and learning; well-developed procedures for assessing learner progress, and parental involvement (Maden, 1996:366). The study provided striking examples of manifestations of these features in the 11 extraordinary schools.

An early example of South African work in this field is given by the research commissioned by the Department of Education in 2000 (Malcolm et al, 2000). The goal of Malcolm et al's Feeder schools project was to identify the characteristics of South African schools that produce strong learning performances under adverse conditions. Nine high schools in four provinces were chosen, all serving African learners in disadvantaged areas and achieving exceptionally well on the national Senior Certificate examination. The study draws conclusions which also provide support to our theoretical framework, including: a strong ethos driving the school, which sees itself as largely responsible for its own development; governance and community relations characterised by one principal as a three-legged pot, where the legs represent learners, staff and parents; an approach to learning in which staff and learners see matriculation as a game where success depends on direct teaching and extensive practice. In such schools, the task of management it to bring all of the aspects of the school together, and to provide an environment in which teachers can teach and learners can learn. Punctuality and a strong work ethic are highly valued.

Seven years later a Ministerial Committee was established to investigate the factors that enabled some schools to 'work' under the same conditions of poverty under which the majority of schools produced very poor learning outcomes (Christie et al., 2007). Based on a sample of 18 high-performing high schools, the study concluded that all these schools valued time highly; were focused on the central tasks of teaching and learning with a sense of responsibility, purpose and commitment; had organisational cultures that supported a work ethic, expected achievement and acknowledged success; and had strong internal accountability systems for 'getting the work done' (Christie et al, 2007:5).

Our own earlier research efforts on the topic of SLM (Taylor et al., 2009) were conducted in eight high schools drawn from one district in each of the Eastern Cape and Free State provinces. We wanted to explore in closer systemic detail the vibrant stories of school life told in these and other South African studies (Christie, 2001; Prew, 2007; Bush et al, 2009). The research design was based on nine of the 15 hypotheses derived above. The study concluded that the energy and vision driving the most successful school in the sample is the principal, who has organised his school into a smoothly functioning team, with a well-defined division of labour among staff, parents, learners and the district. However, on the question of professionalism, a sense of intrinsic motivation

among teachers is missing. The self-belief on the part of individual teachers, and the institution as a whole, that they have the power to extend their own knowledge resources seems to be underdeveloped.

Research design

The case study approach

The research project reported below is designed as a case study investigation into SLM practices in primary schools that serve poor communities in a variety of South African settings. The findings of the NSES modelling exercise reported in Chapter 3 provide the impetus behind the investigation: we wanted to describe the set of practices and relationships that surround proxy indicators of leadership practices associated with improved test scores, such as monitoring curriculum delivery.

Sampling

In our previous set of case studies (Taylor et al., 2009) the best insights were obtained by a comparison between a paired set of schools in the same township, one performing poorly and the other performing strongly. These schools serve essentially the same very poor community, and are administered by the same district. In other words, the main potential influences on school performance, aside from SLM, were relatively constant for both schools. These insights caused us to choose a matched pairs sampling technique for the present investigation. We selected five pairs of schools; within each pair, the two schools are very similar regarding size, apartheid-era department of education, present administrative authority, socio-economic conditions, cultural environment, language of instruction and political economy. Comparability on most of these variables is most easily achieved by choosing schools in close geographical proximity. Nevertheless, finding a pair of schools that exhibit these characteristics proved to be difficult in practice. We were unable to do so within the NSES sample, and a larger population had to be defined in order to meet the sampling criteria. Regarding performance on the dependent variable – test scores – only in the Western Cape (WC), where annual population testing are administered by the province in primary schools, does a longitudinal data set exist to provide valid comparative data on performance. Because of this advantage, we selected two pairs of the schools from the WC, one in an African township school serving squatter and fixed-housing communities, and the other in a very poor coloured township.

We used the scores provided by the Annual National Assessment (ANA) tests conducted by the national Department of Basic Education (DBE, 2010) to identify a further two pairs of schools, one in rural Kwazulu-Natal (KZN) and the other in rural North West (NW). In the latter pair, we settled for two rather different schools regarding size, one with 151 and the other with 399 learners. Even more important, the smaller school (E1, Table 2), has a multi-grade structure, with classes containing more than one grade, and the principal undertaking significant teaching duties. Since the South African system contains a large number of such schools, it was decided to include E1 in our sample. As we shall see later, the inclusion of this multi-grade school introduced a confounding variable into the mix, with interesting consequences for the process of theory building.

The fifth pair of schools was selected using a set of baseline and interim tests provided by a school development project working in the province of Mpumulanga. Test scores and other school details for the five pairs of sample schools are provided in our discussion of the research findings below.

Indicators of effective school leadership

The 15 hypotheses derived above were converted to indicators of good SML practices, as shown in Table 1. The table also shows the criteria used to measure the strength of each indictor in our case study schools.

Table 4.1: Indicators of effective school leadership and management practices

SLM dimension	Indicators of good practice	Rating criteria
1. Setting and communicating learning goals	**1.1 Setting learning goals:** school has a coherent focus on teaching and learning.	• Teaching and learning is the main focus of the school • School has targeted programmes to improve performance • Evidence that programmes are successful
	1.2 Parental involvement: Parents are an integral part of institutional systems.	• Parents incorporated into the following systems: • Homework • Tests and exams • Disciplinary • Fundraising • Other (feeding, substitution, library)

2. Ensuring an orderly and supportive environment	**2.1 Governance:** Productive working relationship between school leadership and SGB	• SGB properly constituted • Clarity on roles and functions • Absence of internal or external conflict • Communication with staff • Fulfil role in selecting staff
	2.2 Union: productive relationship between unions, school leadership and SGB	• Union and SMT/SGB respect each other's roles • School does not observe general strike • Unions do not exceed role on SGB in selecting staff • Unions do not disrupt school for meetings • Unions allow district officials full access to school
	2.3 Regulatory environment: clear norms of behaviour and disciplinary procedures	• Good discipline in the school which promotes teaching and learning • Clearly defined procedures for transgressing school rules by learners • Teachers well prepared and produce marks, etc. timeously • SMT takes responsibility and sets up systems for good discipline of staff and learners.
	2.4 Time management: optimal use of time for teaching and learning	• Absenteeism and late coming at minimum for teachers • Absenteeism and late coming at minimum for learners • Classes all run according to timetable • Few learners out of class during school • Prompt return to class after break

3. Instructional leadership: Planning, coordinating, and evaluating teaching and the curriculum	**3.1 Leadership roles:** clear definition of roles on the SMT, coordination	• Management structures in place in both FP and Intersen • Roles clearly defined • Coordination of structures and functions Curriculum coverage
	3.2 Direct involvement of leadership: management directs curriculum planning, monitoring, and assessment.	• Strong planning in both phases • Effective monitoring • Assessment moderated, recorded and coordinated centrally • Assessment used to improve teaching
	3.3 Collegial practice on curriculum delivery: routine grade-level and content-focused discussions of curriculum delivery among staff	• Leadership sets policy • Regular discussions among all phase, grade level or subject teachers > 2/term • Share information after workshops
	3.4 Collegial practice on assessment: regular structured occasions to discuss learner performance	• Leadership sets policy • Regular discussions among all phase, grade level or subject teachers ≥ 1/term • Share information after workshops
4. Resourcing strategically	**4.1 Books:** Procurement, management and use of books for teaching and learning	• Textbooks for all learners • Taken home and kept for year • Books well managed: retrieval system up to date • Library in place and well maintained • Classes have regular, structured use of library

5. Promoting professionalism	**5.1 Professional attitudes:** teachers exhibit professional habitus	• Ethical comportment • Recognize importance of teacher knowledge • Intrinsic motivation, especially regarding own knowledge
	5.2 Induction: well-defined process of inducting and mentoring new teachers into the school	• Structured process in place • Mentors appointed
	5.3 Professional development and support: District expertise used to improve teaching and learning	• District runs teacher training programmes • Provides curriculum documents • Visits schools and classrooms • Activities highly rated by staff
Language of instruction	**6.1 Language:** promote proficiency in the language of instruction	• Teach English in grades 1-3 • Other measures for improving proficiency in LOLT • Evidence of effectiveness of these measures

Method

Interviews

Six interviews were conducted in each sample school, with the following respondents: the principal (P), deputy (DP) or senior head of department (HOD), a teacher who teaches in Foundation Phase (Grades R – 3) in Maths or Language, a teacher who teaches in Intermediate Phase (Grades 4 – 6) in Maths or Language, the Chairperson of the School Governing Body (SGB) or a senior SGB member, and a focus group consisting of 3 or 4 teachers not previously interviewed. The interviews were semi-structured, with most answers containing explanatory comments by the respondent, which were written down by the interviewer. A schedule of resources and systems was used to audit the school's book management and assessment systems.

Data analysis

The quality of school management practices are difficult to assess. The major difficulty is that studies of this kind depend in large measure on self-report data derived from the parties who have an interest in presenting their practices in the best light. Different members of the staff of any one school are also likely to have different interpretations on the state of the school. We addressed this problem by repeating questions to the various interviewees, and triangulating the data, constructing a picture of the school from the overlapping descriptions of the respondents with different structural positions within each school. While triangulation does not remove all uncertainly concerning the extent to which the reports of respondents add up to 'what really happens' in any school, it does provide a good filter for idiosyncratic ideas and wishful thinking. We addressed the problem of inter-rater reliability by getting members of the research team to rate schools independently, and discussing any discrepancies between these accounts.

Table 1 shows the criteria used to measure the strength of each indicator. We used a five-point Likert scale, and in scoring the strength of each indicator, we started at five and dropped one point for each missing criterion. Where fewer than five criteria are listed, the score is arrived at proportionally, rounding to the nearest unit.

Validity

The large-scale quantitative studies discussed above can be prone to threats to construct validity (Yin, 1994) because of their reliance on self-report data gathered by means of surveys: Whalstrom and Lewis (2008) note that this method does not measure actual behaviours but the perceptions of participants of their own behaviour and that of others. While case studies of leadership suffer the same disadvantage to some degree, gathering data by face-to-face interviews not only allows the observer to judge the construct validity on site, but also to supplement structured interview information with direct observation and unstructured probes. In this way, case studies can generally be expected to exhibit higher levels of confidence with respect to construct validity than survey research.

Findings

Table 2 shows the comparative scores of the 15 indicators of effective SLM practices for all 10 schools. The patterns indicate the extent to which the indicator scores for each pair of schools support, negate or are neutral towards the respective hypothesis (5 shows strong evidence for presence of defined

activity; 1 indicates no evidence). Comparisons between the two members of each pair are considered more valid than inter-pair comparisons because of the large variation in between-pair conditions.

Table 4.2: School scores on SLM indicators

SLM Activity	Indicator	School scores									
		C1	C2	A1	A2	B1	B2	D1	D2	E1	E2
1. **Setting learning goals** and communicating these to staff, learners and parents	1.1 **Setting learning goals:** school has a coherent focus on teaching and learning.	2	5	3	5	3	4	1	4	4	4
	1.2 **Parental involvement:** Parents are an integral part of learning systems.	1	3	4	4	2	3	1	4	1	3
2. **Ensuring an orderly and supportive environment**, making it possible for important academic and social goals to be achieved	2.1 **Governance:** Productive working relationship between SMT and SGB	3	5	2	3	1	4	1	5	5	5
	2.2 **Union:** productive relationship with SMT and SGB	1	1	4	4	2	3	1	3	3	3
	2.3 **Regulatory environment:** clear norms of behaviour and disciplinary procedures	3	5	4	4	1	3	2	5	5	5
	2.4 **Time management:** optimal use of time for teaching and learning	3	5	3	5	3	4	2	4	5	5
3. **Instructional leadership:** Planning, coordinating, and evaluating teaching and the curriculum	3.1 **Leadership roles:** clear definition of roles on the SMT, coordination	2	5	4	4	2	3	3	4	2	3
	3.2 **Leadership directly involved:** management directs curriculum planning, monitoring	3	4	5	5	2	3	1	4	2	3
	3.3 **Collegial practice on curriculum delivery:** routine grade-level and content-focused discussions of curriculum delivery	3	4	4	4	2	3	1	3	2	3
	3.4 **Collegial practice on assessment:** regular discussions on performance	3	4	4	5	3	3	2	3	2	3

4. Resourcing strategically	**4.1 Books:** Procurement, management and use of books	4	5	2	3	2	3	2	3	2	2
5. Promoting professionalism	**5.1 Professional attitudes**	3	4	3	4	3	3	3	3	3	4
	5.2 Induction: process of inducting new teachers	4	4	3	3	2	1	2	3	3	3
	5.3 Professional development and support: District expertise used to improve teacher skills	1	1	4	4	3	3	1	1	3	3
6. Attention to language of instruction	**6.1 Language:** promote proficiency in LOLT	2	4	4	4	2	2	2	2	2	4

Key:

	Distinct association between certain practices and improved learning Primary levers for improving learning
	Associated with better performance, but after a certain threshold these practices appear to add no further value
	Either provide weak support for the hypothesis or are neutral
	Generally not well developed in strong or weak schools Predicted by theory to hold the greatest potential for improvement

We discuss the school pairs in turn and then turn our attention to the patterns that are apparent across the five pairs of schools.

Pair C1 and C2 rural Mpumulanga

Although these two schools are located in a rural area some 60km from the nearest town, the area is relatively densely populated, with people living in villages and on smallholdings. Both schools are part of a school improvement programme initiated and executed by the Maskew-Miller Longman Foundation, which provided training and support to school leadership a textbook for each subject to every child in all grades. Not surprisingly, scores for both schools on indicator 4.1 are high. Tests were administered prior to the intervention in 2008, and again in 2010. C2 shows a very clear advantage on 3 of the 4 baseline scores and also remarkable gains in maths in both the grade 3 and grade 6 tests, and is designated the high performing member of the pair for the purposes of our comparison.

The histories of the schools are rather similar, with both principals having been at their respective schools for around 20 years. However, the two

principals exhibiting strongly contrasting leadership styles, each of which is associated with a very distinctive school culture and learning outcomes. At C1 Mr M is autocratic and dogmatic; he is in conflict with his senior HOD, the school exhibits a less than coherent focus on teaching and learning, and performance is decidedly mixed. At C2 Ms W pursues a participative approach to leadership; staff are motivated and directed by a coherent curriculum programme and scores on 3 of the 4 tests are on a strong upward trajectory.

Poverty levels in the area are high, with erratic water supplies, and C2 has been more enterprising in dealing with these conditions. The school has sunk a borehole sunk, established an extensive food garden, provided systematic support to families affected by HIV/AIDS, refurbished the toilets and built a kitchen, all with the assistance of donor support.

At both schools, school leaders and teachers agree that disruptive union activity in the area is linked to a dispute between the unions and government concerning the filling of top posts in the district. There is a widespread perception in schools that the cause of the standoff is due to SADTU insisting on appointing the top officials in the district: 'These young boys interrupt things even when there is no need to. The union uses us in their battles with the department to fight issues that are very far from us' (deputy principal, C2). Teachers at C2 have been ordered by the union to 'disengage' from district activities and not to allow officials to visit schools. Both schools participated in the 2010 strike for the full period, which seems to have been extended to three weeks in these parts. At C2, the school was instructed by the union that no departmental officials were allowed to visit schools during the third term (September to December 2011) and teachers were not allowed to attend district workshops. The school requested curricular assistance from the maths curriculum advisor but this was opposed by SADTU.

Our ratings for each school on the 15 indicators of SLM practices are shown in Table 2. The difference between the two schools is immediately apparent on indicator 1.1: Setting and communicating learning goals. A standoff between the principal and the senior HOD responsible for curriculum management appears to be the proximal cause of contradictory views expressed by C1 staff on this indicator. In contrast, at C2 all interviewees agreed the school maintains a strong focus on teaching and learning.

In the field of governance, our interviewees at C2 concurred that the SGB plays a very important role in the school. The IP HOD described the relationship thus: 'The SGB is the backbone of the school – it is our employer and keeps the school on the straight and narrow'. At C1, efforts to get parent participation in school affairs are far less enthusiastic: no parent meetings had been held during 2011, a very poor state of affairs for which school leadership must be held responsible. Learner absenteeism is a problem and parents are

invited to school to discuss chronic cases, but very few respond. School leaders blame ineffectiveness of the SGB to poor levels of education among parents.

On the third indicator of a school climate conducive to teaching and learning – the regulatory environment of the school – C2 also scores significantly better than C1. The deputy principal at C2 noted that, given the excellent relationships between all stakeholders, it is relatively easy to solve any disciplinary problems that may arise, for which the school has well developed systems. Procedures for dealing with staff disciplinary issues are place but, according to the IP HOD, have only had to be applied once in the recent past. This occurred when a teacher 'disappeared for two days after pay day'. The teacher concerned was dealt with 'compassionately' by the SGB and was 'soon back in the fold', having appreciated the error of his ways. In sharp contrast to this well coordinated, proactive approach to discipline, our interviewees at C1 said that, although a 'Code for learner behaviour' is displayed on classroom walls and notice boards, staff do not know how to address problems with learner discipline, which is described as 'soft'.

Regarding time management, the two schools are again very different. Learner attendance at C1 can be erratic, especially on days when social grants are paid, while choir practice for 50 members takes place for an hour every day after school, which means senior choir members miss a part of the last period of every day. At C2 all extra murals like choir, music, reading, drama, poetry take place after school; during the second term some grade 4, 5 and 6 learners miss school due to initiation practices, but this is kept to a minimum. Children at C2 often stay after school to finish their work under supervision of staff in order to complete assignments.

Of the four indicators of SLM dimension 3 – Instructional leadership – the sharpest difference between our two Mpumulanga schools lies in indicator 1, which assesses the degree to which curriculum leadership roles are clearly defined and distributed. This critical area is dominated at C1 by the breakdown in communication between the principal and senior HOD, while at C2 the well-coordinated team atmosphere that pervades the school is reflected in a clear division of labour and smooth integration of the various functions. These differences are associated with significantly better functioning curriculum systems at C2, as shown by higher scores on all four indicators of instructional leadership.

On dimension 5, C1 exhibits an unrealistic and complacent view of its knowledge resources, with none of our respondents indicating a need to improve teacher subject knowledge. Staff at C2 perhaps came closer to capturing the rarely seen *intrinsic motivation toward subject knowledge* component of teacher professionalism: interviewees agreed that staff are motivated and encouraged to improve their qualifications, but this 'paper chase' is much more about acquiring qualifications as stepping stones to promotion opportunities, than

it is reflective of knowledge pursuit for its own sake or for the value it adds to classroom expertise.

One of the most significant differences between C1 and C2 lies in the respective approaches to the issue of language of instruction. At C1 the teaching and learning of English as additional language in FP is described by the HOD as 'problematical', but the school has no programme to deal with the situation. At C2, on the other hand, English has been introduced in grades 1 and 2, and other measures for promoting proficiency in English include scheduled reading in class and the dramatisation of stories and poems both in class and during cultural days organised by the school.

Pair A1 and A2, Western Cape coloured township

The schools are situated in a coloured township some 30 km north of Cape Town, and draw their learners from broadly the same very poor community in which unemployment and the social problems associated with poverty are rife. Since the WCED has been administering annual tests in literacy and numeracy for all grade 3 and 6 learners from 2002, comparison of school performance is relatively simple and reliable. School A1 scores fall in the range 40-45% over the last three years, while those of A2 have averaged over 60% across the four annual tests.

The comparative strengths of our 15 indicators of SLM practices across the two schools are shown in Table 2. Aside from the common features according to which the two schools were selected for comparison, they share a great deal more. One that stands out is the political economy that prevails. At both schools teachers belong to a variety of unions and adopt a less confrontational and aggressive approach to industrial relations than is regularly evident in large parts of the country. The two schools are also similar in their governance arrangements: while both have properly constituted SGBs, there is agreement that neither is very effective. A final similarity between the two schools is the language situation. At A1, the language of instruction in three classes in each grade is Afrikaans and in one it is English. The latter is made up largely of Xhosa-speaking learners, although some of these children speak Afrikaans at home. Similarly, A2 is a dual medium school, with the ratio of Afrikaans to English classes at 3:2 throughout the school, even though most learners in the English classes speak Afrikaans at home, while the rest speak Xhosa. While the two schools work under a very similar English/Afrikaans/Xhosa mix, they deal with the situation in different ways, with code switching encouraged at A1 and discouraged at A2, both ostensibly in the interests of improving proficiency in the dominant language of the school.

Four indicators stand out in distinguishing the two schools. First, there is a marked difference as to how the schools measure on indicator 1.1: Setting and communicating learning goals. At A1 there was agreement among all

interviewees that the principal has a democratic leadership style, that the school has a strong focus on teaching and learning, and that all staff work hard, communicate well, and are praised when they achieve. However, results are erratic and not enough attention is paid to improving performance among weak learners. The school has no targeted programmes to improve performance and thus falls down on two of the criteria for judging the strength of this indicator. In contrast, respondents at A2 said that the curriculum is the core business of the school: high expectations and a culture of work characterises the climate of the school. All interviewees are very proud of the fact that the school received an award for the best grade 3 scores in the circuit on the last round of provincial testing.

Second, although the state of textbook provision is similar at the two schools, there is an important difference. While A1 mostly has sufficient supplies to provide all children with copies in the main subjects, learners are not permitted to take books home. In contrast, at A2, while there are insufficient supplies in certain areas, children are encouraged to take books home and to work from them daily.

The third major difference between the schools lies in their approach to time management. Teacher absenteeism has become a problem on Mondays and Fridays at A1. Children who receive school feeding return late after break, because the meal is served 20 minutes from the end of break: the principal complains about this, and seems unaware that it is within his authority to plan this daily event better. In contrast, at A2, on the day of our visit the school was rehearsing for the school concert in which each child appears on the stage and which is very popular with parents. We were impressed with the very efficient use of time around an event that may have caused chaos in some schools: one grade was rehearsing at a time, while the rest were hard at work in class.

The fourth and perhaps most striking difference between the schools lies in the professional attitudes exhibited by staff. While a sense of intrinsic motivation towards knowledge was not seen in any of the case study schools in the present study, A2 came closest when one teacher in the focus group mentioned subject knowledge as a key element of teacher professionalism, and research as a means of making up for knowledge shortcomings. One A1 teacher did mention the need for more knowledge on the part of teachers, but the principal contradicted this view, saying that he thinks teachers have no knowledge needs.

We close the discussion on this pair of schools with a brief look at their histories and speculate about the role of the principal in establishing the current state of school effectiveness. A1 was opened in 2002, with the present principal as a staff member and he was appointed head in 2008. Our assessment is that the school has for some years maintained a good time management culture, although teacher absenteeism recently became worse. We get the impression

that the principal has been a relatively effective yet not inspirational leader. At A2 the principal displays a more proactive attitude toward improvement, for example organising a workshop on discipline for the whole staff on the afternoon of our visit, following unfavourable comment on the topic by the last IQMS[1] assessment. A2 has had three different principals since it opened its doors over 10 years ago and, according to teachers, was fortunate that its second principal was a leader who inspired his staff with a vision of achievement, and established systems for realising these goals. The current head has been in the job for only 1 year: it is clear that he has inherited a strong school, whose momentum of good systems and a coherent staff continue to operate under the new leader. A strong work ethic, staff teamwork and distributed leadership have become integral and valued parts of the school culture. Our assessment is that the principal is seeking to maintain the effectiveness these traditions.

Pair B1 and B2, African township Western Cape

The schools are situated in an African township some 10-15 km to the NE of Cape Town. The township includes a large proportion of informal settlement dwellers. Scores on the annual WCED tests for school B1 fall in the range 50-55% over the last three years, while those of B2 have averaged around 35-40%%. The political economy here is quite different to that of the township containing A1 and A2. When we asked whether teachers had participated in the 2010 national strike, we got the impression that, for all our interviewees at both schools, the question was redundant: all schools in the township would have observed the full two-week work stay away as a matter of course. Regarding engagement with the district, SADTU's policy in the district is that officials may visit schools but may only enter classrooms on the invitation of teachers, and then only if they '... do not criticise ... but are developmental and do not write anything'. However, teachers do attend workshops organised by the district. In the regard one teacher at B2 commented: 'I would go to training even if SADTU tried to stop it: it's me and my learners.'

The most obvious difference between the two schools occurs in the area of governance. Although B1 is the higher performing member of the pair, our strong impression is that the school is in decline, having been without a permanent principal for 3 years. Conflict within the SGB is strongly implicated in this problem. According to the deputy principal, during the first attempt to select a principal two factions on the SGB had different preferred candidates, and after the selection had been made, the losing faction called a dispute, declaring that they had not been trained in the correct procedure; during this process the union observer on the selection panel played a strongly manipulative role. At B2 we saw quite a different picture, with SGB members visiting school and not infrequently calling meetings with staff to discuss issues. There was consensus among our interviewees that the SGB works closely with SMT. One teacher

observed: 'this school cannot work without the SGB', although another said that the SGB may be overstepping its role.

School B2 has also had problems of leadership in the past 2 years. We were told that the previous principal was sickly for more than a year, during which time things declined at the school. However, there has been an improvement over the past 6 months, when the deputy principal was appointed as acting principal. Our assessment is that, following this period of very unstable leadership, largely caused by administrative indecision, the school is on an upward trajectory, albeit from a low base. It would be interesting to observe developments at these two schools over the next two or three years: our prediction is that, if things continue on the present track, that B2 will begin to outscore B1 in the near future.

A second notable difference between B1 and B2 occurs on indicator 2.3, which reflects the regulatory environment and work ethic that pervades the school. Here too, the comparison favours B2, the school that has, in the last three years, underperformed relative to B1. According to the deputy principal at B1, teacher discipline is a big problem, while learners do not listen because they know nothing will happen to them: 'corporal punishment has been banned and there is no substitute'. Staff don't know what to do about this situation and blame the parents, the WCED, and each other. The HOD interviewed said that she sees some young teachers sitting on their cell phones on Facebook when she walks past their classes in the morning. Here too, we see the kind of passive acceptance of behaviour that school leaders decry, but appear to be unable to do anything about.

Both schools score poorly on the language indicator. The deputy principal at B1 is unhappy about the use by teachers of what he dismissively calls 'Fanagolo'[2] in the Intermediate Phase (grades 4–6), but doesn't seem to understand that the school has the authority, indeed the responsibility, to institute programmes to improve English proficiency, and to discourage code switching if this is found to be detrimental. There is also no special language programme in place at B2 where, according to interviewees, the only time children hear English is in their English class, and even here, it is mixed with Xhosa.

Pair D1 and D2, KwaZulu/Natal

The schools are situated in semi-rural southern KwaZulu Natal, some 50 km inland from a rapidly developing coastal town. The majority of parents/guardians are grant-dependent and unemployment, poverty and illiteracy are widespread. In the 2010 Annual National Assessment tests school D2 scored between 50% and 87% in language and maths, while no score at D1 exceeded 20%. There is a great difference in infrastructure with buildings in reasonable supply and repair at D1, but quite inadequate at D2. Both schools are part of

a development programme that provides portable libraries and training and support to school leadership and teachers.

The two schools differ greatly on five indicators of SLM practice: setting and communicating learning goals; parental involvement; effective cooperative governance; a strong work ethic among staff; good time management, and proactive instructional leadership. At D2 the principal is highly respected by teachers and learners, with one teacher describing his leadership style as 'strong but transparent and exemplary'. In contrast, the head at D1 is seen by staff as reticent and indecisive.

D1 reports insufficient parental involvement with less than 100 parents attending parent meetings, while a high and sustained level of parental involvement was reported by all interviewees at D2. One HOD indicated that the principal is responsible for a close relationship between parents and school, establishing systems to engage parents, such as sending notes home and encouraging learners to read the notes to their parents, and stipulating that parents visit school over a period of two days to fetch assessment reports personally from staff who also engage with them on the progress of their children.

Although the SBG is in place and properly constituted at D1, it is seen by staff as ineffective as members lack the capacity to understand their roles and make a meaningful contribution, do not sufficiently support the head and SMT and do not always attend meetings. At D2, interviewees reported that SGB members have a clear understanding of their functions and provide strong support to the principal.

Regarding work ethic, D1 staff do not see discipline as problematic and according to the HOD for FP behaviour-related issues are well handled by the school. However, contradictory evidence from our various interviewees at the school indicates that the SMT does not function as a cohesive unit. In contrast, at D2 the principal's exemplary work ethic and commitment with respect to both his teaching duties and leadership role are provide inspiration to teachers and other members of the SMT. According to our interviewees, this culture of hard work and commitment, transparency, cooperative management is responsible for a very limited incidence of ill discipline by learners.

At D1, on the other hand, the deputy principal sees late coming and absenteeism of learners and staff as a major challenge, with three to 4 staff members regularly absent every day, without adequate explanation. The principal indicated that learner absenteeism is a big problem and that there is little co-operation with parents. At D2 the school has a culture of teachers arriving early and leaving late, absenteeism is at a minimum, and staff always contact the school to make arrangements if they have to be late.

There is also a marked difference between the two KZN schools regarding instructional leadership. At D1 the SMT is in place and functions with

members mostly clear about their leadership roles, but only one of five HODs has a permanent appointment, one has recently resigned because of stress, three acting HODs do not always feel that their authority is accepted and three HOD assistants and phase teams are not clear about their roles. At D2 the SMT is a closely-knit team, summed up by the HOD for IP, who feels that 'Teamwork in the SMT is the strength of our school'. Similarly, the HOD for FP indicated that, 'We willingly walk the extra mile.'

District support is seen by both schools as limited and very few training programmes are presented. Documents and circulars are received, but there is inadequate provision of workbooks across all grades. District officials rarely visit schools and then only when called. The DP at D1 expressed the mood of both schools when she said, 'We are on our own.'

Pair E1 and E2, North West Province

The schools serve villages near the town of Rustenburg, centre of the country's rich platinum mining area. In the ANA tests conducted in 2010 E1 recorded a mean score across grades 3 and 6 literacy and maths of 67%, which compares very favourably with the mean of 38% recorded by E2. However, there is little to differentiate their SLM practices. Counter intuitively, where one school does appear to show improved leadership on a few indicators (notably on parental involvement and language of instruction), it is the more poorly performing E2 that stands out as being better led. As mentioned in our discussion on sampling, we had difficulty finding our fifth matched pair, and ended up choosing two schools of significantly different size and structure. Because the schools are of such different types, with E1 a multigrade school with a small staff, we postulate that quite different leadership and management regimes are appropriate for such schools, a point we discuss in detail below.

Discussion

The findings of our case studies from five matched pairs of schools give ample demonstration why research on school leadership and management is such a fraught enterprise. The first difficulty lies in the complexity of schooling and the large number of activities required to lead effective teaching and learning. Further adding to this complexity is the fact that a number of these variables are difficult to characterise and assess, since they involve issues of personality and individual style. We derived 15 indicators of effective SLM practices that, according to the literature, are likely to impact positively on learning, and formulated a set of criteria for measuring the strength of each as they manifest themselves in the ten case-study schools. Table 2 shows the comparative scores of the 15 indicators of effective SLM practices for all 10 schools. The patterns

indicate the extent to which the indicator scores for each pair of schools support, negate or are neutral towards the respective hypothesis. In looking at these patterns, our starting point is that such a small sample provides very shaky ground for generalisation, and that our analysis at this point remains in the realm of hypothesis building.

History

A third methodological challenge to research on SLM is provided by the perspective of history. This important observation is illustrated by schools B1 and B2, where our hypothetical expectations are reversed, with the poorer performing school scoring better on 10 of the 15 indicators. The most plausible explanation for this apparent anomaly is that the poorer performing school (B2) is on the ascendant, while the school which has shown better test scores in the past (B1) is in decline, due to conflict on the SGB and instability at the level of leadership. While B1 has also suffered leadership instability in the last two years, the SGB has finally ended its equivocation, chosen a leader (although not formally appointed yet), and the school seems to be finding better direction and coherence.

History is also important in understanding that the excellent performance at A2 is probably largely a legacy of the former principal, under whose leadership strong institutional systems evolved and teachers were formed into a cohesive and dedicated team. The school is fortunate, undoubtedly due to the wise choice of the SGB, that the current principal shows every indication of continuing this tradition. Two conclusions follow from the example of A2. It seems that well functioning schools develop a momentum that can be sustained for some time after the departure of the leader under whom success was first achieved, and that the strongest institutions are those in which there is continuity of good leadership.

With these general considerations in view, we discuss the patterns shown in Table 2. The vertical patterns (columns) show three kinds of relationship between performance and SLM indicator scores:

- in three pairs of schools (C1 and C2, A1 and A2, and D1 and D2) the higher performing member scores more highly on the large majority of SLM indicators, as predicted by our theory;
- in one pair (B1 and B2) the first pattern is reversed (the better performing school scores worse on the indicators), but this reversal is explicable in terms of recent historical trends;
- in one pair (E1 and E2), the reversal is due to some factor as yet unexplained.

Two anomalous pairs

One may say that having two pairs out of five reverse our theoretical expectations does not auger well for the theory, unless these reversals are explicable in terms of some or other critical factor not yet incorporated into the theory. As we have argued above, the evidence would indicate that the reversal of B1 and B2 is understandable in terms of trends over the last 2 or 3 years: it seems that test scores lag somewhat behind changes in leadership and management conditions, and that we should therefore expect a reversal in test scores for these two schools in the near future, if current trends persist.

The reversal shown by E1 and E2 poses a more fundamental challenge to our theoretical framework. In our view, the most plausible hypothesis is that the two schools are so fundamentally different in type that quite distinct management regimes operate optimally for the two schools. At E1, the multigrade school in which the principal is one of six staff and carries a heavy teaching load, leadership is more likely to be expressed by means of example than through formal planning and monitoring systems. In such a school, if the principal is a dynamic personality and a good teacher – which he certainly is – one would not be surprised to find good performance accompanied by a minimum of explicit management practices. If this is the correct explanation, then the reversal between test scores and SLM ratings shown by E1 and E2 is most likely a sampling effect. This is an important example for our theory: while we have insufficient evidence to adjudicate competing explanations in this case, it raises the possibility that different leadership models favour differently sized schools. For example, below a certain size (say a roll of around 150) schools may flourish best under an implicit leadership style, in which best practices are modelled by the leader and bureaucracy is at a minimum, while in larger schools the 15 indicators comprising our theory provide a suitable framework for assessing the effectiveness of SLM practices.

Three congruent pairs

The likelihood that the 15 variables are not all of the same importance in determining the quality of school leadership provides a further difficulty in conducting research in this field. Consider the three 'congruent' pairs of schools (A1/A2, C1/C2 and D1/D2) for which the score pattern is as predicted by the theory: higher indicator ratings are associated with better test scores. For these schools the horizontal patterns (rows) of Table 2 show four types of indicator. First are those that appear to be primary levers for improving learning: Setting and communicating learning goals and Time management. On these indicators, for all three pairs, the difference between the high and low scoring schools is at least 2 degrees (5/2, 5/3 and 4/1). In other words, in

these schools there is a very noticeable difference within the pair in terms of having a coherent focus on teaching and learning, and using time optimally for teaching and learning.

The second kind of indicator revealed by the patterns of Table 2 are those which are associated with better performance, but after a certain threshold has been reached these practices seem to add no further value. These are Parental involvement and Governance. Regarding the latter, it is clear that conflict on the SGB can destabilise school relationships and work processes, and affect performance, as is obviously the case at B1. However, while excellent leadership may generally accompany excellent governance (C2 and D2), an SGB that performs its administrative and HR functions adequately, without being too involved in curriculum issues, provides a sufficient platform for excellent performance (A2). Regarding parental involvement, it seems that under conditions of poverty the impetus for parental involvement in the learning systems of the school is more likely to come from the school than it is to be initiated by parents. Further, in the poorly performing schools in each of these three pairs school leaders have a resigned attitude towards parental apathy, while their higher performing counterparts display a proactive stance toward building a relationship with the parent body.

The third set of indicators recognisable in Table 2 is the largest, containing indicators that either support their respective hypothesis or are neutral, but never refute it. This set contains six indicators: relationship with the unions, regulatory conditions, distribution of leadership roles, directing curriculum planning and monitoring, and collegial practice on both curriculum delivery and assessment. Interestingly, the indicator that appears to matter least in this group, if not in the entire suite, is the Relationship between school leadership and the unions. Political economy is another area in which the coloured schools in the WC are different to all eight other schools in the sample: here there is a tolerance of different unions in both schools, a far more moderate approach to strike action, and no sense of union intimidation. At the eight African schools in the sample, there is a curious attitude among teachers. On one hand, membership of SADTU is in the large majority if not ubiquitous. On the other, while teachers largely conform with union policy and practice, there is a significant if not majority view of the unions as a force which is educationally disruptive, and 'out there' rather than arising from within the school. Nevertheless, the relationship between intensity of union activity and school performance appears to be weak at best. Skilful leadership is able to minimise the effects of predatory union behaviour, in this case the appropriation of time for union activity at the expense of teaching hours. Public violence and lesser acts of indiscipline perpetrated by teachers under the auspices of their union do occur, and are severely disruptive to learning. However, the evidence indicates that, where school leaders have sufficient

capacity, productive relationships with teachers, severally and collectively, can be maintained and directed to positive ends.

The fourth set of indicators relate to those activities most proximal to what happens at the classroom chalk face: procurement, management and use of books; promoting professionalism; induction of new teachers; and programmes for the development of proficiency in the language of instruction. With the exception of school A2, the highest performing school in the entire set, scores on these indicators are rather low and poor at distinguishing high performing schools. Therefore, combining their high theoretical importance to learning with their weak presence in the case study schools, we would expect relatively small changes in these indicators to hold the greatest potential for improving the outcomes of schooling.

Conclusion

The theory framing the present study is succinctly captured in Table 1. While only six of our 10 case study schools directly fit the model, two follow suit if the dimension of time is added, while the remaining anomalous pair is best explained by the formulation of a distinct model of effective school leadership and management for small multi-grade schools. Our theoretical model is given further support by the results of the NSES modelling exercise described in Chapter 3. We conclude, therefore, that the framework is sufficiently robust to sustain experimental work and further research, although still far short of providing firm policy recommendations. The least that can be said to follow from our findings is that the quality of school leadership is key to improving performance in at least a large number of the country's primary schools. Starting from this premise, and mindful of the speculative nature of the enterprise, what follows is an outline of what our model predicts regarding better-than-average school leadership.

A key element in effective leadership is the belief in individual and collective agency: poor principals appear resigned to their circumstances, while effective leaders are able to engage productively with the same conditions, be this in using time more efficiently, engaging the community in daily meal production for learners, or using minimal supplies of books effectively. A second general characteristic of good school leaders is that they are skilled in human relations, able to build harmonious team approaches to teaching and learning, and to avoid the kind of conflict that debilitates many schools. It would seem that, in the first instance, principals should be selected on these difficult-to-measure attitudes and 'soft' skills.

Regarding the 'hard' skills required by effective principals, our 15 indicators provide cryptic pointers, which space precludes us from detailing at

this juncture, but which require elaboration before they can be operationalised in teacher training and support programmes and protocols for recruiting and regulating the work of principals. If our model does prove to be robust in the face of further studies, it would suggest that the 15 indicators and their respective hypotheses are the place to start in devising training programmes that are more effective than those currently in use are.

Finally, the model predicts that the greatest learning gains are to be found in those leadership activities that are closest to the teaching/learning interface. Collectively these indicators point to those key nodes in the complex machinery of schooling most likely to leverage improved performance: developing proficiency in the primary medium of learning, the language of instruction; the frequent use of books, the key technology for conveying knowledge; and professional development aimed at building teachers' subject and pedagogical knowledge.

Acknowledgement

Work in schools A1, A2, B1 and B2 was conducted through an association between JET Education Services and the SPADE research project at the University of Cape Town. SPADE is sponsored by the Department of Higher Education and Training and the Department of Basic Education through the European Union Primary Education Sector Policy Support Programme. Additional assistance was provided by a number of organisations in identifying case study schools and facilitating work in these schools: the Maskew Miller Foundation (C1 and C2), the Red Cap Foundation and JET Education Services (D1 and D2), and JET Education Services (E1 and E2). We gratefully acknowledge this support. Any opinion, findings, conclusions or recommendations expressed here are those of the authors and do not necessarily reflect the views of the sponsors.

[1]Integrated Quality Management System, a national quality assurance system for assessing school performance.

[2]Fanagolo, a pigeon amalgam of South African languages composed mostly of commands and directives, was invented in order to communicate with migrant mine workers with little or no English.

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Chapter 5

The language of teaching and learning in South African schools

Carien Vorster, Aneesha Mayet and Stephen Taylor

Introduction

This chapter is an attempt to contribute to the debate around the influence of the language of teaching and learning on learner achievement in South African schools. After 1994, Afrikaans and English were supplemented as official languages by the nine largest African languages (Republic of South Africa, 1996a). The Constitution gives South Africans the choice to receive education in public institutions in any of the official languages. The current reality in the majority of primary schools in 2012 is that School Governing Bodies (SGBs) choose to have the Foundation Phase taught in the dominant home language of the learners in their school, with the language of learning and teaching (LOLT) changing to English from Grade 4. In the high schools, teaching occurs in English, except in a small and diminishing minority of Afrikaans schools.

The prevailing discourse on effective schooling in South Africa is heavily influenced by the language debate. This is prompted by the fact that children with an 'African' home language perform considerably worse on average than English or Afrikaans children and face an obvious disadvantage of having to switch to their second or third language for instruction after Grade 3. However, the true causal impact of language factors is particularly difficult to identify due to other confounding factors. Schools in which the LOLT does not coincide with the home language of most learners are typically also those schools most affected by poverty, poor infrastructure and ineffective teaching and management practices. Moreover, language dynamics may interact with other factors influencing learning. For example, language factors may compound the effects of poor teacher content knowledge (discussed in Chapter 8) and inappropriate pedagogy (see Chapters 6, 7 and 8). Discussions around the performance in South African schools therefore run the risk of,

under- or over-attributing low performance in parts of the system to language issues.

Nevertheless, as the medium through which learning occurs, the role of language cannot be ignored when analysing educational achievement, as emphasised in Chapter 1 in our discussion on the work of Bernstein and the centrality of the elaborated code in developing and communicating meaning. Clearly, research seeking to understand how language dynamics affect learning in South African schools is not a simple matter, and a short supply of research output hampers progress in understanding this important issue.

This chapter begins by reviewing the policy debate on language in education, the two poles of which are: home language education progressively supplemented by others (additive bilingualism), and schooling in English only from Grade 1 (straight for English or SFE). The strength of the evidence for the two arguments will be assessed and the advantages and limitations of the opposing approaches within the South African context explored. This is followed by a discussion of current South African language in education policies with a focus on the new direction taken by government in the formulation of the Curriculum Assessment Policy (CAPS) document of 2011. Lastly, the findings of the National School Effectiveness Study (NSES) will be examined with a focus on the influence of language in teaching, learning and assessment. Although we foresee a somewhat inevitable move towards SFE in urban areas, especially in Gauteng, the chapter will argue that the South African version of additive bilingualism involving a transition to English as the LOLT in Grade 4 seems appropriate, given the available evidence and practical constraints. However, the implementation of this model needs considerable improvement and support. The chapter therefore concludes with recommendations for the improvement of teaching English First Additional Language (FAL) in the Foundation Phase, and the improvement of teachers' skills in all South African languages.

Additive bilingualism

Lambert (1973:25) distinguishes between additive and subtractive bilingualism, where true *additive* bilingualism results when the learner can use both languages very well, while subtractive bilingualism occurs when the additional language effectively replaces the first language. This chapter will use the term 'additive bilingualism', although it is probably the case that most African learners in South Africa who are schooled in English do so at the cost of continuous development of their home languages.

Proponents of additive bilingualism claim that children who begin their education in their mother tongue make a better start, demonstrate increased

self-confidence and continue to perform better than those who start school in a new language (Dutcher, 2004). It is also argued that learners who are exposed to their home language as the medium of instruction over a longer period of time tend to perform better in higher education than those whose schooling has been in a 'foreign language' (Heugh, 2005a; 2005b; World Bank, 2005; 2009; Pinnock, 2010).

Among advocates of additive bilingualism, there is not always clarity on just how long the HL phase should be before the second language becomes the LOLT, although there is agreement that there should be a time of transition, where the HL and the second language are used together in the classroom. The model adopted in South Africa and in many other African countries is an early exit transition model, meaning that after just three years of schooling the transition in the LOLT occurs. However, many linguists maintain that a late exit transition model, where the transition occurs after at least six years, is preferable for establishing a solid foundation in reading and overall cognitive development. One study that is clear on this point concluded that:

> ... using African languages as media of instruction for at least six years and implementing multilingual language models in schools will not only increase considerably the social returns of investments in education, but will additionally boost the social and economic development of African nations and contribute to the improvement of the continent to knowledge creation and scientific development (Alidou et al, 2006: 7).

Overstep

Alidou et al (2006) reviewed research on language in education in 25 countries across Franco- Luso- and Anglophone Africa. The starting point for this research was the fact that most African countries at the time were advocates for the continued use of the respective European language as the primary medium of instruction throughout the educational system. The report conceded that the current language policy and education system had worked well under the colonial system and succeeded in developing the leadership manpower required for the Africa envisioned by the colonial powers. However, it went on to declare that 'This colonial vision of Africa should and can no longer be the vision for contemporary Africa' (Alidou et al, 2006:10). According to these authors mother tongue instruction should ideally be maintained throughout the school, although this will only be viable if the socio-economic environment values these languages so that people with a diploma in an African language will find challenging positions where they can continue to grow professionally. However, this greater emphasis of mother tongue instruction sails against the wind of opinion amongst parents in today's global world. As one parent from an African village argued, 'It's not skill in his mother tongue which makes a child succeed in life, but how much English he knows. Is it going to be one type of school for the rich and another for the poor?' (Alidou et al, 2006: 6).

Giving scientific support to this parent's implicit understanding of the market, Posel and Casale (2011) show that the economic returns to English language proficiency are larger and higher than those to home language proficiency for the majority of employed South Africans. The authors note that this finding helps to explain why there is little incentive to switch to an African language as the language of instruction in schools. However, Posel and Casale also show that African adults are significantly more likely to be proficient in English if they are proficient in their home language. The authors conclude by recommending additive bilingualism as the preferred route to both English and HL proficiency.

In the same vein as Alidou et al (2006) quoted above, the Project for the Study of Alternative Education in South Africa (PRAESA) supports home language instruction as the way to go about creating a learner-centred education system in South Africa. While PRAESA does not specify where HL instruction should end, the assumption seems to be that it should continue at least to the end of primary school. Neville Alexander, the late chairperson of PRAESA, gives an exposition of the underlying assumptions of PRAESA's research programme (Alexander, 2011). He suggests that teachers will have to be extensively re-trained and that resources must be developed in all the official languages of South Africa. Bilingual literacy should then be developed based on the home language and utilising excellent teaching strategies for additional languages, for as long as possible from Grade R. The model presented by PRAESA is that ideally schools should offer a dual-language system with the home language being the main language of learning and teaching for as long as possible, alongside a second language of learning and teaching. In addition, other languages could be taught as subjects in the school curriculum. The assumption is that such a system would gradually convince stakeholders, particularly parents, of the value of the home language in education.

2 generations

Alexander concedes that there are many challenges along this route, not least of which is getting rid of the stigma around home language instruction, and therefore predicts that it would take up to two generations to change the system. PRAESA also does not claim that home language teaching on its own can improve the education system, but states that it could only work together with improved quality of instruction.

One of the earliest South African studies on language in the first three grades, the Threshold Project conducted by Macdonald et al (1991), looked at the underlying causes of the failure of Bantu education to produce literate children at the end of primary school. The study found that what children learn in English-as-a-subject in the years before 'crossing the threshold' from HL to

English as the LOLT is not enough to facilitate their learning in other subjects thereafter. It further found that learners need a good grounding in their home language in order to develop literacy in English. Teachers were found to be in a bad predicament because of the policy of teaching in English only from standard 3 (Grade 5): they knew that teaching in English would alienate most of their learners, while most teachers also did not have the skill (or time) to translate explanations of difficult work from the home language into English. It follows that teachers' proficiency in English is even more important than that of learners (Macdonald et al 1991). In addition, Dutcher (1994) cites McLaughlin's assertion that it is a myth that children learn their first language by the age of six. She adds that McLaughlin's research demonstrated that children take up to 12 years to learn their first language and, in fact, adults still continue learning parts of their first language all their lives. Language development contributes to cognitive development and, in turn, the cognitive development contributes to language development. Hence, she argues that mastery in the child's first language contributes to the cognitive readiness for second language acquisition.

Macdonald et al found that children are more successful at learning English if they have first become literate in their own language (1991). The authors conclude that home language must continue to be taught so that learners develop confidence based on strong literacy and good thinking skills in their own language, which should in turn form the basis of their English learning. When children learn to read, they focus only on decoding the letters. If they also have to focus on the meaning of the words written in an unfamiliar language, it takes that much longer to master the skill of reading. At this stage, reading merely confirms objects, spaces and experiences the child is already familiar with, in other words, they are not reading for new information.

The findings of the Threshold Project recommend a 'transitional approach' – these days referred to as additive bilingualism. Macdonald et al argue that this approach should function on the basis of the following principles: The home language must be very well taught, as it is to function as the basis for learning English as well as learning new content and developing cognitive skills. English must not merely be taught as a second language, but must be introduced slowly and purposefully with the aim to equip learners to use it as a first language. English and the home language should each be used to support learning in the other language through the teaching of keywords – a sophisticated form of code switching – during a phase of transition from one LOLT to the next (1991).

More recently, the Pupil Progress Project (PPP) found that language is the most important factor in achievement after poverty in Western Cape schools (Van der Berg and Yu, 2006). The PPP researched the impact of the LOLT on achievement in literacy and maths, among Grade 6 learners in 90 schools from a range of socio-economic and historical backgrounds in the province. The study found that learners scored higher when the language of instruction or the language of the test was the same as their home language. If the home language did not coincide with the LOLT, exposure to the LOLT at home improved achievement in the literacy test. The findings of the PPP emphasise the importance of learning in the home language and of purposefully developing proficiency in the LOLT when it is different from the home language. These findings support a system of additive bilingualism.

Cazabon, Nicoladis and Lambert (1998) researched the impact of a two-way bilingual immersion programme in the United States, the Amigos Program, the purpose of which is to support the education of linguistic minorities in the US. It is based on the principle of additive bilingualism with the goal of mastering both the home language and the additional language. This is opposed to other programmes in the US, which use the home language only as a transitional instrument to master English.

The Amigos Program was instituted in the USA in 1986. It is made up of 50% home language Spanish and 50% home language English speakers in the same class from Grades 1-8, with a parallel English-only stream. In the mixed language classes, teaching time is shared equally and both cultures are taught. Cazabon et al's analysis emphasises the positive impact of additive bilingual education, and may give us an idea of the conditions necessary to achieve both educational and psychological success through a language programme. To evaluate the success of Amigos, the study looked at attitudes towards bilingualism as well as academic achievement in a cohort of students over at least five years.

Attitudes towards bilingualism were measured in Grade 8, three years into the programme, and found to be very positive. Academic achievement was measured over six years, from Grade 4 through to Grade 8 (1991-1997), through standardised tests in Spanish and English. The results were compared with those of the parallel English-only stream as a control group, and those of other native English speakers enrolled in a regular all-English American school. The Spanish control group consisted of native Spanish speakers in American schools, who were enrolled in transitional bilingual classes. In this stream, they would have focused on achieving competency in English within two or three years in order to continue their education in English. Students in the higher grades in this stream would have recently come from all-Spanish schools, possibly outside of the USA, and could be expected to have high ability in Spanish as a home language (Cazabon et al, 1998).

When the reading and maths results of the Amigos were compared to the results of the control groups, the Amigos almost always outperformed the controls. Both the English and Spanish Amigos outperformed the English controls in reading and maths in the standardised English tests, except in Grade 7 and Grade 8 maths, where there was no difference in results, and in Grade 7 reading and maths, where the Spanish Amigos scored below the English controls. This study shows that learners in the Amigos Program achieved high levels of proficiency in both the home language and the additional language, and that their language skills were well balanced. One of the conditions of success emerging from this research is that teachers should be native speakers of the LOLT, whether home language or English.

Haiti and Nigeria, both countries who went straight for French and English respectively prior to 1980, learnt over time that their national literacy rates were very low and that changing the language of instruction in the primary schools to Creole or Yoruba respectively helped improve literacy levels and the acquisition of the second language of French and English (Dutcher, 2004). This change, however, was supported by improving teacher language competency through the establishment of specialised teacher training centres, and the availability of primary reading materials in the respective home languages. The Nigerian six-year project proved two lessons, viz. indigenous language can be used successfully for education and is flexible enough to express scientific subjects, and secondly, time spent in using mother tongue did not take away successful learning of the language of communication. In other words, mother tongue facilitated the cognitive development upon which the acquisition of the second language depends (Dutcher, 2004).

A major factor in the poor teaching that characterises many South African schools serving poor learners is the generally low level of both English proficiency and general literacy exhibited by primary school teachers (see Chapter 8 for details). As a result, English is poorly modelled to many learners, especially in rural areas where the teacher may well be the only regular point of exposure to English. In addition, learners who have not had the opportunity to engage with the language at home will find that learning the language of instruction at the same time as learning other school subjects is a cognitively challenging process. It seems logical that teachers cannot facilitate higher cognitive learning if they do not have the vocabulary to support it. This is a problem that limits the success of any language policy, whether it is additive bilingualism or SFE.

Straight for English

At the opposing pole of the language debate are those supporting a straight for English (SFE) approach where all formal schooling is offered in English from the first day. Ghana is one of the African countries that adopted SFE in 2002. Before independence in 1957, schooling was conducted in a combination of indigenous and English languages. The first post-independence Ghanaian government changed the policy to SFE. A decade later, between 1966 and 2002, indigenous languages were once again introduced in varying degrees, at times only in the first year and at times up to the sixth year of primary education. Since 2002, this policy has been reversed once again to SFE with the compulsory study of one of the Ghanaian languages as a subject up until senior secondary (Owu-Ewie, 2006).

Some of the reasons offered by the Ghanaian government for changing to SFE include the following:

1. The policy of crossing to English after the early years was not adhered to and teachers continued to teach in the indigenous languages well into secondary school
2. As a result, students' proficiency in English was very poor, even at the end of their school education
3. English is the lingua franca of the Ghanaian state and therefore the schooling system must develop English proficiency in its learners
4. Urban schools were multilingual which made it practically impossible for teachers to teach in all the home languages represented in the early years
5. There is a lack of teachers skilled to teach content subjects in the Ghanaian languages
6. There is a lack of educational resources in the indigenous languages (Owu-Ewie, 2006:78).

Owu-Ewie argues that there was no problem of design with the additive bilingual policy in Ghana prior to 2002, but that it failed at the implementation level. This is because the policy was not supported by the necessary training and resources for teachers and learners to make the successful learning of English possible. Owu-Ewie goes on to advocate the development of indigenous languages into academic languages through the financial backing of the state, much as PRAESA does in South Africa. Also similar to PRAESA's argument is Owu-Ewie's case that a policy of additive bilingualism in itself could not improve the outcomes of education, but that the quality of teaching in languages in the early years must be improved at the same time (Owu-Ewie 2006:78).

Owu-Ewie (2006) argues that under the pre-2002 policy, the transition from HL to English was made too early and too abruptly. Therefore, he advocates

late-exit (Grade 5 at the earliest) transitional bilingual education with the aim to establish literacy in the home language before crossing to English as the LOLT. Owu-Ewie maintains that using HL in the first years will help learners to adjust to the new social environment of schooling.

One of the strongest arguments for the SFE approach is provided by a case study of Singapore, a multi-ethnic, multi-lingual country that performs very well in standardised international tests in literacy, mathematics and science, such as the TIMSS and PIRLS. According to Dixon, Singapore's highly successful implementation of its SFE policy in public schools challenges the argument that home language education or additive bilingualism is best (Dixon, 2005:25).

Following independence from Britain in 1965, Singapore chose the SFE approach for economic reasons and for access to Western science and technology, as they were dependent on international trade and were combating high unemployment rates. Three main ethnic groups are represented in the population: Chinese, Malay and Indian. English was chosen as the 'neutral' language of inter-ethnic communication, effectively becoming the official language of the state. Malay, Chinese (Mandarin), and Tamil were also selected as official languages, representing the home languages of the three main ethnic groups, although many other vernaculars are spoken in the country (Dixon, 2005).

It is worth noting that in Singapore the SFE policy is formally known as a 'bilingual' policy, although not according to the definition used in this chapter. Education in Singapore is bilingual in the sense that the LOLT is English from Grade 1, but home languages are taught as subjects. The SFE policy was gradually phased in, starting at independence when Mandarin, Malay and Chinese became compulsory subjects in English schools. At the same time, the compulsory teaching of English was introduced into Chinese, Malay and Tamil schools. After one year, the government introduced the teaching of maths and sciences in English only, from the first grade. Parents started voting with their feet in favour of English education so that, within 20 years of introducing schooling in English, schools offering home language instruction beside English were virtually non-existent. In 1987, 22 years after the policy was first introduced, government effectively closed the few remaining HL schools by declaring that all subjects must now be taught in English. In other words, the government of Singapore adopted a gradualist approach to change in school language policy, probably in response to or in step with changing social and cultural conditions. Nevertheless, home languages are maintained, and in 2000 only 23% of the Singaporean population reported English as their predominant home language (Dixon, 2005).

It is thought that the economic value and high international status of English allowed it to be readily accepted by Singaporeans as the language of education. Through strong government advocacy, the population was also persuaded to

adopt only three main languages as home languages, with the larger part of the population changing to Mandarin and a significant proportion to speaking English in the home (Dixon, 2005). Dixon also reports on the bilingualism of Singaporean students, referring to three studies, all of which found literacy in both English and one home language to be strong, although reading and writing in English was often stronger, while oral skills were mostly stronger in the home languages (Dixon, 2005:41-42). Education in English seems to depend for its success in Singapore on three important conditions: a competent state, a gradual transition from HL to English as the LOLT, and the continued support by the state of the development of a selection of home languages. Interestingly, the policy in Singapore led to strong bilingualism, despite not taking the theoretically sound route of HL literacy first and English literacy second.

The South African language in education policies

Following the provision in the Constitution that everyone has the right to education in the official language of their choice, the South African Schools Act states that School Governing Bodies (SGBs) should develop their school's language policy in such a way that it does not discriminate against any group of learners (Republic of South Africa, 1996b). Currently the result of this policy is that those children whose HL is English or Afrikaans are taught in their HL, while African children in former African schools generally start with an African language (the HL of the majority of learners in the school) for Grades 1-3 and then switch to English as LOLT in Grade 4. African learners in former whites-only schools (some 54% of their roll[1]), and in former Indian and Coloured schools also learn in English from Grade 1, while a number of African schools opt straight for English (see Figure 2, Chapter 8; Taylor and Moyana, 2005).

Policy on the language of education in South Africa is stipulated in subsection (1) of the South African Schools Act (SASA), the Norms and Standards for Language Policy in Public Schools (Republic of South Africa, 1996b). The Act uses a combination of terms, such as 'multilingualism', 'bilingual education' and 'additive approach to bilingualism' to describe the principles upon which the language-in-education policy is based. However, SASA and other legislation dealing with language in schools do not provide definitions for these terms nor are they consistent in employing them, which could lead to confusion in the implementation of the policy by SGBs. For example, the National Education Policy Act (Republic of South Africa, 1996c, sections 1, 4) states that 'multilingualism' should be promoted to preserve cultural diversity and that 'being multilingual should be a defining characteristic of

being South African'. It further states in section 6 that the education system has an 'obligation' to 'promote multilingualism'. No formal definition of multilingualism is provided, but it can be understood as the ability to use more than one language in spoken and/ or written communication.

Test scores such as those described in Chapter 2 indicate that the South African school system is not achieving the language aims outlined in the legislation. For Naledi Pandor, Minister of Education from 2003 to 2009, to a considerable extent the problem lies in implementation failure, although, echoing the PRAESA goals, she also expressed the ideal of extending HL schooling to the end of Grade 6 and called for political commitment to the development of indigenous African languages (Pandor, 2006). Webb (1999) has argued that the extent to which current policies can be implemented depends heavily on state capacity, and particularly on that of school principals (Webb, 1999). Foley (2007) responds to Minister Pandor's statement by identifying the obstacles faced by government if they are to take serious action in implementing a policy of home language instruction with additive bilingualism up to Grade 6. These are:

1. African languages are not developed as academic languages.
2. The curriculum statements are not available in African languages, not even for Foundation Phase, unless it is the statement for that language.
3. Not enough teachers are educated in African languages to a level that allows them to teach in that language. Pre-service and in-service training will have to be provided.
4. Implementation in schools will depend on serious advocacy because many stakeholders do not see the value of home language education up to Grade 6.
5. Transition to English as LOLT will have to be made at some point and therefore teaching of English as an additional language must be strengthened.

Marketing

Hoadley (2010) agrees with Foley in saying that learners do not develop sufficient proficiency in English in the Foundation Phase to cope with it as the medium of instruction beyond Grade 3. Teachers are often not proficient in English, which limits learners' opportunity to learn. At the same time, additive bilingualism can only be a reality if all learners have the advantage of acquiring English within the context of home language instruction. This would imply that Foundation Phase teachers should be proficient in multiple African languages, which is not the current reality in South African schools (Hoadley 2010).

The Curriculum and Assessment Policy Statement (CAPS) finalised in 2011 is a sign of a new commitment by Government to the more efficient implementation of the additive bilingual model. The CAPS determines that the First Additional Language (FAL) (in practice this is English for most children) should from 2012 be taught as a subject from Grade R through to Grade 3, using the home language as the basis for learning. In schools where English is

the Home Language, CAPS specifies that eight hours per week be spent on HL and two on FAL. In schools where English is the First Additional Language, seven hours is to be spent on HL and three on FAL (DBE, 2011).

While there is some disagreement as to how long HL instruction should persist in the primary school, there is no serious disagreement over the broad goals of additive bilingualism. Furthermore, in placing school language policy in the hands of the School Governing Body, current policy makes provision for local adaptation to changing demographic conditions. In Chapter 1 we noted the rapid urbanisation of the population, including high rates of migration from neighbouring countries and even further afield. Under these conditions, which include a high degree of heterogeneity of home languages in schools and high levels of exposure to English, parents are likely to opt increasingly for a straight for English approach. However, the successful implementation of any policy depends heavily not only on teacher proficiency in the language(s) concerned, but also on the other capacities described in the chapters that follow.

What can we conclude about language disadvantage from the NSES?

Table 1 describes the distribution of the NSES sample by home language. The mean Grade 5 literacy and numeracy scores are also reported. Unsurprisingly, the performance of Afrikaans and English children is considerably better than that of African language children. However, these differences are to a large extent caused by poverty and other overlapping educational disadvantages rather than by language factors alone.

Table 5.1: Distribution and performance by home language in the NSES, Grade 5

Home language	No of learners	Weighted proportion	Performance (mean percent correct)	
			Literacy	Numeracy
Afrikaans	1 029	10.35	48.8	60.5
English	344	4.11	67.4	80.9
isiNdebele	208	1.74	35.0	47.4
isiXhosa	1 264	19.06	35.0	45.8
isiZulu	1 983	25.73	36.6	45.2
Sepedi	1 087	11.73	30.6	38.6
Sesotho	733	10.14	34.0	42.0
Setswana	792	7.99	37.5	44.5
siSwati	331	2.67	42.3	49.4
Tshivenda	132	1.48	29.2	38.8
Xitsonga	476	5.02	32.4	40.5
Total	8 379	100.0	37.7	47.0

A unique research opportunity is presented by the comparability between the NSES data and that of the Department of Education's Systemic Evaluation (SE) exercise undertaken on a national sample of Grade 3 learners in 2007. The same tests were administered to the same learners in both the NSES and the SE, the only difference being that in the NSES learners wrote in English whereas in the SE the test was administered in their home languages. The NSES schools were a sub-sample of the schools who wrote the Systemic Evaluation tests, and we were therefore able to match individual learners who wrote both tests, in their HL in the SE exercise, and in English in the NSES. The NSES fieldwork was conducted in mid-August of 2007, and the systemic evaluation soon thereafter in September and October of 2007. All learners in Grade 3 had to sit for the NSES test, while only 25 Grade 3 learners in each school sat for the systemic evaluation test.

In the NSES tests, learners speaking English as a home language performed best in the English literacy test, followed by Afrikaans home-language learners, but as we have already said, language factors overlie poverty effects in achieving these results Learners speaking Tshivenda and Xitsonga at home demonstrated the weakest results in the English literacy test. In addition, the mean score of the learners speaking any of the African languages as home language was below 50%. Similarly, the learners speaking any of the nine African languages achieved poor results in the numeracy test. However, the results showed an improvement over the three years. Since the LOLT for most learners is English from Grade 4, it was decided to administer the NSES tests in English in Grades 3, 4 and 5 to ensure comparability across the years.

Comparison of the scores of those learners who wrote both the SE and NSES constitutes a type of natural experiment in which all factors, including the actual learners, are held constant except for the language of the test. This presents a unique opportunity to assess the influence of the language of testing on learner performance in tests such as those administered in the NSES, SACMEQ, TIMSS and other large surveys of educational achievement.

The matching of individuals was done using school EMIS[2] numbers together with the first three letters of the child's surname, the first letter of their first name and their gender. The matching process was conservatively done in the sense that errors of excluding learners who did in fact participate in both evaluations were far more likely than errors of false matches. Ultimately, a matched sample of 2 119 learners was realised. Table 2 suggests that the sample that was successfully matched was somewhat stronger than the remaining NSES sample that was not matched to the SE. In both literacy and numeracy, the matched sample achieved a higher mean score than the unmatched sample. There are at least two possible reasons why the unmatched NSES sample performed worse on average. Firstly, it may be that weaker children were more likely to make mistakes when writing their names than more literate children,

thus leading to unsuccessful matching on learner names. Secondly, it is possible that the selection of 25 learners in the SE was not entirely random but was influenced by teachers somehow ensuring that stronger children participated in the SE.

Table 5.2: Performance in NSES of matched and unmatched samples, Grade 3

	NSES Literacy score	NSES Numeracy score	Number of learners
Unmatched (NSES only)	17.34%	24.57%	14 384
Matched sample	23.08%	33.62%	2 119

Table 3 indicates that average performance amongst the matched sample was better in the SE than in the NSES. There are two possible reasons for this, namely the benefit learners had in the SE of being tested in their home language and the effect of learning from writing the same test a second time. The performance difference between the two tests was considerably larger in the case of literacy than in numeracy. For literacy, average performance in the SE was nearly ten percentage points higher than in the NSES. For numeracy, the difference was approximately three percentage points.

Table 5.3: Mean literacy and numeracy scores of matched sample in NSES and SE

	NSES	Systemic Evaluation
Literacy	23.08%	32.72%
Numeracy	33.62%	36.64%

Figure 1 shows the mean literacy scores in the NSES and the SE by home language. To indicate whether the differences between the means were statistically significant, 95% confidence intervals are provided. In the case of English speaking learners who would have written both tests in English the difference in performance across the two tests was not statistically significant. In all the other language groups, performance was higher in the SE, and in eight of these language groups, the difference was statistically significant. One would expect that any potential effect of learning from one test to the next would have the same impact on all language groups. Therefore, the fact that English speakers appeared to do equally well in both evaluations while all other groups did better in the SE than in the NSES would suggest that the language of the test did indeed have an important impact on performance in the NSES.

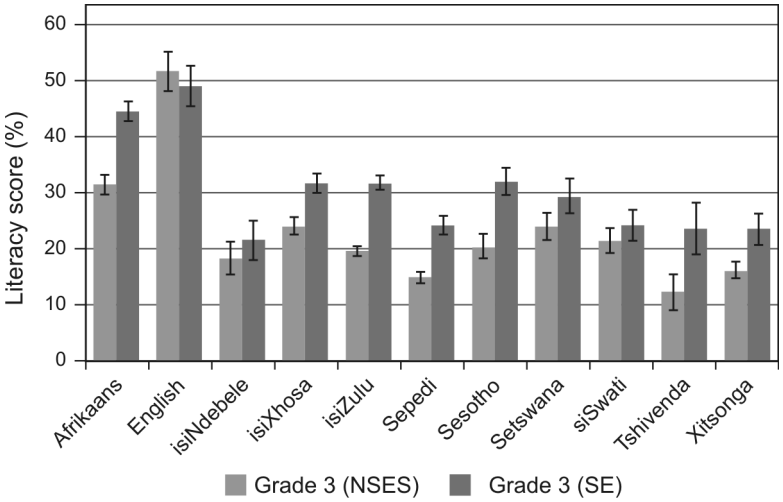

Figure 5.1: Mean literacy scores in NSES and SE by home language

Note: 95% Confidence intervals around the estimated mean are depicted on each bar.

Figure 2 gives the same analysis for numeracy. The same basic pattern emerges although in the case of numeracy, for most language groups, the difference between performance in the NSES and SE is not statistically significant. This would indicate that the language of the test did not have as large an effect on numeracy achievement as it did on literacy. This is borne out in the simple correlation between SE and NSES literacy scores (0.65) being lower than the correlation between SE and NSES numeracy scores (0.76). It would be speculation to attempt to explain the reasons for lower language effects in maths, but one possible explanation which presents itself is that teachers use a great deal of English terminology in their maths lessons, because much of it is not available in the relevant African language, or, where it is available, is not widely known to teachers.

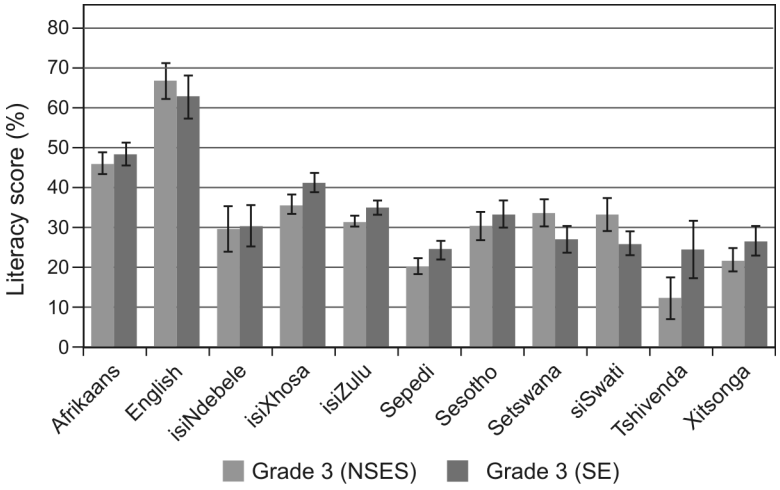

Figure 5.2: Mean numeracy scores in NSES and SE by home language

Note: 95% Confidence intervals around the estimated mean are depicted on each bar.

In order to examine these patterns using a more rigorous statistical technique, a survey regression was estimated with the outcome variable being the difference in achievement between literacy in the SE and the NSES. This model (not shown here) took account of learner socio-economic status, the former education department to which the school would have belonged under apartheid, whether the learner's home language was English, the level of literacy achievement (taken as the average of the NSES score and the SE score) as well as the possibility of an interaction between the level of literacy achievement and the effect of language. The results showed that at the higher quintiles of literacy proficiency (where there are enough observations to compare English and non-English speakers) the performance gap between SE and NSES was significantly smaller for English speakers than for non-English speakers. It is also interesting that at the lowest levels of achievement there was little difference between performance in the SE and the NSES (non-English speakers only). This may reflect that the knowledge base of these learners was so low that writing in their home language yielded no substantial improvement, or, in other words, learners are not learning much in either language

An alternative method for matching the SE and NSES samples was also implemented in order to test the consistency of the results. Under this method, matching was done at the school level rather than at the level of individuals. The disadvantage of this method is that one is left with a smaller sample of 246 schools as observations, while the benefit is that there are no errors of omission or mistaken inclusion due to incorrect matching. Table 4 compares

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school mean literacy and numeracy scores across the two surveys. As the first method showed, performance was better in the SE than in the NSES, especially in the case of literacy.

Table 5.4: School mean literacy and numeracy scores in NSES and SE

	NSES	Systemic Evaluation
Literacy	18.44%	30.55%
Numeracy	27.13%	33.41%

Figure 3 shows the school mean literacy scores in each test by the most common home language in each school. The figure confirms that the difference in performance between the two tests in schools where English was the dominant home language was not statistically significant. However, in nine of the ten remaining language groups school mean performance was significantly better in the SE, as the confidence intervals show.

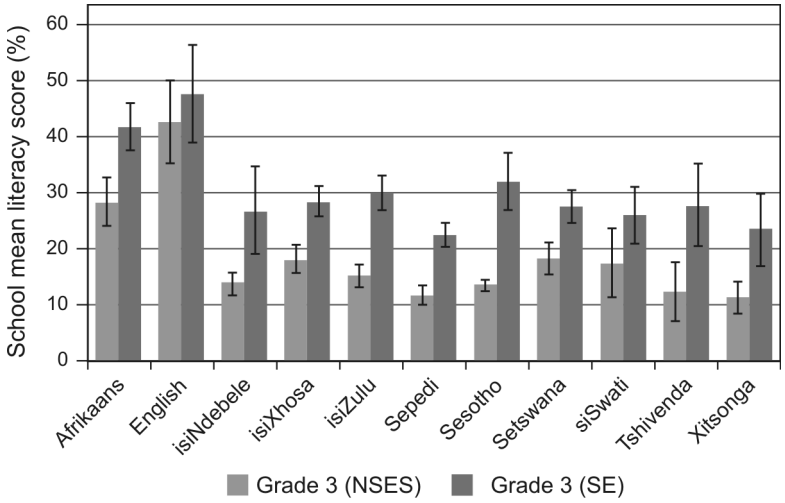

Figure 5.3: School mean literacy scores in NSES and SE by most common home language

Note: 95% Confidence intervals around the estimated mean are depicted on each bar.

For numeracy (not shown here), school mean performance was generally higher in the SE for most language groups but the difference across the two tests was generally not statistically significant. The school-level analysis therefore confirms what the individually matched analysis showed: English-

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speaking learners performed much the same in the NSES than in the SE, while other language groups performed worse in the NSES. This would suggest that writing the test in English was indeed a significant disadvantage for non-English speakers in the NSES. This disadvantage may be less severe in Grades 4 and 5 once learners have been exposed to English as the LOLT, but there is no way to test this conclusively using Grade 4 and 5 NSES data.

Howie et al (2007) have also compared test scores when learners write in their home language using the PIRLS 2006 study. Learners from just over 400 schools were tested in Grades 4 and 5 in any one of South Africa's 11 official languages. Schools were given the choice of test language. Information was collected at the individual level about whether the language of the test was also the learner's home language. Using this information, Howie et al found that, amongst both Grade 4 and Grade 5 children, those in schools that took the test in English or Afrikaans had a considerable advantage if that language was also their home language. It is likely that the performance difference between the 'same' and 'different' groups amongst those taking the test in Afrikaans or English is largely attributable to socio-economic differences. However, there was little observed benefit to speaking the language of testing at home in schools that took the test in any one of the other nine languages.

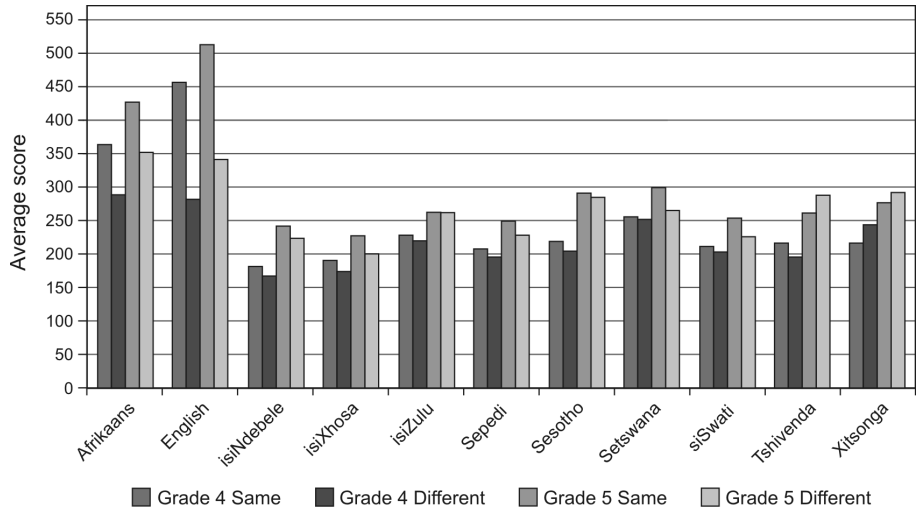

Figure 5.4: PIRLS achievement by language of the test and whether it coincides with home language

Source: Howie et al (2007)

This result from PIRLS appears to contradict the finding from the NSES-SE analysis, where writing in one's home language did make a difference amongst African language learners. So what might account for the two different findings? One key difference is that at Grade 3 (NSES-SE) the LOLT would have typically been the learner's home language, whereas at Grades 4 and 5 (PIRLS) most learners would have been taught in English. The fact that writing in home language in PIRLS was not associated with a performance advantage amongst African language learners may indicate that when one is not taught in one's home language there is little advantage to be gained through writing a test in one's home language.

This idea that comprehensive language immersion is crucial for learning is consistent with the finding in Chapter 3 that frequent exposure to English outside of school (through speaking at home and through the television) was strongly associated with better achievement even amongst those whose home language was not English. Therefore, even if the LOLT does not coincide with home language, frequent exposure to the LOLT outside of school can help reduce the language disadvantage that many South African learners are likely to face. This is also what Spaull (2011) found using SACMEQ data from 2007, namely that Grade 6 learners who spoke English 'always', 'often' or 'sometimes' in the home environment did better in both mathematics and reading than those who did not.

Conclusion

The practice currently followed in most schools serving African learners in South Africa – with the dominant HL as LOLT during the Foundation Phase and a changeover to English from Grade 4 – seems appropriate. But, as in so many spheres of public life, the devil lies not in the policy but in successful implementation, and South African children are not learning to read and write proficiently in any language. As our contextual review in Chapter 1 shows, supported by findings in a number of other chapters in the present volume, the roots of poor learning outcomes lie to a considerable extent in inefficient school management, poor knowledge resources on the part of teachers and ineffective teaching practices.

Regardless of exactly when a switch in language should occur, several things could certainly be pursued in order to ameliorate the language related obstacles to learning in the South African context. Teachers and learners should be given support that is focussed on easing the transition to English as the LOLT. Classrooms should be provided with sufficient reading materials in both English and the HL, and the importance of reading and writing stressed to school leaders and teachers (see Chapters 6 and 7). Pre-service and in-service

training should aim to improve the proficiency of primary school teachers in both African home languages and English. This will empower them to provide a solid grounding in home language and early cognitive development and to facilitate the transition in the LOLT effectively.

The teaching of English as a FAL from Grade R needs to be improved. In this regard, the CAPS provide a step in the right direction by stipulating the weekly time allocated to FAL in the Foundation Phase. The National Development Plan issued by the Presidency in 2011 recommends that specialist Foundation Phase English teachers be recruited from overseas and placed in schools where the need is most severe (NPC, 2011). While it may not be necessary to look overseas, the idea of at least one specialist English teacher per school is worth exploring. An investment at this early phase in the school programme is likely to have compound benefits through better learner performance in not only English, but all subjects up to matric and beyond that are undertaken in English.

In the light of the consistent findings that frequent exposure to English outside of school is linked to better achievement, we recommend that community level interventions that aim to improve English amongst young children be experimented with. Innovative projects that use sport or cultural activities as vehicles for exposure to English may even have benefits that go beyond language proficiency.

The above measures require attention, whatever the language policy of any school may be. Given the rapidly changing demographics of South Africa's cities, school governing bodies are likely to opt increasingly for straight for English policies. Pressures in this direction are provided by parental preference, the presence of many different home languages in any class, and an English-rich environment. The case of Singapore stands as a brilliant example of successful implementation of straight-for-English, a policy not recommended by the literature, but which became a key element in that country's strong school system and its economic miracle during the second half of the twentieth century.

1Data supplied by Martin Gustafsson, calculated from the DBE's Annual School Survey, 2010.

2The Educational Management Information System number assigned each school by the DBE.

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Chapter 6

Writing Matters: The Neglect of Writing in South African schools

Introduction

Writing is a powerful tool that helps us to communicate, think, reason, remember, learn, persuade, and convey knowledge. It permeates all aspects of our society and has transformed the world in which we live. The remarkable power of writing comes from its ability to leave a permanent trace. This unique characteristic makes it possible to re-think, revise, and reformulate what one knows. Its permanence also detaches writing from space and time. Whereas speech is fleeting, a written text can reach audiences across continents and through generations. Now more than ever the ability to express oneself clearly, correctly, and effectively through written language has become indispensable. Despite its importance, there is reason to believe that South African children are not developing this fundamental skill in school.

This chapter will use data from learner workbooks that were collected in the National School Effectiveness Study (NSES) to explore writing practices in South African primary schools. It begins with a brief discussion on learner performance and comments on the neglect of writing in the South African education system. It continues by reviewing the academic literature on writing and explains the methodology used to conduct the learner book analysis for Grades 4 and 5. It then examines the results for more than 200 schools across the nation and investigates the frequency, quantity, and quality of learner writing.

The oversight of writing in South African education

Learner performance in writing

For the NSES English literacy test, 8 383 learners across the country were followed for three years and given the same test in Grade 3, Grade 4, and Grade 5. The test, which assessed reading and writing skills, was made up of 40 items drawn from Grade 1 to Grade 4 (see Chapter 2).

Despite some improvement, learners performed poorly on all three years. By Grade 5, learners achieved a mean percentage score of only 37,7%. The majority of Grade 5 learners were able to complete the most basic reading and comprehension tasks when they contained easy vocabulary words. These items involved matching a simple word to a picture; choosing the missing word in a sentence to describe a picture; and retrieving straightforward information, such as numbers, from a text. In contrast, a little less than half of the learners were able to write a simple sentence describing a picture, and hardly any (less than 10%) were able to provide a written response to a text.

Similar results were found in the Department of Education's 2003 Grade 6 national test, which assessed 34 015 learners in 1 000 schools. Learners performed poorest on writing tasks. They obtained a mean writing score of 31% in comparison to a mean reading score of 50%. The struggle to express themselves in writing is also evident from the mean scores obtained by question type. Whereas the average score for multiple-choice questions was 49%, the percentage dropped to 31% for free-response items that required learners to formulate their own answers (DOE, 2005).

South Africa's poor performance in writing is not surprising when one considers the extent that writing has been neglected throughout the education system. However, South Africa is not alone in this regard. After years of inattention to writing, the United States and the United Kingdom faced their own writing crises and provide an important precedent for South Africa. Back in 1998, nation-wide assessments showed that about three-quarters of American students in Grades 4, 8, and 12 were writing below the proficient level and would be unprepared to meet the demands of higher education and the work place (Greenwald et al., 1999). The results drew national attention and by 2002, a national writing committee had been set up to push forward a writing agenda and bring writing to the centre of school reform (The National Commission on Writing, 2003). By 2007, the writing skills of eighth and twelve graders had improved. Average scores were higher as was the percentage of students who obtained a basic level or above in writing (Salahu-Din et al., 2008).

In the U.K., Beard and Burrell (2010) report that writing has been the focus of national concern over the past ten years. In 1997, before the National

Literacy Strategy was in place, only 53% of 11-year-olds attained the writing benchmark for their grade. Since then, stakeholders have united around how to improve the standards of children's writing, and the figure had risen to 63% by 2004 (Huxford, 2004). Key components of the reform included setting performance targets, developing a curriculum framework for writing, funding literacy consultants in every school district, providing professional development for teachers, and publishing classroom materials.

It is possible that the lag of systematic research in writing has contributed to the oversight of writing in schools worldwide. A bibliometric study revealed that in the 1970s and 80s, for every article focused on writing, there were fifteen focused on reading (Brown and Ellis, 1994, in Jimenez, 2011). The numbers improved in the 1990s but the academic community continued to be disproportionally interested in reading over writing. For every article found on writing, seven were found on reading (Brown and Ellis, 1994, in Jimenez, 2011).

School reform and writing practices

Curriculum innovation and change have been at the heart of post-apartheid education reform in South Africa (Prinsloo & Janks, 2002). However, the National Curriculum Statements (NCS), the curriculum current at the time of the NSES, display a critical weakness in the area of writing. The lack of detail, shortage of examples, and poor progression between tasks is particularly problematic for writing and does not provide clear guidelines for its instruction (JET Education Services, 2010).

Seeing the need to support teachers in the implementation of the NCS, the National Department of Education launched the Foundations for Learning Campaign (FFL) in 2008. The campaign produced many documents meant to assist teachers and raise learner performance in literacy and numeracy. Amongst these publications was a 55-page handbook dedicated to the teaching of reading that was widely distributed across the country (Department of Education, 2008). However, neither the handbook nor the campaign made any specific mention of writing.

Lack of attention to writing has also been apparent at the provincial level, where provincial literacy strategies commit similar oversights. In the case of Gauteng, a predominantly urban and relatively high-achieving province, literacy has become almost synonymous with reading. The Gauteng literacy strategy, which was released in 2010, is based on the Simple Literacy Approach and has two important components- reading and phonics (Gauteng Department of Education, 2010). Although writing is not explicitly mentioned in their action plans, the literacy strategy intends 'to bring about real and lasting improvement in reading *and writing* across the system' (15). While part

of the strategy is to provide learner workbooks encouraging daily writing, the exercises favoured by a workbook format (fill-in-the-blank and short response) are not sufficient to develop children as writers.

The literacy strategy in Mpumalanga, a predominantly rural and under-performing province, also spotlights reading at the expense of writing. The strategy was introduced in 2008 and similar to Gauteng, expects to see improvement in learners' writing skills. It consists of eight key action steps; four focus on reading, none mentions writing (de Chaisemartin, 2010).

Looking forward at curriculum policy

To address previous problems in the curriculum as well as low levels of learner performance, the National Department of Basic Education produced the Curriculum and Assessment Policy Statement (CAPS) in 2011. The CAPS aims to be far more directive on the topics that should be covered per subject as well as methods for their instruction. It is clear that the Intermediate Phase English Home Language CAPS document pays a greater attention to writing. Of the 6 hours a week allocated to English Home Language, the CAPS suggest that two to three hours be dedicated to writing (DBE, 2012). Reading and writing are integrated, in that learners are asked to write similar texts to what they are reading. Learners also get practice writing a variety of texts and make routine use of the writing process.

However, when compared to international standards, the CAPS document seems to set low expectations for writing. For instance, standards in the United States recommend that learners write every day from Grade 1 (New Standards Primary Literacy Committee, 1999) whereas the CAPS suggests learners write twice a week. The CAPS document also specifies the amount of written text required of learners at different grade levels; Grade 5 learners in English Home Language should be able to write stories that are 50–60 words in length, essays that are 60–80 words, and respond to comprehension exercises that are 160–180 words. In comparison, American learners that are meeting the standards set for Grade 3 are writing pieces that are up to 400 words in length (New Standards Primary Literacy Committee, 1999).

The programme outlined by CAPS also falls short by requiring little exploratory, analytical, and informal writing. The CAPS document recommends that learners be engaged in comprehension exercises once every two weeks, which is far too few, and it is not clear whether it asks learners to provide written responses to texts. The programme also does not seem to have a place for writing argumentative essays, which is thought to be amongst the most important type of writing that learners do in school, nor does it include informal writing, which is important for developing fluency in transcription (Graves et al., 2004).

It is difficult to predict what kind of changes will be brought by yet another change to the South African curriculum. A lot will depend on how the policy is implemented, teacher knowledge of writing, and teacher training. If it can increase the amount of extended writing learners do in class, it will have been a step in the right direction.

Teachers and training programmes

It is possible that many South African teachers are ill prepared to teach their learners about writing (see Box A). An evaluation study of the Cape Teaching and Leadership Institute (CTLI), one of the nation's largest, in-service teacher training institutes situated in the Western Cape, tested 82 primary school teachers[1] on their knowledge of the language curriculum as well as their proficiency in the language they teach (de Chaisemartin, 2011). The study found that the majority of teachers did not fully understand how to engage learners in the writing process despite their participation in a language-training course. Knowledge of the writing process, which is key to producing extended pieces of writing, was poorest among Intermediate Phase (Grades 4–6) teachers. Of the 35 Intermediate Phase teachers, only 7 (20%) were able to order the steps of the writing process correctly or made minimal mistakes. The rest of the teachers showed limited understanding of the writing process and often gave illogical responses (see Box A for details).

Teachers' responses to the writing prompts in the proficiency test showed that most teachers have not acquired adequate writing skills themselves nor have they mastered different writing genres. One question asked teachers to describe a family member and include certain details about the person. While teachers were fairly successful at expressing their ideas in spite of grammatical mistakes, the majority of paragraphs failed to be particularly descriptive. Teachers received an average score of 3.3 out of 6 points, which corresponds to a paragraph that shows some attempt at a logical organization, includes at least one descriptive detail, and contains weak sentences with some errors.

A second question asked teachers to write a short paragraph explaining and justifying one thing that should be done to fight crime. Many teachers struggled to argue their point of view clearly and they scored an average of only 3.1 out of 6 points. Typical errors include failure to justify their position, poor grammar (fragments, run-ons, punctuation, prepositions, tenses), and poor sentence structure. Below are two responses that scored a two, which are characteristic of 40% of the responses submitted.

- 'Police should wear private no use of uniform even their van should be private the only thing they have in hand is their badges. Because the criminals once they see the police van/police in uniform they run away especially during dark hours police van have that blue light, which make things easy for criminals.'
- 'Each an every street ther must be street committee. The street committee must sign a register of absent and present everyday. The street committee must be paid by the government.
  Street committee's register must stay at the nearest Police Station.
  This way the crime will end in our country.'

For comparison, we include a response that scored a five, the highest mark earned, which is characteristic of 18% of responses.

- 'Firstly, we need to think why do people do crime? I think the answer is they are bored, they have nothing to do. If government can create more jobs and give people skills then the crime rate will be reduced. Some people resort to crime because they say they are poor (hungry), although that is unjustifiable I think if more people can be employed, crime rate will be reduced. Even when they are prisoned they need to be taught skills, so that when they come out they don't go back to crime, but instead can do something to earn a living.'

Box 6.1: Teacher responses to writing exercises

The writing samples shown in Box A suggest that teacher-training programmes would do well to address writing and strengthen the teachers' own writing skills. In the case of CTLI, little course time was devoted to writing. The language course offered in 2009 and 2010 was made up of roughly 110 training hours spread over a four-week period. Of this time, only one or two hours were dedicated to writing. Furthermore, a curriculum review of the training materials used for the 2010 language course found the materials were too focused on policy and theory, lacked a practical component, and dealt with topics that were inappropriate for teachers in Grades 4-6.

If teachers are ill equipped to teach writing and training programmes do little to change the status quo, it should not be surprising to find numerous regional studies who say South African learners write too little in class (Taylor & Moyana, 2005; Du Toit & Taylor, 2009; Reeves, 2010; de Chaisemartin, 2011).

Review of the writing literature

The value of writing

The academic literature upholds the importance of writing and high-quality writing instruction. Writing is more than just a powerful tool for self-expression,

it shapes the way we think, reason, and learn. It is an essential skill that extends well beyond the language classroom. As Langer and Applebee (1987) put it, 'to improve the teaching of writing ... is also to improve the quality of thinking required of school children' (3).

Some of the first writing-to-learn studies examined the effects of simple writing activities on learning new material and found that activities involving writing lead to better recall than activities involving reading or studying alone (Anderson and Biddle, 1975; Michael and Maccoby, 1961). Subsequent studies tested the effects of different kinds of writing tasks on learning, such as answering study questions, note-taking, summarizing texts, and writing analytic essays (Applebee, 1984; Langer and Applebee, 1987; Newell, 1984; Newell and Winograd, 1995).

Overall, these studies found that different writing tasks focused the writer's attention on different aspects of the text, evoked different thinking patterns, and resulted in different types of learning. Short-answer study questions focused attention on a particular set of ideas in the text, but rather superficially. In completing the task, learners searched for the answer and transcribed it onto paper without integrating any content across questions. Note-taking and text summaries allowed learners to concentrate on a broader range of information but still in a cursory manner. When taking notes, learners listed information in the same order as it appeared in the text without re-organizing it in their own way. Similarly, when learners wrote summaries they paraphrased the main ideas of the text in a linear fashion with little to no interpretation, evaluation, or analysis of the ideas contained.

The analytical essay is different. Fewer ideas are drawn from the text but they are considered in a more thoughtful and substantial way (Langer and Applebee, 1987; Newell, 2006). In order to defend their point of view, learners are forced to link concepts together and reconstruct their understanding of the text, leading to a deeper level of reasoning. In turn, the more complex manipulation of the information yielded a more lasting mental representation of that content. Analytic writing led to the best understanding and retention of information due to the higher degree of manipulation it required. However, these positive effects were limited to the ideas that were being written about and not the passage as a whole.

Writing can foster learning and improve one's understanding of the text, but it depends on the writing task. A number of studies make the important point that writing tasks are not the same (Applebee, 1984; Langer and Applebee, 1987; Newell, 2006). They vary in the breadth of information they focus on and the depth of processing involved. As a result, writing assignments can be used to achieve different learning goals in the classroom and should be carefully selected by the teacher. Study-questions lead to short-term recall of a good deal of specific information and can be a useful means to review several

elements of a text in preparation for a more demanding task. Note taking and summaries are most suitable for reviewing and remembering a general body of information. Analytic essays are best at achieving a deep understanding of concepts and their relationships, which need to be remembered for a longer period of time.

Writing also has great value in that it plays a role constituting thought (Elbow, 1973; Galbraith, 1999). E.M. Forster best expressed this notion in *Aspects of the Novel* (1927) by saying 'How can I tell what I think till I see what I say?' Writing can be a process of discovery, where in the course of writing one's thinking emerges and new ideas are produced.

Studies have also found positive carry-over effects of writing on reading. This connection is not surprising as reading and writing are complementary skills that share a close and reciprocal relationship. Research has found that reading and writing depend upon a common base of knowledge and cognitive processes (Shanahan, 2006). A recent meta-analysis of 95 reading-writing studies provides further supports that writing is a powerful tool that enhances reading (Graham and Hebert, 2011). The analysis confirmed that writing about a text improves learners' comprehension of it and that increasing the amount of writing has a positive effect on how well learners read. In addition, the study found that writing instruction, particularly spelling and sentence construction skills, had an impact on reading by improving reading fluency and word recognition. It should, nevertheless, be mentioned that despite the strong relationship, reading and writing are not identical processes and instruction in one can never be an adequate replacement for instruction in the other.

Cognitive processes involved in writing

By the 1980's, research in the field had established writing as a complex, multi-layered, recursive process (Nystrand, 2006), a finding that has significant implications for its instruction. Among the most instrumental works of this time was Flower and Hayes' cognitive model of writing (1981), which sought to map out the mental behaviours of experienced writers in the act of writing. The model consists of three major cognitive processes: planning, which is concerned with the writer's overall goals for the text, such as what they want to express and to whom, as well as the generation and organisation of ideas; translating, which refers to the conversion of ideas into written language; and reviewing, which encompasses reading, evaluating, and editing of the text. An important feature of the model is that it is not linear and processes do not occur in an ordered fashion. A writer's mind is simultaneously engaged or rapidly switching between different processes as determined by a central monitor. Writing processes are also influenced by the task environment (the writing assignment and text produced thus far) and the writer's long-term

memory, which includes knowledge of the topic, audience, genre, and the rules that govern language.

In essence, writing is viewed as a complicated process of problem solving, where the writer has developed an elaborate set of goals for the text and ideas are generated and expressed to meet these goals. As text is produced and evaluated, goals for the text are revised to improve the text at the conceptual and linguistic level.

Writing processes require working memory resources and place a formidable cognitive demand on the writer (Bereiter and Scardamalia, 1987; Flower and Hayes, 1981). Working memory capacity is limited and writing processes compete for mental resources (Flower and Hayes, 1981; Hayes, 2006; Torrance and Galbraith, 2006). To avoid cognitive overload, the central monitor must carefully coordinate the various writing processes whilst effectively managing cognitive resources such that writing is not brought to a halt.

Children do not typically engage in the sophisticated writing process depicted in Flower and Hayes' model. McCutchen (2000, 2006) argues that the processing demands of writing are too great for children to cope with them. Bereiter and Scardamalia (1987) put forth an alternative writing model that distinguishes between novice and expert writers, which is more suitable to explaining how children accomplish writing. In their model, novice writers employ a 'knowledge-telling' strategy. 'Knowledge-telling' has been referred to as a 'think-say' method of writing because ideas are retrieved from memory in response to a topic and translated directly into well-formulated text (Galbraith and Rijlaarsdam, 1999). Unlike expert writers, ideas are neither developed nor evaluated to meet communicative goals for the text. Furthermore, little time is spent planning or revising the text, as these processes are more effortful than text production (Olive, 2004). When planning and revision do occur, they differ in nature than when employed by a skilled writer. For novices, planning is dominated by content generation rather than conceptual elements (Bereiter and Scardamalia, 1987) and revision is limited to surface features of the text as opposed to the text's meaning (Chanquoy, 2001; McCutchen, Francis, & Kerr, 1997). Knowledge telling tends to produce texts that cover the relevant material but lack reflection and a distinctive point of view (Galbraith and Rijlaarsdam, 1999).

Writing Instruction

There are a number of ways to help children adopt more sophisticated composing processes and produce higher quality texts (Graham, 2006). One important way is to reduce the cognitive demands they encounter when writing. Studies have found that spelling and handwriting require a lot of mental effort from children and can present a considerable challenge

(Berninger et al, 1997, 2002). When these skills are not well developed they consume valuable resources and interfere with the fluidity of transcription (Berninger & Swanson, 1994, reported in McCutchen, 2006; Olive et al., 2009). With practice both spelling and handwriting can become automatised, freeing up cognitive resources for higher level processes such as planning and revision (Berninger & Winn, 2006; McCutchen, 2000). However, once automaticity in transcription has been established, children still require direct instruction to develop higher-order aspects of writing.

Two instructional methods that have systematically been shown to improve the quality of children's writing are strategy instruction and the process approach to writing. The aim of strategy instruction is to teach children strategies for planning, writing, revising, and editing text. In this method a strategy is typically introduced, discussed, and modelled by the teacher. Learners then practice using the strategy and progressively receive less support until they can perform it on their own. Studies have found robust evidence indicating that strategy instruction is effective at improving overall writing quality, structural elements in the text, length of the composition, and revisions, particularly when using the Self Regulated Strategy Development approach, and that these effects are maintained over time (Graham, 2006). Nevertheless, strategy instruction is not a complete writing programme and should be integrated with other writing methods, such as the process approach.

The process approach to writing refers to a cluster of writing techniques that emphasises the composition process as opposed to the final product of text. This instructional model has greatly evolved since it emerged in the 1970s yet different views about its constituent elements as well as its implementation abound today (Pritchard & Honeycutt, 2006). At present, most researchers would agree that the writing process includes both procedural knowledge and writing strategies that can be taught and nurtured directly. These include helping learners search their prior knowledge; teaching them about writing genres, audience, style, and tone; training them to use self-regulation strategies for writing; practicing how to revise a text and edit surface level errors; and providing structured feedback from teachers and peers (Pritchard & Honeycutt, 2006). Despite its varied interpretations, empirical research has found that key to the success of the model in improving the quality of learners' writing is teacher direction (Pritchard & Honeycutt, 2006). Moreover, as writers internalise the various strategies and skills acquired, these processes become automatised and the quality of writing improves (Calkins, 1983; Honeycutt, 2002, in Pritchard & Honeycutt, 2006).

Writing is a highly complex and demanding process. To learn to write children must develop both lower and higher-level processes that make composition possible. Spelling and handwriting must be automatised to enable fluid transcription and free up cognitive resources for more challenging

components such as planning and revision. Children must also learn about literary conventions, the different processes involved in writing, and how to coordinate them in order to meet communicative goals for the text (Galbraith & Rijlaarsdam, 1999). It goes without saying that engaging children in meaningful, extended writing tasks as often as possible is paramount for their success as writers.

With this background in mind, we now turn our attention to the NSES data and what it says about writing practices in South Africa.

Methodology

Our assessment of writing in South African primary schools is based on the NSES data for Grade 4 and 5. A random sample of 268 schools in eight of the nine provinces constitutes the database for what follows. The sample was stratified and weighted by province. Aside from Gauteng who withdrew from the study, the sample is representative of the South African school population at the national and provincial level.

Learner books were collected between the 15th of August and the 15th of September 2008 for Grade 4 and again in 2009 for Grade 5. Teachers were asked to nominate the best child with the best attendance, as only one set of books was examined per class. Fieldworkers analyzed all of the language books in the language of learning and teaching (which in these grades is English for the overwhelming majority of African learners) used by that child throughout the year, including class work, portfolios, and test books. The assumption behind analyzing only one set of books per class is that the work of the most conscientious child represents a best case scenario for the quantity and quality of writing in that class.

The analysis was based on the number and type of written exercises found in the learners' books. An exercise was defined as the amount of writing that occurred in one day, given that learners date all of their assignments. In addition to counting the total number of written exercises, fieldworkers counted the number of exercises that consisted of single words, sentences, paragraphs, and non-verbal forms of text (tables, graphs, mind maps, and diagrams). For Grade 5, the category of transcriptions was also added.

If the exercise contained a mix of different types of writing, fieldworkers credited the exercise as containing the most complex form of writing. For example, if an exercise contained a few single words, sentences, and a paragraph, the exercise would have been credited as containing a paragraph. In the case of non-verbal forms of text, however, both the graphic and any writing that accompanied it were recorded separately. In Grade 4, fieldworkers wrote

down whether each type of exercise was half a page or less in length or more than half a page. In Grade 5, this distinction was only made for paragraphs.

Fieldworkers also wrote down the dates of the first and last exercise for the Grade 5 learner books. The number of exercises done by August 30th was then estimated based on the exact date of the data collection, as not all schools could be visited on the same date.[2] It is important to note that August 30th corresponds to three quarters of the school year, meaning our data is indicative of about 75% of the written work that learners would have done in their grade[3].

A small number of schools who participated in the NSES study were excluded from the analysis. These schools presented no learner book, had no dates for the first or last exercise, or began writing after March, leaving the possibility that the first book used in the year was not analyzed, or showed inconsistencies in the data collected (e.g.: the total number of exercises did not match the count of different types of exercises). For Grade 5, a total of 238 classrooms in 223 schools were included in the analysis. For Grade 4, a total of 255 classrooms in 232 schools were included in the analysis. It is difficult to say whether the exclusion of these schools introduced a bias in the data. It cannot be determined whether the irregularities found were due to the schools being weaker than the average or if they were errors on the part of those who collected and captured the data. However, it is likely that the results reported here would have been even weaker if some schools had not been omitted.

Several other measures were taken to ensure the soundness of the data. The fieldworkers used in the study were all ex-teachers familiar with the language curriculum in the primary grades and they were trained to conduct the analysis of the books. During the school visit, fieldworkers requested to see an additional learner book to verify the content of the book under examination. This practice was helpful in identifying any missing dates, episodes of transcription (where all children copy the same text), as well as other types of written exercises. In many schools, the learner book analysis was conducted in the presence of the teacher. However, in all schools the teacher was available to answer questions regarding the contents of the books.

Results

How much and how often are children writing in the classroom?

In Grade 5, according to the NCS, one and a half hours of every school day are reserved for the teaching of language (DoE, 2008). Despite the amount of time dedicated to the subject, Grade 5 learners had only written an average of 42.1 exercises in their books by the end of August. This figure implies that

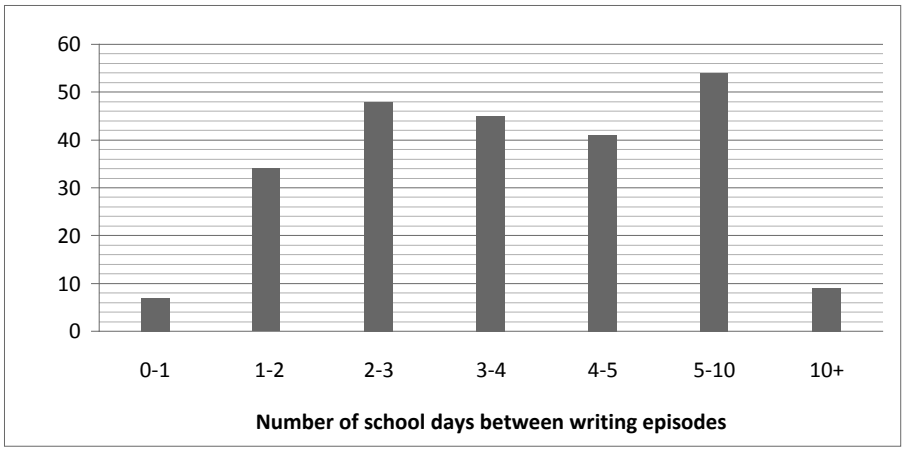
learners wrote one exercise every 4.3 days. Thus, in the average South African classroom Grade 5 learners write in their books merely once a week. Figure 1 shows that only in a fraction of the classrooms visited, children wrote an exercise every day or second day (naught to one day). In other words, only 3% of learners across the nation wrote in their books every day.

Table 6.1: Number of exercises and frequency of writing in Grade 5

Number of classes	Total number of exercises				Number of school days between writing episodes*
	Average	Standard deviation	Max	Min	
238	42.1	27.0	189.0	6.3	4.3

* We assume 126 days of school from January 21st–August 30th, 2009, excluding school and public holidays.

Figure 6.1: Frequency of writing in Grade 5



The numbers varied slightly amongst the provinces, but were statistically different from the mean for the Eastern Cape and Western Cape. Learners in the Eastern Cape had the least practice writing and only completed 31 exercises in their books. In contrast, learners in the Western Cape wrote 64 exercises in the same amount of time, twice as many as their Eastern Cape peers.

The Grade 4 data paints a similar picture. On average, Grade 4 learners wrote a little less than Grade 5, with a total of 37,5 exercises by the end of August. The Grade 4 data also tells us something about the length of these exercises. The vast majority of exercises found in the learner books (29.6 or 78%) were half a page or less in length. On the whole, learners get very few chances to write in class, but when they do they hardly write anything down.

Table 6.2: Total number and length of exercises in Grade 4

Number of books	Average number of exercises	Percentage of exercises that were half a page or less	Percentage of exercises that were more than half a page
255	37.5	78%	22%

What kind of writing are they doing in the classroom?

Single word exercises are the most common type of writing found in the learner books. On average, half of all exercises written over the course of the year, 55% in Grade 4 and 51% in Grade 5, consisted of isolated words. Exercises comprised of sentences follow, making up 27% and 28% of all Grade 4 and Grade 5 exercises respectively. Although it forms part of the curriculum, non-verbal forms of text, such as tables, graphs, diagrams, and mind maps are rarely found in learner books. On average, learners will have encountered these exercises one or two times a year. In provinces like the Eastern Cape, where the average of non-verbal exercises is as low as 0.4, it is doubtful that most learners were exposed to these exercises at all.

Of greatest concern is how little extended writing there is in the books. Over the school year, Grade 4 learners had written only 3.8 paragraphs and Grade 5 learners only 3.6 paragraphs. At this rate Grade 4 learners complete one paragraph every 33 school days and Grade 5 learners complete one paragraph every 35 days. This means that on average, learners write one paragraph every month and half of school. Furthermore, the Grade 5 data reveals the paucity of writing. Most of the paragraphs found in Grade 5 books, 2.6 out of 3.6 paragraphs, were half a page or less in length.

Table 6.3: Types of exercises in Grades 4 and 5

	Single words		Sentences		Paragraphs		Non-verbal		Transcription	
	freq	%	freq	%	freq	%	freq	%	freq	%
Grade 4	20.5	55%	10.2	27%	3.8	10%	2.4	6%	n/a	n/a
Grade 4	21.6	51%	11.9	28%	3.6	9%	1.5	4%	3.9	9%

It should be noted that the Western Cape is the only province that deviates significantly from the provincial averages. Not only do learners in the Western Cape write more frequently and more at length, but they also write more paragraphs, sentence, and non-verbal exercises. Whereas the majority of exercises found in the learner books of other provinces contained isolated words, these types of exercises make up only 39% of the exercises found in the books of Western Cape learners.

Table 3 clearly shows that children do very little extended writing, but it is even more alarming to consider the number of children that never wrote a paragraph at all. Table 4 shows the percentage of learner books that did not contain any paragraphs. The problem is particularly serious in Grade 4, where 44% of learners had not written any paragraphs during the entire school year. Although the percentage decreased in Grade 5, the figure remains unsettlingly high. Close to one-third (32%) of the books examined did not contain a single paragraph. The lack of extended writing is particularly problematic in some provinces. In the North West and Northern Cape, close to two thirds of all Grade 4 classrooms in the sample (62% and 63% respectively) had not written any paragraphs throughout the year. For Grade 5, the numbers are still higher for the Northern Cape, where close to half of all classrooms (47%) had not written any paragraphs either.

Table 6.4: Percentage of books with no paragraphs in Grade 4 and 5

	Total number of books	Percentage of classes who did not write a paragraph
Grade 4	255	44%
Grade 5	238	32%

Overall, the picture evoked by the learner books is disconcerting. Instead of writing every day, learners write once a week. When they do write learners tend to write very little, filling up half a page or less in their books. In most of the exercises found, learners were only required to write single words. The majority of learners had few opportunities to compose a short paragraph, whereas a significant minority had no opportunities at all.

Given the infrequent and inadequate exposure to writing, it is hard to imagine that learners are acquiring the skills necessary to communicate functionally through written language. Without practice, learners will find it difficult to organise their ideas into a sentence and link sentences together into coherent paragraphs. Yet this is the minimum of what is expected if these primary school learners are to acquire the academic literacy required for high school. Learners should be practicing composing texts for a variety of purposes and audiences. Given the small number of paragraphs written over the course of the year, one can assume that their exposure to different genres is quite limited if they are exposed at all. The scarcity of extended writing furthermore suggests that the writing process is not being taught widely in South African classrooms. All in all, learners are not getting the opportunity to grow and develop as writers.

Is classroom writing linked to socio-economic status?

Findings suggest that the amount and type of writing in learner books is linked to poverty, as measured by the school's quintile[4] ranking (Table 5). Learners in the most underprivileged schools known as Quintile 1 wrote the least number of exercises (33.9) and the least number of paragraphs (2.2). The figures increase for Quintile 2, 3, and 4 schools. On average, learners in Quintile 2 and 3 schools wrote about 41 exercises and 3 paragraphs, and learners in Quintile 4 schools wrote 49.9 exercises and 5.2 paragraphs. As expected, children attending the most privileged schools, Quintile 5, had the greatest exposure to writing. In Quintile 5 schools, learners wrote as many as 66 exercises and had a total of seven paragraphs in their books, which practically doubles the number of exercises found in Quintile 1 books and more than triples the number of paragraphs.

Table 6.5: Amount of writing in Grade 5 according to school quintile

Quintile	No. of books	Average number of exercises	Average number of paragraphs	
			Half a pg. or less	More than half a pg.
1	81	33.9*	1.7*	0.5*
2	57	40.6	2.6	0.7
3	52	41.3	2.3	0.8
4	23	49.9	3.7	1.5
5	25	66.3*	4.6*	
TOTAL	238	42.1	2.6	1.0

* Statistically above or below the mean (p<.1)

However, even learners at the most affluent schools fall far behind international standards for writing. The New Standards Primary Literacy Committee in the United States calls for Grade 3 learners to write daily; routinely rework, revise, and edit their work; and polish 10 to 12 multi-paragraph pieces over the course of a year (New Standards, 1999). With an average of 2.7 paragraphs longer than half a page, Grade 5 learners attending the most resourced schools in South Africa are not even close to attaining standards set for Grade 3 in the US.

Is classroom writing related to better performance in literacy?

Results suggest a possible relation between classroom writing and learner performance in the NSES literacy test. Overall, Grade 5 classes who obtained the lowest mean score on the test also wrote the least number of classroom exercises throughout the year. Classes who scored under 20% on the test had only written an average of 28.9 exercises in their books. In comparison, classes who scored around the mean (35-39%) had written 39.2 exercises and the best performing classes who scored above 60% had written as many as 79.7 exercises. Whereas the lowest performing classes did not even write one exercise per week, learners in the top performing classes wrote an exercise every other day. Indeed, the Pearson correlation coefficient of .54 indicates a medium association between quantity of classroom writing and achievement in the literacy test.

Overall, the pattern that emerges is that there is a different focus in the learner books of poor, average, and top performing classes. Single word exercises that require little cognitive demand dominated the learner books of poor performing classes, making up 70% of all written work in the year. In contrast, single word exercises made up 57% of all written work in average performing classes and only 34% of all written work in top performing classes. Average and top performing classes had a greater percentage of work dedicated to writing sentences, paragraphs, and in some cases, to transcription. Non-verbal exercises played an equally small and unimportant role in all books regardless of performance. Thus, classes who achieved significantly better scores on the literacy test had not only written a similar or greater number of single word exercises than the poor performing classes, their written work consisted increasingly of more complex exercises requiring more complex cognitive processes, such as extended writing. This confirms what was found in Chapter 3, namely that the frequency of written exercises, and particularly of paragraph length writing, were significantly related to learner achievement even after accounting for a host of other factors such as socio-economic status.

Conclusions

The chapter began with three questions concerning the role of writing in South African English language classrooms. The study examined the books of Grade 4 and 5 learners in a national sample (excluding Gauteng) of over 200 schools to find out how much writing happens in class, how often, and of what kind.

Results are disconcerting as they show that learners are hardly engaged in writing of any kind. Over the course of the year, learners had merely written

an average of 37 exercises in Grade 4 and 42 exercises in Grade 5, meaning learners were instructed to write only about once a week. Each exercise tended to require very little writing. More than three quarters of the Grade 4 exercises were less than half a page in length. Furthermore, the predominant form of writing consisted of single word exercises, which made up about half of all exercises in Grade 4 and 5 books. Learners had few opportunities to practice constructing sentences and even fewer opportunities to practice composing an entire paragraph. On average, only 3.8 and 3.6 exercises involving paragraphs were found in Grade 4 and 5 books respectively. Even more unsettling is that 44% of Grade 4 classes and 32% of Grade 5 classes never had to write a paragraph at all, despite the crucial role of extended writing in developing basic writing skills.

Some differences were found amongst different groups of schools. Western Cape learners tended to do more writing and more frequently than their peers in other provinces. They also had a greater chance to compose paragraphs. Quintile 1 schools had the poorest set of writing practices while the more affluent Quintile 5 schools had the best set of practices. However, even the learners at the most affluent schools in South Africa fall far behind international writing standards. Lastly, it appears that the amount of writing performed in class may be related to learner achievement. Higher performing classes wrote more exercises than average performing classes, who in turn wrote more than poorer performing classes. Their learners' books also showed evidence of more complex forms of writing than average or poor performing classes.

The educational implications of these findings are significant. Writing is a critical skill in today's world and the limited amount of writing performed in South African classrooms, in particular extended writing, is insufficient to develop even the most basic writing skills. Ideally, children should be engaged in extended writing every day. Not all writing needs to be formal. Children should aim to polish a limited number of written pieces over the course of the year (about ten). A lot of the writing children do in class can be ungraded and informal, and need not take up more than the first five to ten minutes at the start of the day. What is certain is that children require significantly more opportunities to practice writing to develop into competent writers.

Research has shown that writing is a time-consuming, complex, and demanding activity, which in addition to practice, requires explicit instruction of lower level and higher-level processes, literary conventions, grammar, and vocabulary. It is possible that South Africans teachers as a whole are not well prepared to teach writing and may be weak writers themselves. Thus, it is fundamental that teacher-training programmes address teachers' knowledge of writing. Teachers need to know what constitutes good writing, how it is accomplished, and be armed with effective methodologies for its instruction. Moreover, training programmes will need to address teachers' own writing

skills. It is inescapable that for teachers to become experts at teaching writing, they will first need to become writers themselves.

To improve learners' competency in writing, many things need to change in South Africa. It is important to remember that other countries have faced similar challenges in the past and can serve as guidance. The CAPS document has given a greater focus to writing in the South African curriculum and that is a good start, but it is not enough. National attention must be drawn to the status of writing in schools and a writing agenda must be set forth. The United States accomplished this via a National Writing Committee. Establishing such a committee in South Africa would help to assure that a writing-revolution take place in South African schools.

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[1]The sample of teachers tested came from diverse regions of the Western Cape and taught at the least privileged to the most resourced schools. An overwhelming majority of teachers (over 80%) indicated having at least a teaching degree or diploma. On average, they had 16 years of teaching experience.

[2]The estimate was achieved by taking the number of exercises written between January 21st (the first official day of school) and the date of the last exercise, dividing it by the number of school days within this period, and multiplying it by 126 (the number of schools days until August 30th).

[3]This figure assumes that school began on the first official day of school, that learners stopped working after the first week of November to prepare and take end-of-year exams, and takes into consideration all school and public holidays.

[4]School quintiles refer to the official classification given to South African public schools, determined by the socio-economic profile of the community in which they are situated; this is used for allocating some spending to be pro-poor. Quintile 1 schools are located in the least privileged communities whereas Quintile 5 schools are located in the most privileged. It is important to note that school quintiles do not represent 5 equal-sized groups; quintile 5 is considerably smaller than 20% of schools.

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Chapter 7

Writing and learning mathematics

Nick Taylor and Benita Reddi

Following the discussion in Chapter 6 about the role of writing in learning language and literacy, we turn now to consider how writing is implicated in the learning of mathematics. Chapter 3 tells us that the quantity of writing produced by any child in a year is significantly related to her math score, but these statistics do not tell us anything about practice. The present chapter starts by exploring the literature on the representation and communication of mathematical entities and ideas. We then use the NSES data to describe how these representational forms manifest in the writing of South African primary school learners. Finally, we speculate about the implications for classroom practice suggested by the NSES findings.

Learning and representation[1]

The study of semiotics provides an important perspective on the nature of mathematics learning. It is from this perspective that we are able to appreciate the role of signs – pictures, diagrams and symbols – in learning and communicating mathematics. Semiotics has its roots in Pierce's (1898) notion that all thought occurs in signs and Piaget's (1971) view of the signifier as a *representation* of the signified, and incorporates Bruner's (1957) distinction between enactive, iconic and verbal representations of thought. For Radford, the 'semiotic platform' enables us to envisage signs '...losing their representational and ancillary status ... in order to become the *material* counterpart of thought' (2009: XXXV); signs are not mere indicators of mental activity, but 'constitutive parts of thinking' (XXXVI). Walkerdine wants to move beyond Piaget's representational view to explore the idea that the relationship between signifier and signified involves *a process of signification*. She shows how pre- and early grade learners work with pre-arithmetical and arithmetical sign systems (verbal and symbolic) in

grappling with mathematical concepts (1988). Walkerdine's scheme may be expanded to include algebraic signs, as shown in Figure 1.

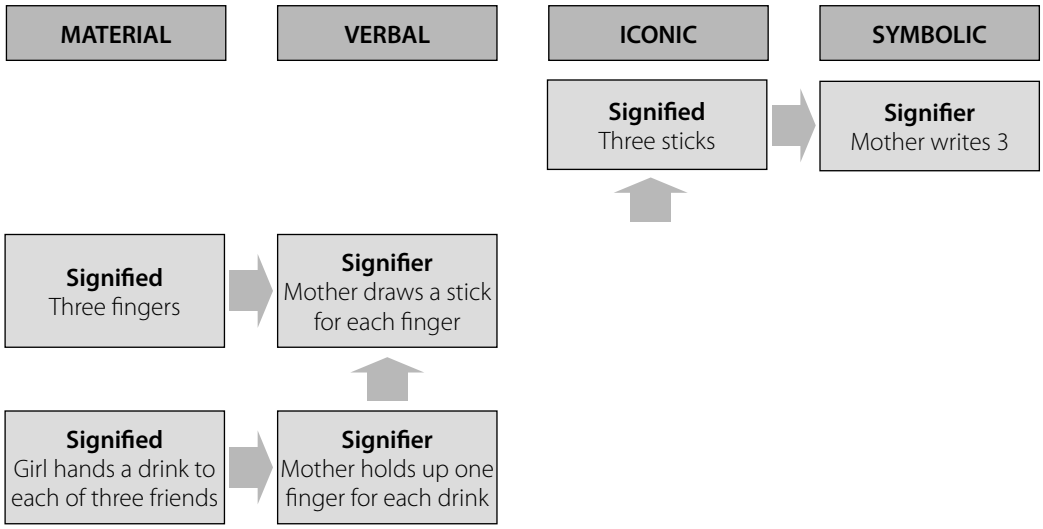
Words		Symbols	
Pre-arithmetical	**Arithmetical**	**Arithmetical**	**Algebraic**
Some children are playing ball. Others joined in. There are a lot of children now.	Three children were playing ball. Four children joined in. There are seven children now.	3 + 4 = 7	$a + b = c$

Figure 7.1: Verbal and symbolic signs in the development of arithmetic and algebraic ideas

Source: Elaborated from Walkerdine, 1988:117

In addition to the alphanumeric signs shown in Figure 1, the literature has identified visual imagery as a useful form in which to exemplify mathematical entities. Vergnaud (1979) recommends the use of diagrams, which exhibit the mathematical structure of problems in mediating between natural language and algebraic symbolism. Walkerdine shows how iconic signs may be incorporated into the process of signification, mediating the passage from material instantiations of concepts to arithmetic symbols. This process may involve 'chains of signification', in which iconic signifiers – such as sticks drawn on a page to stand for fingers, which in turn stand for children's drinks – themselves become signified entities, as they are replaced by symbolic signs (Figure 2).

Figure 7.2: Chain of signification showing development of concept '3'



Source: Constructed from Walkerdine, 1988:120

According to Walkerdine, formal academic mathematics, as an axiomatic system, operates by means of suppression of all aspects of multiple signification. The symbolic forms are stripped of meaning, and the math signifiers become empty. This is central to the power of mathematics as a system or discourse, which may be 'superimposed onto and read into all others' (Walkerdine, 1988:96). The progress shown in Figure 2 from material objects (drinks) to a written symbol (3) involves a suppression of the referential content of the discourse (1988). The material, verbal, iconic and symbolic signs involved in the process of signification exhibit different metaphoric forms of the same metonymic relation, in this case the concept of 'three'.

Steinbring brings a further insightful perspective to bear on this discussion, positing a triangular relationship between a context (such as a zoo worker giving a monkey 2 bananas from a bunch of 5), a symbolic depiction of the transaction (5 – 2 = 3), and the concept of subtraction (Steinbring, 2005:25). His scheme brings home to us the ineffable nature of mathematical concepts. We see and imagine many instantiations of any mathematical idea, and we have a language to describe it, but nowhere do we ever see the concept. This is why multiple representations are so important in early mathematics learning.

Alphanumeric and iconic symbols may be combined, a device particularly appropriate for symbolising mathematical operators, as for example used by O'Halloran (2011) in her solution of a trigonometric problem, and by Long (2011) to illustrate conversions between equivalent ratios (Figure 3).

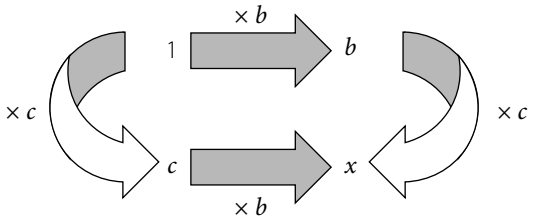


Figure 7.3: The equivalence algorithm expressed in symbolic and iconic imagery

Source: Adapted from Long (2011:170).

Steinbring notes that a critical point in the development of theoretical mathematical knowledge lies in the transition from pure object, or substance thinking, to relational or functional thinking (2005:19), a point which Davis (2010a) emphasises in his idea that an essential feature of mathematics is that all its operations are functions. The function shown in Figure 3 is a succinct way of stating that, applying a multiplicative operation to both numerator and denominator to any ratio (1/c in this case) will result in a new ratio (b/cb) that is equivalent to the first.

For Sfard (1991) condensation and reification are important steps in the process of learning mathematics: condensation of mathematical ideas into precisely defined symbols enables easier manipulation; during reification the sign becomes detached from the process that produced it, and now derives its meaning from becoming a member of a certain category (Sfard, 1991). O'Halloran describes mathematical symbols as the semiotic resource through which mathematical problems are solved (2011). We can summarise the passage from material instantiation to symbolic sign – via verbal and iconic descriptions – as a journey from more ambiguity to less, from contextual and evocative images to more coolly formal and abstract entities, from low levels of condensation to high, from fuzzy language to precise tools for conducting mathematical discourse. In Bernstein's (1990) terms, condensation may be seen as moving from context dependant meanings to context independence. In Figure 2, a great number of material situations, verbal descriptions and iconic representations exemplify the concept '3', but a single sign is needed to work with this idea mathematically.

For Radford learning can be theorised as processes of objectification. In solving the typical number pattern problem shown in Figure 4, Radford describes how 13–14 year old learners first invoke a 'concrete' form of algebraic thinking: "Jimmy: Figure 10, it will be 11…Dan: … 11 on top, and 12 on the bottom" (2009:XXXIX).

Figure 7.4: Iconic representation of a number pattern

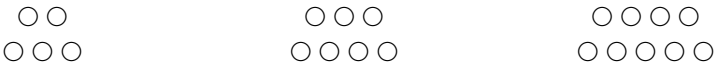


Figure 1	**Figure 2**	**Figure 3**
Find the number of circles in	(i) Figure 10	(ii) Figure 100

Source: Radford, 2009: XXXIX

A common form of iconic signage in primary texts is the use of Dienes blocks to represent numbers and to embody place value relations: 'units' (small cubes to represent unit numbers); 'rods' (10 small cubes in a row); 'flats' (100 small cubes in a square), and large cubes (a cube made of 1 000 small cubes) to demonstrate counting and simple operations on whole numbers. Schoenfeld (1986) explains why Dienes blocks are such a good representation of the decimal number system: the isomorphism between the block patterns and the number concepts provides a coherent reference world through which children come to understand the principles of place value.

Walkerdine points out that, because the use of 10 as a base for our number system is arbitrary, the teacher must tell the learners what they are supposed to be discovering when using material or iconic representation of numbers

(Walkerdine, 1988). Giving learners materials with which to count is a pedagogic act, which may assume that the relations and values of the numerals will become apparent to the child because they are presented concretely or visually. On the contrary, asserts Walkerdine, it is the properties of the place-value system which give structure to the arrangement of the iconic images, and if this is not shown to them '... there would be no reason for the children to give the grouping of matchsticks any significance' (1988:169). In other words, working with manipulatives and their iconic images is not a discovery process so much as an expository one, an exemplification of the concepts. The larger pedagogical lesson is that material, iconic, verbal and symbolic images are important in facilitating learning, and that they may be presented to the child either as tools for undertaking investigations, or as illustrations of mathematical ideas.

For Steinbring learning is inseparable from communication: signs are connecting elements between mathematical knowledge and mathematical communication (Steinbring, 2005). Writing is the technology through which knowledge accumulation occurs, the medium through which, for example, the study of what is now known as the theorem of Pythagoras has circulated down the millennia, from as far afield as ancient China, India, Egypt, Arabia and Greece, to medieval Europe (Joseph, 1991), and across the globe today where it permeates every branch of science and technology. In emphasising the importance of writing, O'Halloran notes that ' ... in some cases the meaning of the written symbolic mathematics is not equivalent to the spoken language ... Quite simply, talking mathematics is not the same as doing mathematics ... ultimately students.... must understand and use the unique grammatical resources of mathematical images and symbolism which function differently to language...' (O'Halloran, 2011:234).

In conclusion, what this discussion brings to the fore is the importance of exposing learners to different representational forms of mathematical entities, and getting them to work with these as they explore the concepts and procedures of the subject. Before looking at the kinds of writing undertaken by South African learners, we turn to an examination of ways in which learning may be impeded by a failure in mathematics classes to negotiate the complex processes of signification.

Rules without reasons and other learning perversions

One way of assessing the quality of learners' writing is to investigate the kinds of cognitive tasks, which they are required to write in their classrooms. Most systems designed to distinguish cognitive tasks owe a large debt to the widely

cited Bloom's Taxonomy of Educational Objectives (Bloom, 1956), which distinguishes six levels of cognitive skill, in order of increasing complexity: knowledge (exhibit memory of previously-learned materials); comprehension (demonstrate understanding of facts and ideas), application (use new knowledge); analysis (break information into parts to identify motives or causes, make inferences and find evidence to support generalisation), synthesis (compile information together in a different way); and evaluation (present and defend opinions).

A difficulty in applying Bloom's taxonomy to mathematical tasks is that the degree of difficulty, or cognitive challenge, posed by any task depends on many factors: on the type of skill demanded, on the complexity of the task, on the size of the numbers involved and on the form in which the task is posed (verbal/symbolic/iconic). To complicate matters further, these factors may vary independently of one another (see Chapter 2 for examples). Thus, a relatively straightforward analytical task may prove to be easier for a student to perform than a complex comprehension task. Difficulties in applying Bloom have led math educators to develop a typology of proficiencies in the subject, and most would agree with Kilpatrick et al (2001) that conceptual understanding (comprehension of mathematical concepts, operations, and relations) and procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently, and appropriately) are two essential elements of mathematical proficiency.

For Hiebert et al (1997), skills and understanding are best learned together. Hiebert and Lefevre (1986) agree, but point out that productive interaction between the two is often impeded. A common form of impedance occurs when teachers present mathematics as a set of unrelated procedures, at the expense of understanding the conceptual relations underlying the procedure. One of the simplest and most enduring formulations of this problem was given by Skemp (1976) who distinguished between relational and instrumental understanding in the classroom, where the former signals 'knowing both what to do and why', and the latter reflects the application of 'rules without reasons'.

Davis (2010b) approaches the same problem from the perspective of Hegel's notion of 'ground'. In quoting Pierce, Davis links the notion of ground to the semiotic discussion outlined above: 'The sign stands for something, its *object. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representamen*' (Peirce, 1931: 135, quoted in Davis, 2010b: 379). This perspective enables Davis to characterise as 'pseudo-operations' a particular type of learning malfunction, which has no principled ground, where learners are taught nonsensical procedures (for example when adding integers: 'The sign .. of the bigger number. You look at the bigger number between the two … and then you take the sign … of the bigger number' Davis, 2010b: 384). While such pseudo-operations may serve as useful algorithms under specific conditions, they are not based on

mathematical principles and hence neither illuminate the structure of the discipline, nor do they provide general guidance in solving problems.

Manipulative materials – such as counters, Dienes blocks, geometric shapes and the like – are commonly assumed to promote conceptual understanding, since they embody concepts in material and visual form, providing content to abstract symbols, and illustrating the reasons behind the rules. However, if not skilfully used such manipulatives can distract and hinder progress, as illustrated in the lesson described in Figure 5.

This is school B1 in Chapter 4, and the observation was undertaken in August 2011. It serves a poor rural community, and has a declining roll of 386 learners and 11 staff, with one classroom block standing empty, one used as a library, another as a hall and a third as a staffroom, a total of six classrooms in this relatively new face-brick building constructed in 1993.

The Grade 3 mathematics class observed, contains 37 learners. This is a well-appointed classroom over which the teacher has taken great care. The DBE Numeracy Bk 2 is in the hands of every child and has been completed to pp 71/128 (starting on p 65). The DBE Literacy Bk 2 has similarly been completed to p 82/125 (starting p 65). If we assume that Bk 1 of each series had been completed, then these learners, on average, write far more frequently than is the norm for poor schools in the NSES (see Figure 6).

Teacher leads a class discussion on subtraction: she is writing on the board and learners are sitting in pairs, each pair with a set of blocks used for counting.

1. 135 – 19 = 116
2. 487 – 19 = 468
3. 176 – 9
4. 657 – 29
5. 678 – 29
6. 411 – 37
7. 414 – 9

Teacher works through the examples. Standard 'borrowing and carrying' notation is shown and explained verbally. The teacher starts each problem by asking: 'Five subtract nine is what?'
After eliciting 'impossible!' (which is strictly speaking not correct, a pseudo-operation) from the class, she proceeds to borrow, carry, subtract and write the answer.

During the subtraction stage, each pair has to count out: 15 – 9 = 6, using the blocks as counters. This is extremely laborious and the lesson would proceed far faster if the learners knew these simple number bonds and did not have to rely on the concrete method to do each subtraction. This is a pity because these problems are at about the right level for grade, but the learners could be moving so much faster and covering so much more ground if the teacher did not insist on keeping them stuck in concrete thinking. They only got through four problems in the lesson.

Figure 7.5: Grade 3 mathematics class, rural school

Picking up on the sort of problem illustrated in Figure 5, Schoenfeld (1986) warns that progress in developing understanding can be impeded when an iconic representation of the concept obscures the idea it stands in place of, impeding access to abstract thinking. It seems that this too is a common problem in South African schools, where Schollar (2008) has identified the use of what he calls 'unit counting', in which learners cover a page with tiny iconic marks, often running into hundreds, representing numbers, and then proceed to perform operations by counting the marks (see also Fleisch, 2008; Hoadley, 2011). The iconic representations are used to perform the operations of addition and subtraction by counting on or counting back. Multiplication and division are performed using repeated addition and subtraction.

The scope for making errors of counting is large with such inefficient procedures, and the margin of error rapidly widens as the numbers increase in size. This behaviour illustrates the problem of learners stuck in iconic and material modes of thinking about mathematical entities, and underlines the need to move on to the more highly condensed and efficient symbolism of arithmetic and algebra. In a sense these practices, very widespread among South African primary school learners (Schollar, 2007), represent the mirror image of Skemp's (1976) 'rules without reasons': by not moving to manipulating symbolic signifiers, learners are stuck in a Sisyphean labour of operating on uncondensed symbols which have a one-to-one relationship with real or imagined objects. The great power of mathematics, to abstract lower level concepts to symbolic entities in order to make higher order concepts more manageable, is neglected: these learners are not learning to do mathematics, but to use only counting procedures to perform complex operations. Perhaps it is not surprising that South African learners exhibit such crude arithmetic methods, given their very low exposure to examples of mathematics (or literacy) texts, a topic we look at briefly in the following paragraphs.

Access to textbooks in South African primary mathematics classrooms

Two large-scale surveys (Economics Department, 2010; Spaull, 2011) and a number of small-scale studies (see Hoadley, 2010 for a recent review of the literature) converge on the conclusion that the large majority of South African classrooms exhibit a lack of print materials, especially textbooks. In a comparison of textbook availability in 4 Southern African countries participating in the SACMEQ III study, Spaull (2011) found that Botswana has the highest proportion of students with their own reading books (63%) and own mathematics textbooks (62%), followed by Mozambique (reading 53%, mathematics 52%), South Africa (reading 45%, mathematics 36%), and Namibia (reading 32%, mathematics 32%) (Table 1).

Table 7.1: Mathematics textbook availability in four Southern African schools

	Botswana	Mozambique	Namibia	South Africa
No textbooks	2%	4%	2%	11%
Only the teacher	3%	5%	11%	17%
Share with 2+	11%	24%	27%	12%
Share with 1	21%	14%	28%	24%
Own textbook	62%	52%	32%	36%

Source: Spaull, 2011:51

The fact that 28% of South African mathematics teachers report that their Grade 6 learners never see textbooks, while only just over one-third (36%) have their own copies, reveals the meagre nature of textbook access for the country's learners. It must be noted that both the SACMEQ and NSES data was collected prior to the distribution of workbooks in language and mathematics to all learners in Grades 1–6 commencing in 2010 (seen in the classes described in Figures 5 and 7), and the situation has almost certainly improved since. However, what Table 1 does reflect is the low regard in which textbooks are held in the majority of South African schools, where there are sufficient funds to provide books to all learners.

These findings mask provincial differences, but are broadly supported by data derived through a baseline study of conditions existing in target schools prior to the first year of the Literacy/Numeracy Strategy initiated by the Western Cape Education Department in 2010 (JET Education Services, 2010). Table 2 reveals great variation of textbook availability across classes within the same school, a pattern that indicates an absence of a school-wide approach to the procurement and use of text in these schools, an important indicator

of instructional leadership discussed in Chapter 4. But the most noteworthy feature of Table 2 is how few learners get to take books home. In a situation in which well over half the learners have very little access to books at home or through a library, the school is the only source of textual material, a function which most schools in the province, the country's most highly developed, clearly do not fulfil.

Table 7.2: Books observed in mathematics classes in 31 schools, Western Cape

Type of textual materials	Number of copies	Percentage of classes where observed			
		Grade 1	Grade 2	Grade 4	Grade 5
Textbook	Only teacher copy	0%	50%	66%	17%
	Learners share copies	0%	0%	0%	17%
	Every learner has a copy	0%	50%	33%	67%
	Learners take books home	9%	9%	19%	25%
Worksheets	Only teacher copy	6%	0%	0%	0%
	Learners share copies	0%	0%	6%	0%
	Every learner has a copy	94%	93%	94%	100%

Note: Schools selected purposively from a sample of 125 WC schools by districts to reflect a variety of performance levels.

Source: JET Education Services, 2010

The ubiquitous presence of teacher-made worksheets in these classrooms is also a striking feature of Table 2. A survey undertaken on behalf of the WCED (Department of Economics, 2010) summarises the limitations of worksheet use. Most important of these is that, unless teachers consciously structure and build links between the tasks and activities that they give their learners, exercises or activities can be selected in an ad hoc fashion from different sources, and used in ways that do not reflect systematic progression through the curriculum. In contrast, good textbooks provide a structured course, which systematically explores the intended curriculum.

This problem is not confined to South Africa, but occurs in developed countries too. Based in case study work in US classrooms, Hill and her colleagues argue that solid mathematical tasks and representations that come from a drab textbook are preferable to teacher-created math lessons in the hands of teachers with little mathematical knowledge for teaching, and that 'Without the ballast of mathematical knowledge, teachers' implementation of supplementary materials is chancy at best' (Hill et al, 2008: 499).

Perhaps the starkest finding regarding the availability of textbooks in South African mathematics classrooms is shown by a survey conducted by

Fleisch et al (2011) in 22 randomly selected primary schools in quintiles 1–4 in Gauteng. In only one school, a small school with only 12 learners did Grade 6 learners have access to individual copies, in 9 schools only the teacher had a copy, while in the remaining 12 schools learners shared a textbook. But even when books are available, they are not necessarily used by teachers: in a sample of 10 teachers who formed part of an evaluation study of the textbook *Maths for all*, Ensor et al (2002) found that, although all classes were provided with books, only three teachers allowed learners access to them, and all teachers used the books selectively and generally not as intended, subverting them to their own deductive teaching styles.

Writing in mathematics classes

An examination of learners' writing at the end of a school year tells us a great deal about what has happened in the class over the year. It tells us about which topics have been studied, how many exercises were performed in each topic, as well as something about the complexity of the exercises. To use Ensor et al's (2009) terms, student writing reveals both the cognitive density and scope of the encounters with mathematics experienced by these learners during the year. In the second and third years of the NSES study, learner writing books for mathematics were examined and the frequency and extent of written exercises recorded for each of the 268 schools in the study.

In order to ascertain what mathematical topics learners are exposed to, the exercise books of the best learner in each mathematics class in Grades 4 (in 2008) and 5 (2009) were examined. Using a list of all the topics specified in the curriculum, fieldworkers noted each topic on which one or more written exercises had been completed. For each topic, we then computed the mean percentage of classes that had completed at least one written exercise on this topic. The results shown in Figure 6 indicate that that writing is done very seldom in mathematics classrooms. In the majority of classes (58% in Grade 4 and 53% in Grade 5), learners write on 50 days of the year or fewer. This is equivalent to about one day in three or more. In a very small minority (2% in Grade 4 and 7% in Grade 5) do learners write on at least 4 days a week.

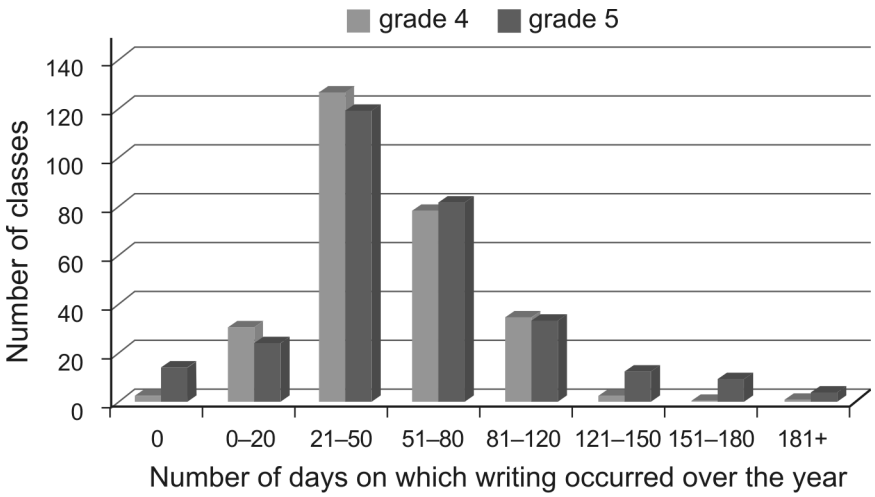


Figure 7.6: Frequency of writing in mathematics classes, NSES sample

Source: NSES data

Learners in South African mathematics classrooms are systematically deprived of access to written text, whether this is in the form of being exposed to ideas, explanations and activities through reading, or in the form of expressing themselves in writing. Not only does this practice severely inhibit learning, but the natural curiosity of children towards text is unable to find expression in the classroom, as so poignantly illustrated in the lesson described in Figure 7.

The school is situated in the rural Transkei, one of the country's most impoverished regions, 2 hours by car from Mthatha, the former capital of the apartheid 'independent homeland' of Transkei. The school is in mountainous topography and reached by dirt road which deteriorates as it winds its way into the mountains. On the day when the following lesson was observed, it was raining and heavily misted making progress under slippery conditions treacherous. The teachers live in Mthatha and make this round trip every day, although the principal hardly ever appears. The school exists under what must be the most challenging conditions anywhere in the country, set in some of the most beautiful scenery.

The visit was undertaken as part of a school improvement project through which textbooks in every subject in every grade were supplied to all learners, while teachers received teacher guides and instruction on how to use books in class. The school was one of the best performers of the eight primary schools in four provinces participating in the project, achieving gains in the order of 20–30 percentage points in numeracy tests administered at the start of the project and again two years later. The visit occurred in September 2011, some 9 months after the national Department of Education had distributed a workbook in key subjects to all learners in Grade 1–6 across the country.

Among six lessons observed at this school, the Grade 6 class described below is on fractions. This was obviously a contrived situation, repeating a lesson that the teacher had given before, but the style and content are surely indicative of the kind of lesson typical of this teacher. Each child has a DBE workbooks for Mathematics Grade 6, labelled with her name and a school date stamp (March), but no exercises had been completed. Learner exercise books show that writing happened on 37 days between January and August: these were mainly very short exercises – around five examples of single-step procedures. The lesson proceeds purely by expository definition, with no attempt at conceptual or procedural explanation or demonstration.

T (*writing on the board*): A fraction is a part of a whole.
Ls (*repeat in chorus*): A fraction is a part of a whole.
T (*drawing a square and then dividing it in half*): Whole; half. (*writing under the diagrams*) $\frac{1}{2}$.

A few learners are bored and start paging through the DBE book, which is lying on the desk of each child, unopened. During the lesson, this practice gathers momentum as more learners lose interest in the lesson, and one cannot help wondering why the teacher is proceeding with her patter and not exploiting the curiosity so obviously being shown by the learners in these attractive workbooks. Apparently oblivious to her learners' needs, she doggedly proceeds, writing on the board:

$\frac{1}{2}$ ——— numerator
——— numerator

T: A proper fraction has the numerator smaller than the denominator.
Ls (*repeat in chorus*): A proper fraction has the numerator smaller than the denominator.
T: An improper fraction ... etc.
Ls (*repeat in chorus*): An improper fraction … etc.

An increasing number of learners become interested in the DBE workbooks.

T (repeats the definitions again)
Ls (chorused repeats)
and then:
T: (commits a gaffe) … equivalent fractions have the denominators the same …

$$\frac{2}{4} \quad \frac{3}{4}$$

Ls: (repeat the incorrect definition)
T: Coming to adding equivalent fractions, you add the numerators and do not change the denominators.
Ls: (repeat in chorus).
T (writes):

$$\frac{2}{4}+\frac{3}{4}=\frac{5}{4}$$

T: Now take out your textbooks (Day by Day) and complete page 2, activity 5.

This takes an inordinately long time, and after 5 minutes fewer than half the class has complied.

Figure 7.7: Grade 6 mathematics class, rural school

The nature of the curriculum and the concept of coverage

If we follow Vernaud (1994) in viewing mathematics as a set of interlocking conceptual fields – or networks of concepts, representations and situations in which concepts are manifest – then individual content topics are strongly interrelated. Thus, the powerful notions of ratio, rate and proportion are built upon the simpler concepts of whole number, multiplication and division, fraction and rational number, and are themselves the precursors to the development of yet more complex concepts such as triangle similarity, trigonometry, gradient and calculus. Two implications follow from this conception of mathematics. One, curricula, textbooks and classroom instruction should be structured so as to introduce this unfolding network of mathematical ideas to learners systematically and sequentially. Two, if learners are not led to explore the whole curriculum, to have the opportunity to acquire this hierarchical network of concepts, skills and applications, then vital knowledge gaps are inevitable which threaten the coherence of the entire edifice of mathematical knowledge in their minds.

Of course, the curriculum must be worth covering, without omitting topics that are key to knitting together the nodes in the important conceptual fields that constitute the subject school mathematics. For the purposes of the NSES, we assume that the subject matter content of South Africa's National Curriculum Statement for mathematics (NCS) (DOE, 2002), the course of study in force when the NSES was conducted, met this condition. This is considered to be a reasonably safe assumption, given the absence of any serious controversy among the South African mathematics education community on this issue. It follows that coverage of the NCS is necessary for developing mathematics proficiency among the country's learners. Short of sitting in on every mathematics lesson offered to any one class over the year, an analysis of the writing undertaken by learners during the year provides the best, and indeed the only practical way of assessing curriculum coverage for that class.

Table 3 shows the results of the workbook analysis of the NSES regarding curriculum coverage.

Table 7.3: Coverage of the five topic areas in Grades 4 and 5

Topic area	Grade 4		Grade 5	
	Number of topics	Mean % covered	Number of topics	Mean % covered
Numbers, operations and relationships	32	35	34	38
Patterns, functions and algebra	12	13	12	12
Space and shape (geometry)	15	23	14	18
Measurement	14	17	17	15
Data handling	11	12	12	10
Total	84	24	89	24

Source: NSES data

On average, only 24% of topics were covered (in the sense of having been the subject of at least one written exercise over the year) in both Grades 4 and 5. Overall, 88% of teachers had covered no more than 35 (40%) of the 89 topics specified in the Grade 5 mathematics curriculum, and 58% had covered no more than 20 topics in Grade 4, which make up only 22% of the curriculum.

There were very few topics in which at least half the sample had completed one exercise or more. These included only the simplest of topics in areas that constitute the foundations of school mathematics: counting, writing numbers, the operations of addition, subtraction and multiplication, rounding off numbers, decimal and common fractions (Table 4). If covered adequately, these topics would provide a good start in mathematics, although Grade 5

learners should also be studying ratio, a topic addressed in only 22% of NSES classes. The problem is that these key topics should be addressed in every South African Grade 5 classroom, and not, as is the present practice, in only about 55% of classes. Furthermore, Table 4 shows that advanced topics, including those that constitute the building blocks for a conceptual understanding of the subject, are covered by very few teachers. Such key nodes in the conceptual fields that intersect within primary mathematics include the topics:

- Check solutions to exercises/problems (13%)
- The commutative, associative and distributive properties (10%)
- Investigate numeric and geometric patterns to find rules represented in physical or diagrammatic form (17%)
- Finding rules to linear and non-linear patterns (4%)
- Describe pattern relationships in own words (5%)
- Write number sentences (18%), and foundation concepts in probability (3% or less).

Table 7.4: Frequency of coverage of selected NCS topics, Grade 5 mathematics

Percentage of classes which attempted these topics			
50% or more	**At least 20% but less than 50%**	**Between 5% and 20%**	**5% or less**
Count and represent whole numbers to at least 6-digits (58%) and common fractions to at least twelfths (59%). **Equivalent forms of** the numbers listed above, including **common fractions** (54%). **Rounding** off (62%) **Addition and subtraction** of whole numbers with at least 5 digits (57%) **Addition and subtraction of common fractions** with the same denominator (52%) **Multiplication** of at least 3-digit by 2- digit numbers (57%)	**Decimal fractions** of the form 0.5, 1.5, 2.5 (21%) **Multiples** (46%) and factors (40%) **Place value** to at least 6-digit numbers (33%) **Financial** calculations (26%) **Simple ratio** (22%) **Division** of at least 3-digit by 2-digit numbers (44%) **Finding fractions** of whole numbers (40%) **Equivalent fractions** (47%) **Mental calculations involving multiplication** to at least 10 × 10 (46%) **Building up and breaking down** numbers (47%)	**Check solutions** to exercises/problems (13%) The **commutative, associative and distributive properties** (10%) **Investigate numeric and geometric patterns to find rules** represented in physical or diagrammatic form (17%) Describe pattern relationships in own words. (5%) **Write number sentence** to describe problem situation (18%)	**Rules in patterns** not limited to sequences involving constant difference or ratio (4%) **Interpret data**, draw conclusions and make predictions sensitive to the role of categories within the data such as gender and race (3%) **Classify certainty** of events happening from daily life (2%) **Possible outcomes for simple experiments** (including tossing a coin, etc) (1%) **Frequency of actual outcomes** for a series of trials (3%)

Mental calculations including: adding and subtracting in columns (62%)	**Rounding off and compensating** (41%) **Doubling and halving** (35%) The reciprocal **relationship between multiplication and division** (22%) The **equivalence of division and fractions** (22%) **Flow diagrams** (20%) **Solve number sentences** by inspection or trial-and-improvement (22%) Similarities and differences between **cubes and rectangular prisms** (39%), **squares and rectangles** (41%) **Properties of two-dimensional shapes and three-dimensional objects** including: number and shape of faces (42%), number and length of sides (34%) **Use S.I. units** for: mass (34%), capacity (34%), length (37%) (no conversions) **Organise and record data** using tallies and tables (27%), bar graphs (22%)	**Investigate two-dimensional shapes and three-dimensional objects** by making models (14%), trace their nets (8%), draw shapes on grid paper (15%) **Investigate symmetry** (rotations, reflections and translations) using geometric figures and solids (6%) Tessellations (11%), line and rotational symmetry (13%) **Views of a simple three-dimensional object** in different positions (7%) **Locate position** on a coded grid (7%) **Conversion** between appropriate time units (11%) **Temperature** using Celsius scale (17%) **Measurement**, including: mass (7%), capacity (10%), length (11%), temperature (7%) Investigate: perimeter (18%), area of polygons (9%), volume/capacity of objects (7%) Recognise right angles in two-dimensional shapes (5%) Count objects in order to collect data (15%) Find the mode of a data set (8%) Display and interpret data including: pictographs (16%) Interpret data (6%)	**Convert** between appropriate S.I. units (4%)

Source: NSES data

The method for collecting the data shown in Table 4 ensures that these figures reflect the most optimistic scenario concerning curriculum coverage, since the presence of a single five-item exercise in any one topic is counted as 'covering the topic'. Table 4 gives no indication of the quality of this coverage. The problem is well illustrated by, on one hand, noting that 46% of classes in the NSES sample had addressed the NCS topic 'Mental calculations involving multiplication to at least 10 × 10'. On the other hand, the WCED survey mentioned earlier revealed that a quarter of Grade 3 learners in the sample of poorly performing schools could not tell what two times three was, almost a third could not tell what two times four was, and almost two thirds did not know what three times six was – despite the fact that three-quarters of their teachers professed that they practised the times tables at least three times a week in class (Department of Economics, 2010:8). The larger point is that the extent to which learners are exposed to key topics prescribed in the curriculum gives only the broadest indication of the opportunity provided to learn the subject matter: coverage represents an obviously necessary but far from sufficient step towards learning. Of critical importance in shaping the processes and outcomes of learning is the quality of the curricular explorations undertaken in class, a topic to which we now turn.

The quality of learner writing

The level of cognitive challenge posed by any mathematical task, or cognitive density (Ensor et al, 2009), is an important aspect of learner's writing, but one that is difficult to capture in a survey such as the NSES. In addressing this problem, the TIMSS textbook study developed a scheme for classifying text, and problem-solving activities of the kind envisaged by Hiebert and his colleagues was one of the elements the TIMSS team looked for when analysing nearly 400 books from 36 participating countries (Valverde et al, 2002). Problem-solving is a broad topic that has been prominent in the discourse on mathematics education since the 1990s. Drawing on Dewey's (1933) notion of reflective inquiry, Hiebert et al insist that both curriculum and instruction should begin with problems, dilemmas and questions for the student; even routine activities, such as 62–37, if presented in a problem format with which the student can identify, can lead to deep cognitive engagement, construction of appropriate mathematical procedures and productive peer communication (Hiebert et al, 1996:13); through these processes new relationships are uncovered, signalling a deeper understanding of the concepts involved (15).

However, when looking at learners' writing, it is not always clear what kind of task a particular writing exercise is a response to. Indeed, much of the writing seen in the NSES is so sparse and cryptic that a very simple scheme was sufficient to capture much of the variability. In order to record task complexity,

we followed the TIMSS video study (Hiebert et al, 2003), and assessed this characteristic using the simple distinction between tasks containing a single step and those requiring more than one step. This distinction would certainly not be sufficient to capture the range of capabilities of older students, but at this level (Grades 4 and 5) it was found to be adequate, given the relatively few 'complex' exercises, and the limited nature of those that do occur. The quality of each exercise was classified according to scheme used in the TIMSS video study. Exercises showing more than one step (complex) were further subdivided according to whether they contained responses to five or fewer individual problems[3], or whether they consisted of six or more responses. Regarding the production of complex exercises, over one-quarter of Grade 4 learners and 16% of Grade 5 learners did no writing of this kind over the year, while 85% in both classes do 20 or fewer such exercises.

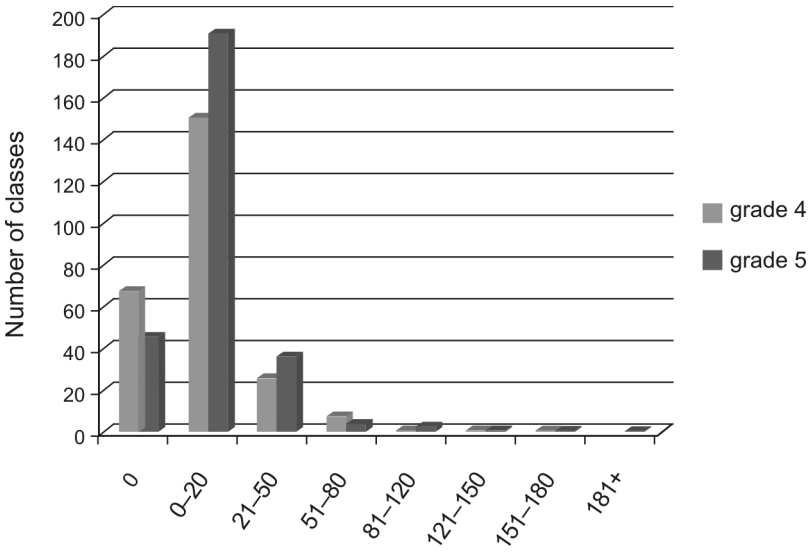


Figure 7.8: The prevalence of complex writing

Note: Complex writing is defined as a response containing more than one step
Source: NSES data

Conclusion

Semiotic studies in mathematics classrooms underline the importance of writing in the learning and communication of mathematical knowledge. These

theoretical predictions are supported by the NSES data. One of the factors most strongly associated with improved math performance in our regression models shown in Chapter 3 is the quantity of writing. Thus, in the model which tracks two year gain scores on the numeracy test (Chapter 3, Table 14), this factor shows up as substantial and statistically significant, with an eight percentage point gain being associated with writing on more than 156 days of the year. But, as we see from Figure 6 above, very few learners fall into this category, and there is a high correlation between socio-economic status and quantity of writing. The question for mathematics education arising out of the NSES findings is: How can we best promote reading and writing in schools serving poor children?

The data derived from large-scale studies such as the NSES is cryptic and untextured. We know that the results generalise to the population, but we are not sure what they mean. In both this chapter and the next, we show qualitative descriptions of classrooms in order to glean insights into the processes which lead to poor test scores. While the conclusions derived in this way may not be as reliable as those obtained through statistical correlation – in the sense that we do not know how they are distributed through the population – the insights gained are more informative about what happens in classrooms. In other words, the implications of a qualitative description may not be as true as those derived by quantitative means, but, where they are in any degree truthful, they are likely to be more meaningful. An example illustrates the point: we may not know what proportion of lessons are like the one depicted in Figure 5, but the classroom vignette clearly shows progress being slowed through the use of concrete means to complete simple calculations. This is a phenomenon commonly seen in South African classrooms (Ensor et al, 2002; Ensor et al, 2009; Schollar, 2007; Fleisch, 2008; Hoadley, 2010), and the implication is that practices such as these are inhibiting learning; it would follow that teachers should move their learners to using algorithmic procedures fluently by the middle years of the primary school. The research literature tells us that the development of fluent procedures should be accompanied by the building of sound concepts and conceptual linkages, through the recursive use of multiple representations in verbal, iconic and symbolic forms.

The larger question for this chapter is: What is it that so inhibits reading and writing as a form of classroom behaviour? Is it that books are not budgeted for, or is a large proportion of allocated funding lost to fraud? Does the problem lie in inefficient procurement, or are schools so apathetic towards books that they fail to procure at all? Or does the problem lie in the classroom, where teachers fail to use books that are available? The last of these situations may arise either through ignorance of the importance of books, or through fear that giving learners access will expose their own poor knowledge foundations. Either way, depriving learners of books is a way of severely limiting their access

to knowledge, thus making poor learners heavily dependent on the knowledge resources and pedagogical methods of their teachers. Available studies indicate that there are sufficient books available in most schools to provide learners regular access, a situation that has strengthened considerably since the introduction of the Department of Basic Education workbooks in 2011. If this is so, then the most important policy question becomes: What do teachers need that will enable them to make full use of available textual materials?

This chapter and its successor provide much information about classroom patterns that frustrate learning. The qualitative data is very different from but consistent with the quantitative findings: low coverage shown by the NSES data would be expected to be accompanied by the kinds of impedances to learning described above, and both in turn would be expected to lead to poor test scores. But ultimately, both kinds of data are symptoms of a larger problem. It is obvious that poor curriculum coverage and infrequent writing will result in poor test scores. The important question is why are teachers unable to expose their learners to a greater proportion of the intended curriculum, to more frequent reading and writing in all subjects, and to more complex explorations of text? We will return to this issue in Chapter 10. But first, there is further evidence to be examined about the kinds of knowledge required for effective teaching, a topic that occupies us in Chapter 8.

Acknowledgement

The classroom vignettes shown in Figures 5 and 7 were recorded by the first author in August 2011 during visits to schools participating in the School Support Project of the Maskew-Miller Longman Foundation.

[1]This section is indebted to Long's (2011) review of the literature on the semiotics of school mathematics. Responsibility for the arguments presented here, remains with the authors.

[2]Each exercise is partitioned from the next by a new date. The number of exercises therefore indicates the number of days on which writing occurred in class or at home. Missing dates were imputed from the average length of exercises where dates were available.

[3]Each response partitioned from the next by a label such as 1(a), (i), etc.

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Chapter 8

Teacher knowledge and professional habitus

Nick Taylor and Stephen Taylor

This chapter picks up on the subject of teacher professionalism, a key element in the theoretical framework derived in Chapter 4 for describing the school learning environment. In particular we return to Elmore's notion of professional practice as a collection of patterned actions, based on a body of knowledge, skill and habits of mind that can be objectively defined, taught and learned (2008: 64), and his contention that teaching is a pre-professional occupation, which has as yet been unable to specify norms of practice. In this chapter, we explore what this body of knowledge might consist of, what evidence there is of South African primary school teachers knowing it, and how it is related to learners' learning.

Teacher professional knowledge

A number of authors are of the view that teaching should not follow the other professions in developing an explicit knowledge base. Thus, Apple argues that the intensification of teachers' work, brought about by the bureaucracy which inevitably accompanies the systematisation of practice in the name of science, has taken the focus off the essential task of fostering critical literacy in students and made the implementation of 'what works' the key focus of teachers' work (Apple 2000, 118-119). According to Goodson and Hargreaves (1996), teacher professionalism should move beyond attempting to reduce educational knowledge to the level of scientific certainty, rise above 'the recent clamour for technical competency and subject knowledge', and deal with the more morally-laden and politicized areas of teaching (Goodson and Hargreaves 1996:20). Sockett (1987:1) concurs, arguing that the development of a scientific knowledge base for teaching would deny the contextual, emotional, reflexive

and iterative elements that are integral to good teaching – in short, it would deny the craft and artistry of the profession.

Notwithstanding the reservations of these authors regarding the notion of a scientific basis to teaching, others such as Hiebert, Gallimore and Stigler (2002) want to codify knowledge for teaching:

> … we recognize the value of teachers' craft knowledge. We now ask whether it is possible to build this personal craft knowledge into a trustworthy knowledge base that can be accessed and shared widely in the profession… we propose that professional knowledge must be public, it must be represented in a form that enables it to be accumulated and shared with other members of the profession, and it must be continually verified and confirmed. (Hiebert, Gallimore and Stigler 2002:3-4).

Grimmett & Chinnery (2009) agree with this view, putting forward the notion of teaching and teacher education as a profession with a formal, research-based body of knowledge that distinguishes qualified educators from lay persons.

Despite these disagreements about the nature of teacher professional knowledge, there is general consensus that a systematic understanding of teaching must constitute the central axis of the profession, whether this occurs in tacit form, as a public dialogue about education within the professional community (Hyslop-Margison and Sears 2010), or whether it takes the form of a codified abstract knowledge system, a key characteristic of the high status professions according to Abbott (1988). A second feature of this debate is also subject to wide agreement: professions adopt a collegial form of organization that is instrumental in setting and maintaining the standards of both training and practice, and plays a role in the continuing professional development of members.

Further, being a professional is not simply a matter of undergoing training in a knowledge field and belonging to an association. In Chapter 4, we quoted Beck and Young's (2005) description of a teacher professional habitus as consisting of specialist expertise and adherence to the values of a particular occupational community and its standards of judgement. We also saw in Chapter 4 that the giant South African Democratic Teachers Union (SADTU) seems caught between the predatory acquisition of public resources for the benefit of its members, and defending teacher interests in the face of civil service incompetence and corruption. At the same time, the Association for Mathematics Educators of South Africa is well supported, with attendance at the annual conference around 2000 active members, with scores of activities occurring through the nine provincial branches. Formed in 1996 as the first non-racial association for math educators, the roots of AMESA go back to active subject-based organisations in the 1980s. The South African Association of Language Teachers (SAALT) is even older, having been formed in 1966. It seems that for the majority of South African

teachers' professional interests and matters relating to working conditions are kept separate, with SADTU catering for the latter and subject associations pursuing the former. Interestingly, at the time of writing SADTU was developing a training programme for the new curriculum, which it plans to offer to all primary school teachers in 2012 and beyond.

However, back to the topic of a knowledge base for teaching: What would it contain? Bernstein (1990) identifies professional knowledge domains as 'regions', which are distinct from the disciplines. From this perspective, regions look backward to the field of knowledge production and forward to the field of practice: 'Regions are the interface between disciplines (singulars) and the technologies they make possible.' For teachers of mathematics, the *disciplinary* part of their professional knowledge is mathematics; for language teachers it is literature, grammar and rhetoric.

Still following Bernstein (1994), a school curriculum is formulated through a process of recontextualisation from the disciplinary base: this involves selecting parts of the relevant discipline and describing the selection in new terms; the result does not necessarily resemble its foundation subject in all its aspects, although its ultimate warrant is always in terms of the *principles of that discipline*. In a country with a national curriculum, such as South Africa, formulating the subject curriculum is the task of the official recontextualising field, which comprises the state and its agents (Bernstein, 1994). A second set of recontextualising agents – researchers, teacher educators, expert teachers – perform a second transformation: selecting from the discipline of mathematics, from the school curriculum, and from the findings of research into teaching and learning, and casting this selection as *subject knowledge for teaching*.

Finally, there is a third component of teacher professional knowledge, practical *classroom competence*. This is the craft part: no matter how much the teacher knows about her subject, and no matter how well she has mastered the research literature on the teaching of the subject, success in the classroom is a performance affected fundamentally by the teacher's experience, commitment and personality, and many personal and contextual conditions.

In conclusion, teacher professional knowledge comprises three components: disciplinary knowledge, subject knowledge for teaching, and classroom competence; or, put another way, content knowledge of the respective school subject; theoretical and research findings concerning the nature of the subject and methods of teaching it; and the practical ability to convey the subject to learners in real classrooms. We concern ourselves in this chapter primarily with the first two and do not say much more about practice, although we will offer some remarks on the issue of pedagogy where these arise below.

On the first component of teacher professional knowledge, the Concise Oxford Dictionary gives the etymology of 'discipline' as deriving from Latin: *disciplinare (v.)*, *disciplina (n.)*, *from discipulus DISCIPLE* (COD, 1995, 385),

which itself derives from discere 'learn' (COD 1995, 384). This history evokes images of a curriculum that disciplines the mind and provides those who graduate with a language, system of thought, code of ethics, and professional community. To use Bernstein's (1996) language, the pedagogic device acts as a symbolic regulator of consciousness. We can say that the training process socialises the novice into a way of thinking and acting. Muller (2009a: 214) puts it this way: 'A strong academic identity thus binds the social to the cognitive'. It is in this sense that we cited Beck and Young's (2005) notion of a professional 'habitus' in Chapter 4.

We have called the second component of our envisaged code of professional teacher knowledge 'subject knowledge for teaching' and described it as deriving from the research literature. One of the first to give this component a name was Shulman (1986) in his much quoted AERA Presidential address in 1986 when he distinguished between content knowledge, pedagogical content knowledge (PCK) and curriculum knowledge. The first corresponds to what we have called disciplinary knowledge, while the last, the most neglected in Shulman's view, reflects the teacher's understanding of how the different curricular topics and subjects fit together and how they relate to each other at successive grade levels. This is the sort of knowledge that forms the basis for good instructional leadership, as described in Chapter 4. The data presented in Chapters 6 and 7 indicate that many South African teachers possess inadequate levels of *curriculum knowledge*.

Of Shulman's three knowledge categories, it is PCK that has attracted the most attention, and which he defined as *subject matter knowledge for teaching*; this is still content knowledge, as distinct from pedagogy, but focuses on those aspects, which are most germane to its teachability. PCK includes knowledge about the most useful forms of representing an idea, and the most powerful illustrations, examples, analogies and demonstrations (such as the forms of representation described in Chapter 7); it includes an understanding of what makes a topic easy or difficult to learn; and it includes an understanding of the kinds of misconceptions which learners are often prey to, and how these misconceptions may be overcome. This is the same sense in which Heather Hill and her colleagues use the term content *knowledge for teaching mathematics* (*CKT-M*) (Rowan et al, 2001; Hill, Rowan and Ball, 2005; Hill et al, 2008). CKT-M is defined as the specialised knowledge of math needed for the work of teaching:

> By 'mathematical knowledge for teaching,' we mean not only the mathematical knowledge common to individuals working in diverse professions, but also the subject matter knowledge that supports that teaching, for example, why and how specific mathematical procedures work, how best to define a mathematical term for a particular grade level, and the types of errors students are likely to make with particular content. (Hill et al, 2008:431)

Adler and her colleagues refer to the same idea as *mathematics for teaching* (Adler & Davis, 2006). In line with Shulman, Hill et al insist (2005) that CKT-M is math knowledge not pedagogy; it is the knowledge teachers use in classrooms. Hill and her colleagues attempt to capture this kind of knowledge in items designed to measure teacher CKT-M. Examples of such items ask teachers to show or represent numbers or operations using pictures or manipulatives, and to provide explanations for common mathematical rules (e.g., why any number can be divided by 4 if the number formed by the last two digits is divisible by 4) (Hill et al, 2008:439). Figure 1 shows one item.

Figure 1.8: Example of an item measuring CKT-M

1. Which of these three methods will work for multiplying ANY two whole numbers? Explain why.

A.	B.	C.
35	35	35
× 25	× 25	× 25
125	175	25
+ 750	+ 700	100
875	875	150
		+ 600
		875

Source: Constructed from Hill, Schilling and Ball (2004:28)

According to Hill et al (2008), to respond to this situation, teachers must draw on mathematical knowledge, including making sense of the steps shown in each example, then gauging whether the steps might make sense and work for all whole numbers. This is teacher-specific work; appraising nonstandard solution methods is not a common task for adults who do not teach. We would elaborate this description to say that a complete answer to the question posed in Figure 1 would show how the solution depends on an understanding that the three algorithms shown are based on three different manifestations of the distributive law, all derived from the decomposition of 35 and 25, as follows:

A. $(30 + 5) \times (20 + 5) = (5 \times 25) + (30 \times 25)$
B. $(30 + 5) \times (20 + 5) = (5 \times 35) + (20 \times 35)$
C. $(30 + 5) \times (20 + 5) = (5 \times 5) + (5 \times 20) + (5 \times 30) + (30 \times 20)$

All three methods can be generalised to all whole numbers. The most elegant way of arguing for this conclusion is by invoking the fundamental mathematical principals of place value, the operations of addition and multiplication, and the distributive property. Only in this way can a satisfactory explanation of the equivalence of options A-C be constructed be constructed. It follows from this discussion that CKT-M depends on understanding the concepts of the discipline of mathematics (decomposition, distribution and generalization), and of the forms of representation of mathematical entities and operations

discussed in Chapter 7. In other words, the work of Heather Hill and her colleagues begs the hypothesis that strong disciplinary knowledge is a prerequisite for developing proficiency in CKT-M.

The relationship between teacher knowledge and learner scores[1]

Research has not consistently found a strong association between the subject-matter knowledge that teachers possess and teaching effectiveness, as measured by learner test scores. In an early meta-analysis, Byrne (1983) summarised the results of thirty studies relating teachers' subject matter knowledge to learner achievement: the results were mixed, with 17 showing a positive relationship and 14 showing no relationship. Ashton and Crocker (1987) found only five of 14 studies they reviewed exhibited a positive relationship between measures of subject matter knowledge and teacher performance. In a later overview of the field, Hanushek & Rivkin (2006) note that there is little agreement on what the characteristics of a high quality teacher are, although most would agree that teacher quality is very important for learner performance.

One hypothesis that has been put forward to explain these counter-intuitive results is that knowledge of the material to be taught is essential to good teaching, but that returns diminish beyond some minimal level of subject matter expertise, a postulate supported by Monk's study of mathematics and science achievement in a sample of 2 829 students from the Longitudinal Study of American Youth (Monk, 1994). Monk found that teachers' content preparation, as measured by coursework in the subject field, is positively related to student achievement in mathematics and science but that the relationship is curvilinear, with diminishing returns to student achievement of teachers' subject matter courses above a threshold level (e.g., five courses in mathematics). In a multilevel analysis of the same data set, Monk and King (1994) found both positive and negative effects, generally insignificant, of teachers' subject matter preparation on student achievement.

The work of Hill and her colleagues on CKT-M stands in contrast to the very mixed results sampled above. Hill et al (2005) found not only that teachers' CKT-M was a significant predictor of student gain scores in math, but that CKT-M is the strongest teacher-level predictor of such gains, exhibiting more of an effect than teacher background variables and average time spent on mathematics instruction each day. This research has also established a link between teacher scores on CKT-M items and the quality of instruction, as indicated by the appropriateness of teacher's responses to students and their mathematical errors, the richness of the mathematics taught, and mathematical language used in class (Ball and Bass, 2000; Ball, Hill and Bass, 2005; Hill,

Shilling and Ball, 2004; Hill et al, 2008). Based on these findings the authors predict that efforts to improve teachers' mathematics knowledge through content-focused professional development and pre-service programmes will improve student achievement. (Hill et al, 2005).

In their replication of work in the CKT-M tradition, Carnoy et al (2011; 2012) reached the same conclusions in a comparative study of teachers in South Africa's North West province and neighbouring Botswana. In an analysis of video-taped lessons, the study used a framework for assessing teacher knowledge and instructional quality consisting of four components: the mathematical content of the lesson; the mathematical proficiency learners have the opportunity to acquire; the level of cognitive demand at which material is presented; and teacher knowledge, including both her subject knowledge and her ability to elaborate this in class. (Carnoy et al, 2011; Sorto and Sapire, 2012). The study found that teaching of procedures is given most time in the lessons observed, with higher level thinking and reasoning skills getting the least attention. A large percentage of the lessons (around 90 percent) required students to simply recall rules and definitions, or perform algorithms with no understanding of the underlying concepts. Carnoy et al (2011) conclude that learners' gains are not only directly related to both the quality of mathematics teaching received and to curriculum coverage, but that these teacher characteristics, in turn, are related to teachers' knowledge of the mathematics they are supposed to be teaching.

Based on the findings of Hill et al's work on CKT-M, and those of Carnoy et al, we propose an alternative understanding of the relationship between teacher knowledge and learner performance. This hypothesis states that a principled understanding by the teacher of the subject discipline is a prerequisite for effective teaching and improved learning, and that improvements in teacher knowledge at low levels (i.e. from very low knowledge to low knowledge) have little impact on the quality of teaching and learning. In investigating this hypothesis, we start by providing insights into the state of subject knowledge of South African Grade 6 math and language teachers.

The state of knowledge of South African teachers

The last few years has seen the accumulation of evidence to indicate that the majority of South African teachers know little more about the subjects which they teach than the curriculum expects of their learners, and that some teachers know considerably less than this (Taylor, 2009). The SACMEQ III data provides the first opportunity to assess the nature of teacher subject knowledge in any systematic way. Furthermore, the data is particularly interesting in that

a number of items were repeated in the learner and teacher tests, providing the opportunity to compare teacher and learner scores directly.

In describing the data from the SACMEQ teacher tests, we discuss mathematics and language separately. For both subjects three categories of items emerge when teacher and learner responses are compared on the same items. The first category included items on which teachers performed well (>=75%) and learners also performed fairly well (>=40%). In this pattern, there is a *correlation* between the two sets of scores, in the sense that a majority of both teachers and learners got the correct answer, although learners scored well below their teachers. This pattern allows for the possibility that teachers are effecting learning on the types of knowledge tested by these items, by whichever means, a process that we call *transmission* for the sake of brevity[2]. Although the analysis presented here in no way proves a causal relationship between teacher knowledge and learner performance on these items, in view of the literature reviewed above several speculations are made about specific items based on a descriptive analysis of teacher and learner performance on these items.

A second pattern is shown by items in which both teacher and learner scores are low. In this case, whatever pedagogy the teachers may be employing, they would find it extremely difficult to transmit this knowledge to their learners if they are without it themselves. We call this pattern *knowledge impedance*. Although there may be other disadvantageous factors affecting performance on these items, the weak knowledge of teachers represents a precondition for learning that is lacking. The third pattern is where teacher knowledge is high (≥75%) but learner scores are low (<40%). One is tempted to conclude here, along with Spaull (2011), that the impedance to learning is due to the teacher's inability to convey the knowledge they obviously have, although as we shall see below, the explanation is probably a lot more complex. For this reason, we label this pattern of scores *complex impedance.*

Mathematics

Carnoy et al (2011) found that Grade 6 mathematics teachers in North West province record an average score of around 40% on a test designed to assess their mathematics knowledge, using items drawn largely from the Grade 6 school curriculum. Teachers did well on most questions that dealt with basic arithmetic operations and simple geometry, but poorly on questions of decimals and fractions and those questions that required more underlying knowledge of mathematics and mathematics pedagogical knowledge. The NSES teacher interview instrument included a short test on math or literacy, depending on the teacher's specialisation. Chapter 3 shows that there is a discernible difference in learner gains only when their teachers get all five items correct; this effect is enhanced for teachers who teach for more than 18 hours a week.

The best data on the knowledge of South African teachers derives from SACMEQ III. The 42 items in the teacher math test may be clustered into 5 mathematical strands: arithmetic operations; fractions, ratio and proportion; algebraic logic; rate of change; and space and shape. The distribution of items and their mean scores is shown in Table 1.

Table 8.1: Teacher/learner scores by mathematical strand, SACMEQ III teacher test

Score (per cent correct)	Mathematical strand				
	Arithmetic operations	Fractions, ratio and proportion	Algebraic logic	Rate of change	Space and shape
95	1(95/30) 2(95/26) 4(95)				
90					34(92)
85		3(85/43)		12(85/32)	14(83)
80	7(78/21) 11(78)	23(79)			
75		27(75)	5(77/46)		16(75/19)
70		10(70)			13(68/13)
65	19(67)	28(67)	30(67) 38(64)		
60			21(60) 32(60)		
55	6(55/23) 31(57)				8(57/20) 40(62)
50		22(50) 36(48)	20(51)	15(48/18)	25(52)
45		26(43)		29(47/37) 24(47)	
40		35(40)	18(38) 39(42) 42 (43)	41(41/10) 37(38) 17(38/18)	
35					
30					33(31)
25		9(24/18)			
Total items	8	10	9	7	8

Key: 1(95/30) indicates that 95% of teachers and 30% of learners scored item 1 correctly. 4(95) indicates that 95% of teachers scored item 4 correctly; item not in learner test 3(85/43) – correlation between t and l scores; 6(55/23) – knowledge impedance; 1(95/30) – complex impedance.

Source: Own calculation using SACMEQ data.

Arithmetic operations

Stephen Hawking notes that the Pythagoreans tried and failed to found all of mathematics on arithmetic (2005). Nevertheless, the very fact that they tried indicates the profound influence of the study of numbers and arithmetic on the discipline of mathematics. One could certainly say that all of primary math starts with numbers, counting and the four operations, and if learners miss a good grounding in these concepts, they cannot make much headway in understanding higher mathematical ideas and processes. Eight of the items in the SACMEQ teacher mathematics test fall into this strand. Teachers exhibit high levels of proficiency on the first five, with at least 78% selecting the correct responses. The most interesting feature of these items is that, of the three repeated in the learner test, learners scored 30, 26 and 21 percent, compared with the 95, 95 and 78 recorded by teachers. Clearly, teachers possess the knowledge required to answer these questions, but are unable to convey it to their learners. This is an example of what we term *complex impedance. One plausible explanation for the transmission failure in this case may lie in the linguistic complexity of the items. Consider, for example, item 1:*

1. When you subtract one of the numbers below from 900, the answer is greater than 300. Which number is it?

The representational form in which items are cast (see Chapters 2 and 7) has an effect on the difficulty level, and we know that learners generally perform worse on items posed largely or entirely verbally, than they do when a question is phrased in symbolic form, such as 7 – 3 = ___ . As discussed in Chapter 2, verbal representations require translation into a mathematical function before computation can be done, and this additional step, in turn, requires a certain degree of language proficiency. In the case of item 1 and a number of other problems in the test, the learning failure may be due to a language problem, with learners having an insufficient grasp of English to understand the relatively complex syntax through which the question is posed.

A different kind of explanation is needed to account for the transmission failure with respect to item 6, which is posed in symbolic form:

6. $10 \times 2 + (6 - 4)\ ,\ 2 =$

While a small majority of teachers (54%) are able to compute the correct answer, only 22% of learners can do so. The item requires an application of the classic BODMAS[3] rule for choosing the order in which to perform operations in a problem containing more than one operation. The first distractor for this

item is obtained by ignoring the rule and performing the operations from left to right, a procedure followed by 37% of teachers and the largest category of learners (38%). Clearly, a good proportion of teachers and almost all learners are confused about the application of this fundamental arithmetic property, and we may ascribe the transmission failure in this case to a lack of disciplinary knowledge on the part of teachers (knowledge impedance). There is a third possible explanation – inappropriate pedagogy (such as exhibited in Figure 5, Chapter 7, for example) – for the transmission failure with respect to item 1. But for item 6 the fact that teachers do not know the mathematical convention must trump all other explanations, on the assumption that teachers cannot teach what they do not themselves know.

Fractions, ratio and proportion

As discussed in Chapter 7, while the suite of concepts comprising our second strand itself rests on an understanding of the arithmetic operations, and in particular those of division and multiplication, the concepts fractions, ratio and proportion form the foundation for much higher mathematics in geometry, trigonometry and algebra. A good grasp of the relationships and procedures arising from this cluster of concepts also underlies the successful application of mathematics to the sort of problems encountered in 'daily life', such as computing best buys while shopping, estimating investment returns, monitoring fuel consumption, calculating distance, time and average speed, and the like. The SACMEQ teacher test contains 11 items in this strand, only two of which – the easiest (item 3) and the most difficult (item 9) – appear in the learner test.

Item 3 is a rare instance in which both teacher and learner scores are high. The item requires testees to select two diagrams out of four that represent the same fraction (¾ and 6/8). In this case teachers are relatively successful at conveying the concept to learners. However, teachers did not fare well on most items in this critically important strand of mathematics. Figure 1 shows that on only four of the ten questions did at least 70% of teachers select the right responses. Only 40% were able to answer item 35 correctly, a question which draws on the definition of a simple three-part ratio involving single-digit whole numbers. Fewer than half (48%) could compute the height of a tree from the length of its shadow, given the height and shadow length of a vertical stick. Poor scores on item 26 (43%) show that at least half of South Africa Grade 6 teachers are unable to apply proportional reasoning to simple number relationships. Looking back to Table 4 of Chapter 7 and noting the low level of coverage in South African classrooms of foundation activities involving ratio, it is clear that poor classroom coverage is associated with low levels of teacher knowledge about this key concept.

Algebraic logic

We have adopted the name 'Algebraic logic' for this strand, in preference to the terms 'Patterns, functions and algebra' (primary level) and 'Functions and algebra' (secondary level) used in the SA national curriculum. This strand encompasses number patterns – such as multiples (item 5), squares, etc – 'brain teasers' (items 30, 38 and 39), and elementary algebra (18, 20, 21 and 32); more than one of these elements are often present in any one item. Eight of the SACMEQ teacher test items fall into this category and, aside from item 5, a very elementary number pattern represented iconically in the form of geometric shapes, teachers did not do very well on these problems. Item 30 (score 67%) is a good example of a 'brain teaser' containing algebraic symbolism:

30. Joe has 5 fewer hats than Mary, and Lilian has 3 times as many hats as Joe. If Mary has n hats, which of these represents the number of hats that Lilian has?

A.	(1)	$3n - 5$	C.	(3)	$5 - 3n$
B.	(2)	$3(n - 5)$	D.	(4)	$n - 5$

Tasks of this kind commence in the early grades without the algebraic elements present in item 30, where they are solved using trial and error and logical reasoning, with or without diagrammatic representations or the proto-algebraic techniques shown in Chapter 7 (see Figure 4). Unfortunately, many teachers seem to miss the point of these tasks, which is to promote systematic thinking using number patterns, leading to algebraic generalisation, representation, manipulation, and the construction of new patterns. The classroom vignette sketched in Figure 2 below illustrates the point. Here the teacher is intent on getting to an answer as quickly as possible, to the extent that she provides learners with the age of one of the children, apparently oblivious to the fact that the purpose of this problem is to develop the thinking skills and problem solving strategies required to find this very information.

This school is another participant in the donor supported book project described in Chapter 4. Although situated in semi-rural Transkei, parents insist that teaching and learning be conducted in English from Grade R. There are 65 learners in the class. Exercise books show writing occurred on 69 days (to 15 September), most of it less than half an A4 page in length.

The lesson observed focused on one problem, taken from a popular Grade 5 textbook:
Mandla is 3 years older than Fezile. Thobile is 4 years younger than Fezile. The sum of their ages is 29 years. Find the ages of Mandla, Thobile and Fezile.

After much discussion about 'using operations to solve problems', what operations are, and the nature of the problem, none of it illuminating to the task at hand, the teacher tells the class that Mandla is 13 years old. Now, the heart of this problem is to find a way to ascertain Fezile's age, because it is in relation to him that the ages of his brothers are defined. The most common way of solving this problem at Grade 5 level is through trial and error, and indeed some of the learners did embark on trial and error strategies, but the teacher killed this very promising development by telling them Mandla's age and then reducing the whole exercise to the Grade 1 problem of calculating the ages of the other brothers.

Problems like this are designed to stimulate thought processes that go beyond the purely procedural and this teacher twists the task to the opposite purpose. Indeed, she confused any attempt by the learners to apply logical processes by insisting on reducing the exercise to one of finding the right answer.

Figure 8.2: Grade 5 – Mathematics class, village school near Mthatha

The fact that teachers score only modestly (around 60%) on the majority of items testing algebraic logic would seem to indicate that the very poor pedagogy exhibited in Figure 2 is based on a partial, or perhaps intuitive, understanding of tasks of this type. This juxtaposition of evidence begs the hypothesis that transmission failure derives from poor pedagogy, which in turn is an effect of teachers' partial grasp of the processes of algebraic logic themselves.

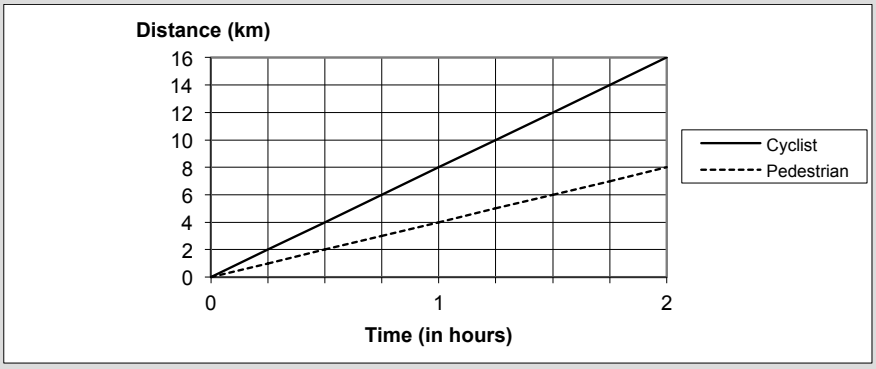
Rate of change

Another type of problem commonly seen in textbooks is one involving distance and time. Successful solution of these teasers rests on a foundation of proportional reasoning, and therefore such items could be classified into our second strand described above, or indeed into the third strand since they also require algebraic logic. However, we would argue for a distinct strand that elicits rate of change reasoning, while recognising that the boundaries between these 3 strands are relatively fluid. Problem situations illustrating this kind of mathematical task involve the distance, time and speed relationships of one (item 12) or more (items 15, 17 and 41) moving objects; the progress of bouncing balls (item 24); and changes in the volume, time and height

relationships of one (item 29) or more (item 37) tanks of different capacity emitting water at different rates. The goal of each problem is to model the situation using algebraic functions, one or more equations, and/or graphical representations, and then to make predictions from the mathematical models so derived.

Items of this type are most difficult conceptually and procedurally, drawing on ideas and functions from all three of the earlier strands. On only one (item 12) of the seven problems in this strand in the SACMEQ teacher test, did more than 50% of teachers produce a correct answer. We illustrate the problem type using item 15:

15. The graph below shows a distance-time line for a cyclist and a pedestrian. Use the graph to answer the question. How much further did the cyclist go than the pedestrian did in $1\frac{3}{4}$ hours?



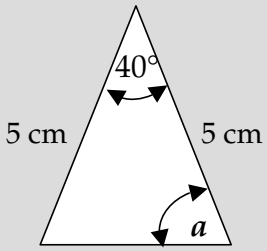
Successful solution of this problem involves reading the graph with comprehension, calculating the distance travelled by each body in the given time, and then finding the difference. It is clearly too complex for both teachers (38%) and learners (18%). This association of poor scores for both learners and teachers is seen in all four items in the Rate of change category that occur in both the learner and teacher test. The most obvious explanation for learners not scoring well on these items is that it is not specified in the Grade 6 curriculum, and therefore they almost certainly would not have studied it in class. However, regarding teachers, the ability to solve this problem implies a high state of understanding of the principles of direct proportion, a capacity many South African teachers clearly do not possess.

Space and shape

In the primary school this strand of mathematical activity is concerned with spatial perception and the measurement of various entities, including angles, areas and volumes. At higher levels this strand moves into investigations in deductive logic, transformation geometry and trigonometry. Item 16 provides another example of what has, by now, become a familiar pattern: teachers scoring relatively well but unable to convey this knowledge to learners:

16. The size of the angle marked '***a***' is …

A.	(1)	40°	C.	(3)	80°
B.	(2)	70°	D.	(4)	140°



While 75% of teachers selected the right option, only 19% of learners did so. The majority of learners (59%) chose option A, indicating that they know that the triangle is isosceles, and that two angles of such a triangle are equal, but they misidentify the equal angles. Alternatively, they might have seen a '40' in the picture and regarded it as a best bet.

Language

As in the case of mathematics, the SACMEQ language tests provide the most detailed insights yet into both the English language competency of Grade 6 teachers and the correlation between teacher and learner scores on 21 items common to both tests. As we did in the case of the NSES learner test discussed in Chapter 2, we classified the SACMEQ teacher test items according to the PIRLS framework, constructing a grid using the PIRLS purposes for reading (*reading for literary experience* and *reading for the use and acquisition of informatio*n) on the vertical axis, and the four processes of comprehension (focus on and *retrieve explicitly stated information*; *make straightforward inferences*; *interpret and integrate ideas and information*; and *examine and evaluate content, language, and textual elements*) on the horizontal axis (Howie et al, 2007). However, unlike the NSES test, which assessed both reading and writing, SACMEQ is purely a reading test in which all items are posed in multiple-choice format.

The SACMEQ test consists of comprehension exercises on 11 separate texts, ranging in difficulty from those containing only very simple vocabulary and syntax, to relatively dense technical descriptions and complex discursive passages. A variety of text types includes literary writing, expository descriptions, philosophical speculation, a school timetable, a job advertisement, and a collection of 3 posters on healthy living. As is clear from Table 2, the degree of difficulty which testees experience in responding to any particular item depends not only on the comprehension processes evoked by the question, but also on the type, length and complexity of the text.

Table 8.2: Teacher/learner scores by text type, SACMEQ III teacher language test

Purposes of reading	Text	Language and syntax	Processes of comprehension (per cent correct)			
			Retrieve	Infer	Interpret	Evaluate
Literary experience	**Tembo** Narrative account of boy looking down into home valley. 9 lines	Simple, poetic	1(90 70) 3(65 33) 4(90 40)	2(45)		
	Paracutin Narrative passage on the volcano Paracutin. 21 lines	Simple, non-technical	19(62) 20(90)	21(75) 22(52)	23(38) 24(65)	
Acquisition and use of information	**Maria's timetable** School timetable. 6X7 table	Symbolic	5(90 55) 6(83 35) 7(95 50) 8(95 55) 9(58)			
	What is quicksand? Descriptive passage on quicksand. 12 lines	Simple, non-technical	11(95) 12(98) 13(85)		10(87)	
	How to read the age of a tree Descriptive passage on how to tell the age of trees. 32 lines	Detailed but non-technical.	14(98 50) 16(98 42) 17(95 38) 18(98)	15(58 32)		

	Peking Man Narrative account of palaeontological excavations. 24 lines	Detailed, with technical language	25(82) 28(62)	30(15)	26(42)	27(38) 29(1)
	The Indian Tailor Bird Description of how the birds make their nests. 9 lines.	Simple, non-technical	31(98 78) 34(80 35)	32(78 21) 33(75 17)		
	The Walrus Description of the habits of the walrus. 16 lines.	Simple, non-technical	35(81 40) 36(79) 37(80)			
	Vacancy Job advertisement. 18 lines	Bullet points, technical	38(62) 39(80)			
	Health Three posters with pictures. 17 lines on tooth care, 8 lines on good diet, 4 lines on vaccination	Simple, non-technical language	40(98) 41(98 32) 42(90)	43(80) 44(95 41)		
	Effective thinking Philosophical speculation about cognitive processes. 25 lines.	Technical language, complex vocabulary and syntax			45(11) 46(18) 47(30) 49(41)	48(63)
	Smoke Descriptive account of the health dangers of smoking. 35 lines.	Technical language, complex vocabulary and syntax	50(57 8) 51(90 43)			52(78 25)
Total			31	9	8	4

Key: 1(90 70) indicates that 90% of teachers and 70% of learners scored item 1 correctly; the two tests overlapped in the case of the 21 items with double scores.
2(45) indicates that 45% of teachers scored item 2 correctly; item not in learner test
1(90 70) – correlation between t and l scores; 3(65 33) – knowledge impedance; 6(83 35) – complex impedance

Source: Own calculations using SACMEQ data.

As discussed in Chapter 2, although the four processes of comprehension generally show increasing complexity, from information retrieval, through inference and interpretation, to evaluation, a number of other factors interact in determining how difficult learners may experience any item to be. The SACMEQ language test for teachers exposes testees to a wide variety of texts, but covers the processes of comprehension only to a limited extent, being skewed toward easier tasks. Thus, the majority of questions (32/52) require only that the reader retrieves information explicitly stated in the text. In general, within each text, testees exhibit lower levels of competence on the higher cognitive processes of inference, interpretation and evaluation.

The four *evaluation* questions require the reader either to comment on the intentions of the author, or to characterise the text stylistically. Item 52, the one evaluation question that features in both teacher and learner tests, is related to the text 'Smoke':

Smoke

The relationship between smoking and cancer, smoking and heart attacks and many other serious diseases is undeniable. Convincing evidence comes from many statistical studies that show the close relationship between the number of cigarettes smoked daily and the probability of dying of cancer or a heart attack.

The explanation for this terrible phenomenon comes from research laboratories. It has been shown that a single puff of smoke can break down the DNA in human cells, this being the long molecule which contains the cell's genetic and metabolic information. What destroys the genetic code are some tar-like substances produced by the process of combustion. In chemical terms, these are oxidising molecules, but one can also accurately describe them as little ravenous monsters that tear apart the bonds that keep the DNA together. After each poisonous whiff the DNA patiently reconstructs itself again but clearly at each restoration the probability of errors increases and in the end some malignant genes (which are always present in unstressed DNA) manage to get the upper hand and thus stimulate cancer. This is the destructive process that the cells of the organs which carry the smoke to the lungs have to undergo every time. It is not surprising that mouth, tongue, larynx, windpipe and bronchi in smokers are more often affected by malignant tumours.

The smoke's final destination is the lungs where, besides tar, it deposits natural radioactive substances concentrated by combustion. Every day a heavy smoker – one who smokes more than 20 cigarettes a day – absorbs the same amount of radiation which he would receive when having a chest X-ray. Nicotine, on the other hand, goes straight into the blood stream and has a strong constrictive action on the arteries. This way the circulation of the blood to all the tissues

diminishes. That is why skin temperature decreases, sexual organs produce fewer hormones and nervous metabolism slows down. The brain becomes less efficient, dizziness and giddiness appear but such sensations are barely perceived by the heavy smoker. On the contrary, these are very strong sensations in those who smoke for the first time and they constitute the 'drug effect' that has led many towards becoming habitual smokers.

Item 52 asks:

52. The main aim of the text is to …

A.	(1)	describe the action of smoke on DNA.
B.	(2)	show the relationship between smoking and drugs.
C.	(3)	give a scientific explanation of the causes of cancer.
D.	(4)	warn the readers about the dangers of smoking.

While teachers did relatively well (78% giving response D), learners (25%) either did not understand the question, or could not distinguish between the main and subsidiary aims of this complex text.

On item 50 both teachers (57%) and learners (8%) did poorly, probably under the influence of the high density of technical terms:

50. Smoke is dangerous for the lungs because …

+

A.	(1)	nicotine and tar accumulate there.
B.	(2)	it causes a greater predisposition to cancer there.
C.	(3)	stronger bonds form between DNA and malignant genes.
D.	(4)	tar and radioactive substances are deposited there.

Item 50 provides an example of the low-teacher/low-learner pattern and, as in the case of mathematics, the obvious explanation is that teachers are unable to convey knowledge they do not possess themselves (knowledge impedance). Three of the 21 items common to both tests fit this pattern.

Item 51 is easier, in that technical language is less dense, although it also represents no more than the simplest comprehension task, the retrieval of information explicitly stated in the text:

The result of nicotine's constrictive action on arteries is that …

A.	(1)	the arteries become larger.	C.	(3)	the temperature of the body rises.
B.	(2)	the blood circulation slows down.	D.	(4)	the nervous metabolism speeds up.

Item 51 is an example of the high teacher/moderate learner pattern in which there is a type of correlation between teacher (item 90) and learner (item 43) scores. The 'Smoke' passage is the most difficult text common to both tests, illustrating the kind of linguistic heights to which Grade 6 learners are expected to rise. It is clear that the majority of teachers do not possess the language proficiency required to assist their learners to negotiate this level of text comprehension, and poor learner scores on items 50 (8%) and 52 (25%) (see Table 2) illustrate the point.

Turning to the much simpler text on the 'Indian tailor bird', the same patterns are evident.

The Indian Tailor Bird

One of the most interesting birds I have seen is the Indian Tailor Bird. It is a small olive green bird that doesn't look at all unusual, yet it has a most unusual way of making its nest. The birds work together in pairs. First they find a leaf, the right size, and make holes along the edges with their beaks. Through these holes they thread grass. One bird pushes the thread from the outside, while the other bird sits in the nest and pushes it back until the edges of the leaf are sewn together to make a kind of bag, still hanging on the tree, in which the Tailor Bird lays its eggs.

Item 31 is perhaps the easiest in the whole test:

31. What does the Tailor Bird use in place of thread?

A.	(1)	Grass	C.	(3)	Spider web
B.	(2)	String	D.	(4)	Thorns

This very straightforward 'retrieval' question attracts a high correlation between teacher (98%) and learner (78%) scores, the most plausible explanation for which is that on skills of this type, transmission has occurred fairly successfully.[1] Eleven of the 21 common items follow this 'transmission' pattern to a greater or lesser extent. However, as soon as the cognitive task gets even slightly more difficult, as is the case in item 34, both sets of scores decline (80 35):

34. The Tailor Birds make their nests …

A.	(1)	from leaves.	C.	(3)	in the tall grass.
B.	(2)	in a hole in a tree.	D.	(4)	with a lining of grass.

Here there is little or no transmission (80 35), even though teachers score well on average. This effect becomes even more marked when the cognitive processes move to the higher level of inference, as in the cases of items 32(78 21) and 33(75 17). Scores on items 32, 33 and 34 fit the high-teacher/low-learner pattern. Seven of the 21 common items follow this pattern, where transmission failure could be due to one or a combination of three causes: teachers having sufficient knowledge to answer the question themselves but insufficient to guide their learners to understanding, inappropriate pedagogical practices, or deficient language competence.

Certainly, much bad pedagogy is evident in South African classrooms, as the account in Figure 3 demonstrates by way of example. This shows very inefficient and low levels of use of text, even where learners are supplied with books. While this is a lesson on the subject EMS (economic and management science), it illustrates a particular use of text in the classroom, in which the teacher keeps firm control over the selection and flow of text and over the cognitive tasks through which the text is studied, and which must result in the very slow development of these learners' literacy skills.

This is school C2 described in Chapter 4. The school is participating in a book-focused project in which textbooks in all subjects are supplied to all learners, and teachers trained in their use. The visit described here was unannounced.
The class contains 32 learners. The classrooms is in a poor state: three posters on the wall, a timetable, a class duty roster and a list of class rules. The floor is dirty, thick with dust and strewn papers. Exercise books contain a total of 23 individual writing episodes.

The teacher has filled 3 of the 4 blackboards with notes, which come verbatim out of the EMS textbook supplied to learners, although the books are nowhere in sight during the lesson. The headings are: 'What are leaders and managers? What is a team? The roles of leaders and managers. Types of leadership. What skills do managers need?' After the learners have copied the notes, the teacher asks questions, taken directly from the notes, and the learners answer by reading off the board. She then ends the lesson some 10–15 minutes early, telling the learners that they will be tested on the notes the following day. The remainder of the time is spent unproductively, with most learners milling around and chatting.

What a wasted opportunity! So much more could have been achieved by, say, setting the learners the task of reading the relevant passage from the textbook for homework in preparation for a class discussion on the topic, or setting them an essay discussing different leadership styles. Instead, most of the lesson is wasted writing up text which they already have in a book. Furthermore, the class discussion which does occur never goes beyond direct retrieval of information from this very simple text ('Name two kinds of managers', what is the difference between leaders and managers', etc).

Figure 8.3: Grade 6 Economic Management Science (EMS) lesson, rural Mpumulanga

Referring back to the theory of writing postulated in Chapter 6, copying text involves much lower cognitive engagement on the part of the writer than tasks requiring original text construction. This teacher spends the best part of the lesson putting her learners through tasks of negligible cognitive demand. A final point about the lesson sketched in Figure 3: it is difficult to separate the three components of professional knowledge we postulate in our introductory discussion to this chapter. We don't have a score for the teacher in Figure 3 on the SACMEQ literacy test, but the impression is that it would not be high: if a teacher does not construct tasks to elicit higher order comprehension processes in her learners in class (pedagogical competence), it must be because she does not understand how they function in developing cognitive capacity (subject knowledge for teaching), which in turn is certain to arise if she does not herself apply the perspectives of inference, interpretation and evaluation (disciplinary knowledge) to her own appreciation of text. The same could be said for the teacher shown in Figure 2.

How do SA teachers compare to other SACMEQ teachers?

SACMEQ data show that, on average, South African teachers have received more years of teacher training than those in most other countries in the region and yet our teachers are below average in terms of content knowledge in mathematics (Table 3) and slightly above average in reading (Table 4). In addition, there are two particularly weak areas of mathematics content knowledge: In the areas of 'fractions, ratio and proportion' and 'Space and shape' South African teachers perform considerably worse than other teachers. The particularly poor showing on the first of these is of concern, given the importance this conceptual field has in underpinning much mathematics in the high school and beyond. However, the fact that in other areas South African mathematics teachers are equal to their regional peers, augurs well for

improvement in these two topics if appropriate interventions are implemented. Of course interventions could improve teacher knowledge in all five areas but this analysis indicates that there is clearly space for improvement regarding 'fractions, ratio and proportion' and 'space and shape' amongst South African teachers.

Table 8.3: Teacher percentage scores on the SACMEQ mathematics test

	Arithmetic operations	Fractions, ratio and proportion	Algebraic logic	Rate of change	Space and shape	Total
SACMEQ	69.55	57.65	48.75	44.47	66.33	57.47
SA	67.15	49.68	46.51	42.30	56.44	52.39

Source: Own calculations using SACMEQ data

Table 8.4: Teacher percentage scores on the SACMEQ language test

	Retrieve	Infer	Interpret	Evaluate	Total
SACMEQ	73.64	54.82	37.27	36.07	61.90
SA	75.06	55.21	36.61	39.73	62.99

Source: Own calculations using SACMEQ data

Provincial variation within South Africa shows the Western Cape to be the highest performing province by some distance in both language and mathematics. However, when comparing SA's top province against other African countries the picture is sobering. For example, Kenyan teachers (910) outscore those in the Western Cape (850) by a significant margin in mathematics.

What is the relationship between teacher knowledge and learner scores in SA?

Chapter 3 included information from the brief tests administered to teachers in the NSES in several multivariate models. It was found that good content knowledge in mathematics was linked to better learner numeracy achievement. In particular, teacher content knowledge was associated with higher numeracy gain scores from Grade 3 to Grade 5.

Applying the traditional education production-function approach to the SACMEQ data, Spaull (2011) found that teacher knowledge was statistically significantly related to learner achievement, with a stronger relationship in reading than in mathematics. However, the magnitudes of the estimated effect sizes were rather small: a change in the teacher reading score of 100 points was

associated with a change in the learner reading score of only about 7 points. Spaull therefore concludes that teacher knowledge is not a major determinant of student test performance, and speculates that 'the ability to teach students well at the Grade 6 level is not very dependent on subject-knowledge, but perhaps more on the teacher's ability to convey that subject-knowledge' (Spaull, 2011: 23). This implies that the cause of learning impedance is largely pedagogical. Our item-by-item comparison of the SACMEQ teacher scores with those of their learners suggests that this may be part of the explanation, but that other issues are impacting on the relationship between teacher knowledge and learning. For example, in some areas there are clearly knowledge gaps on the part of teachers while in other items the apparent lack of transmission may have more to do with the language complexity of the questions.

Shepherd (2011) has also analysed the importance of South African teacher knowledge in SACMEQ, using a more sophisticated technique in order to account for the possibility that within schools better learners may be allocated into classes with better teachers, and that this may drive the observed relationship between teacher knowledge and learner performance. Indeed, she found that after accounting for this possibility the effect sizes were smaller and in some instances statistically insignificant. Interestingly, though, she found that amongst the richest 20% of South African schools there was a significant relationship between teacher knowledge and learner performance in the case of mathematics. This points to the possibility that other barriers to learning in the poorest 80% of schools may be prohibiting variations in teacher knowledge from impacting on learner performance.

We further investigated the relationship between teacher knowledge and learner achievement by dividing teachers in the SACMEQ dataset into four quartiles of mathematics content knowledge. Figure 4 shows – for South Africa and for the rest of SACMEQ – the average mathematics performance of learners taught by teachers falling into the four quartiles of teacher knowledge.

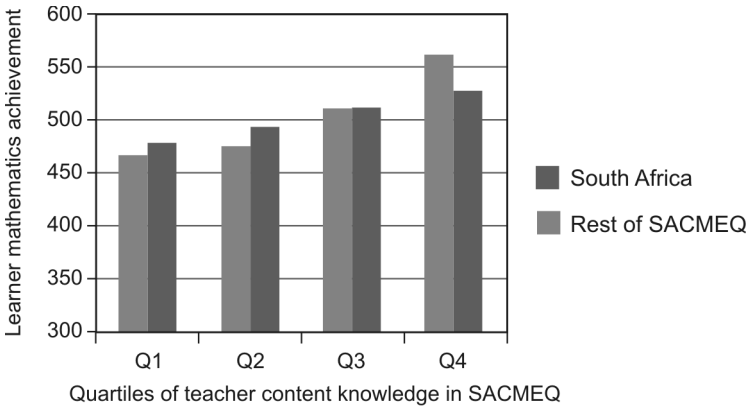


Figure 8.4: Learner mathematics achievement by teacher knowledge, SA vs. SACMEQ

Source: Own calculations using SACMEQ data

Two patterns exhibited in Figure 4 are worth highlighting:

1. South African learners taught by teachers with weak content knowledge perform poorly even compared with learners in most other countries who are taught by teachers with the same content knowledge. I.e. there could be other barriers to learner performance in these South African schools that prohibit these learners from scoring as well as learners with teachers of similar content knowledge elsewhere.
2. South African learners taught by teachers with strong content knowledge perform well even compared with learners in most other countries who are taught by teachers with the same content knowledge. I.e. there could be other enabling factors in these schools (e.g. good management) which allow for a better conversion of teacher content knowledge into learner achievement. Conversely, it is also possible that disabling factors in the schools in other SACMEQ countries taught by such teachers could explain the better performance of South African learners.

We also estimated a full multivariate regression model for mathematics in SACMEQ, which included socio-economic controls, learner demographic characteristics, school level information and other teacher characteristics, and in which the focus was on the role of teacher knowledge. Table 5 shows the estimated coefficients for different ways of entering the teacher mathematics score into the model. Note that the coefficients on all the other variables are not reported here for the sake of space, but that these other variables were entered identically into each of the models presented in Table 5.

Table 8.5: Regression model showing the effects of teacher knowledge on learner performance in mathematics

	Linear	Quadratic	Cubic	Dummies
Teacher score	4.32*	–13.64*	–25.77	
Teacher score squared		3.09***	7.40	
Teacher score cubed			–0.45	
Teacher score: good				6.39
Teacher score: Very good				28.46***
Observations	7854	7854	7854	8917
R–squared	0.50	0.50	0.50	0.51

Note: * p<0.1 ; ** p<0.05 ; *** p<0.01

Source: Own calculations using SACMEQ data

Columns 1, 2 and 3 of Table 5 show what happens when one enters teacher knowledge as a linear function, or as a quadratic or as a cubic function. The results show that there is value in including the quadratic specification but not so much in adding the cubic. The quadratic and cubic specifications are easier to interpret when depicted graphically. Figure 5 therefore depicts the predicted learner achievement by teacher knowledge according to the linear, quadratic and cubic specifications. The quadratic and cubic specifications show that the impact of improved teacher knowledge is greater at higher levels of teacher knowledge. The magnitude of increasing teacher knowledge by one standard deviation from a score of 4 to 5 is associated with about 13 points in learner performance.

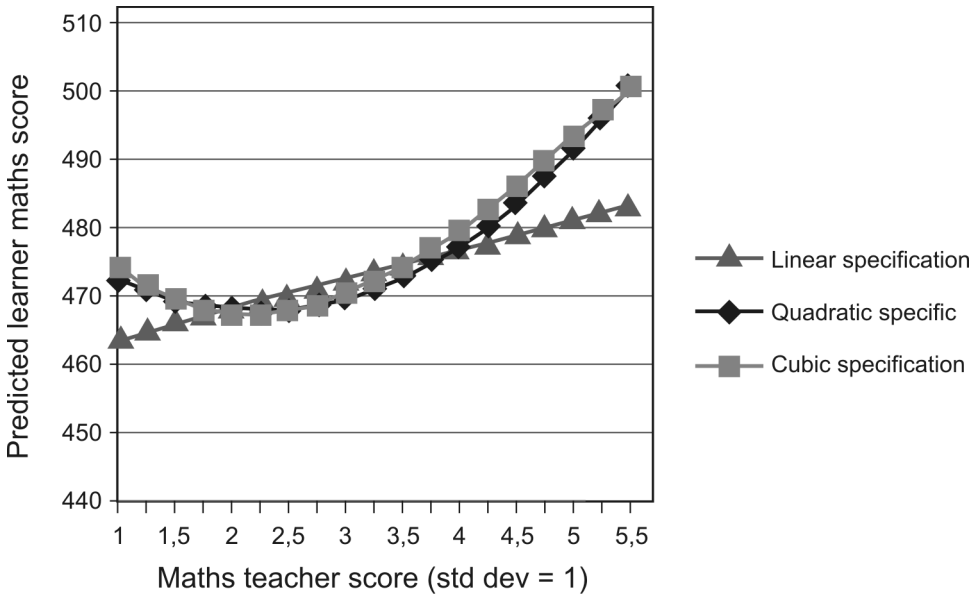


Figure 8.5: Linear, quadratic and cubic specifications of teacher content knowledge

The model with the most explained variation is that in the far right column of Table 5. In this case there are 2 dummy variables for teacher knowledge. Very good knowledge is defined as the top 5% of teacher knowledge, good knowledge is defined as the 75th percentile to the 95th percentile and the reference category is the bottom 75%. The results confirm that those taught by teachers with very good knowledge do noticeably better than the rest. However, even the 'good' category is not associated with significantly better learner performance. The results of the quadratic specification and of the dummy variable approach confirm what was found in Chapter 3 using the NSES teacher test, crude as it was: truly sound teacher knowledge is linked to better learner performance

while teachers with some gaps in their knowledge do not produce significantly better learner achievement than teachers with large gaps.

Conclusion

The SACMEQ teacher-test data suffers some uncertainty over its generalisability, since around 15% of teachers declined to take the test (Spaull, 2011). It is probable that the true picture is more pessimistic than the one presented here, since it is more likely that teachers with poor language and/or mathematical proficiency declined to write. Nevertheless, the SACMEQ test scores are quite unprecedented in the information they provide concerning the depth and extent of teachers' knowledge in English and math. Furthermore, comparisons between teacher and learner performance on the same items provide unique insights into the kinds of impedances to learning which occur in South African classrooms.

Four observations arise from an analysis of the math data. First, the subject knowledge base of the majority of South African Grade 6 mathematics teachers is simply inadequate to provide learners with a principled understanding of the discipline. While many of the items in the teacher test draw on knowledge not in the primary school curriculum, it is through these concepts, procedures and representations that teachers gain the insights necessary to provide learners with a flexible, conceptual understanding and procedural fluency. Teacher performance on these items is poor, and is not a lot better on a number of critically important topics specifically listed in the Grade 6 curriculum.

Second, the pattern showing both high teacher and learner scores, possibly indicative of successful transmission, is seen in only two very simple mathematics items. Item 3 is a visual comparison of two fractions, and item 5 involves a geometric pattern showing multiples of three. It is also possible, however, that learners achieved high scores on these two items simply because they were conceptually easy rather than because of a process of transmission from teachers.

Third, for the pattern characterised by low-teacher and low-learner scores, it seems self-evident that insufficient teacher disciplinary knowledge creates an *a priori* barrier to learning. Teachers do not possess the knowledge themselves and therefore cannot promote its learning among learners. Eight of the 15 items common to the teacher and learner tests fall into this category.

Fourth, interpretation of the high-teacher-low-learner-score pattern is a more complex matter. In these 5 cases transmission failure could arise from one or a combination of three factors: insufficient subject knowledge on the part of the teachers, bad pedagogy, or poor language facility on the part of teachers and/or learners. There is evidence to indicate that all three factors are

present to a greater or lesser degree, but fine-grained classroom observation studies would be required to map these in detail.

Language teachers did not fare well on the SACMEQ reading test either. They performed best on items requiring no more than the retrieval of information stated explicitly in the text. In general, within each text, performance fell off as soon as the higher cognitive processes were required to answer a question. Some good scores were recorded on items requiring straightforward inferences to be made, but questions involving interpretation and evaluation were generally very poorly done.

Of the 21 items common to the teacher and learner language tests, both learners and teachers scored highly on 11 items, a much higher proportion than is the case for mathematics (2/15), although the strength of this correlation varies and in 5 of these items is rather weak. As shown in Table 2, items on which transmission occurs are most frequent in the 'retrieve' category, with teachers finding it harder to teach the higher order comprehension skills of inference, interpretation and evaluation. This is hardly surprising, since the majority of teachers are not proficient in these skills themselves.

Seven common language items are labelled in Table 2 as *complex impedance*, with relatively high-teacher scores and low-learner scores. There certainly is much evidence of bad pedagogy in South African classrooms, such as getting learners to spend half an hour copying a text off the board, which they have in their textbooks (Figure 5), and the widespread occurrence of such practices could explain a large part of the failure of teachers to convert their ability to answer these questions into learner ability.

There is evidence in both math and language to indicate that pedagogy and subject knowledge for teaching are difficult to distinguish from each other, and that both are rooted in a sound understanding of the principles which underpin the subject. For example, it would seem obvious that the teachers shown in Figures 4 and 5 would score poorly on the SACMEQ test, and that their failure to conduct even moderate-level cognitive activities in class stems from their poor subject knowledge. If a teacher does not construct tasks to elicit higher order comprehension and problem-solving processes in her learners in class (pedagogical knowledge), it must be because she does not understand how they function in developing cognitive capacity (subject knowledge for teaching), which in turn is certain to arise if she does not herself undertake complex problem-solving activities or apply the perspectives of inference, interpretation and evaluation (disciplinary knowledge) to her own appreciation of her subject. These conclusions support the hypothesis that, in order to be effective, a teacher needs to have a deep understanding of the principles of the subject discipline, and that different degrees of a relatively shallow understanding have no marked effect on learner performance. The implications are that providing teachers with a deep

conceptual understanding of their subject should be the main focus for both pre- and in-service teacher training.

We might expect some short-term efficiencies to be generated by obvious improvements in pedagogy, such as getting school leaders and teachers to understand that reading and writing should be done every day in every subject, and that extended writing in all subjects, interpretive analysis of language texts and complex problem solving in mathematics should be undertaken weekly. However, any such pedagogical gains are likely to reach a low ceiling, unless a great deal more attention is paid to teacher subject knowledge at the same time. The larger question as to why the majority of teachers do not seem to possess the kind of professional habitus, the intrinsic motivation, which would drive them to study their subject for its own sake and in the interests of improving their classroom effectiveness, is a key question which should occupy policy makers and teacher trainers alike.

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[1]This section is indebted to a literature review conducted by Carla Pereira.

[2]The term 'transmission' is used here in a formal sense to indicate that at one point in time only the teacher possesses a certain concept, and at a later point learners also possess it; this is the founding assumption of schooling. Distinguishing between 'transmission' and 'impedance' is not intended to imply any particular theory regarding interaction between teacher and learner, nor the process which enables learners to exhibit proficiency in any knowledge field, and any of the following terms would serve equally well as place-holders for 'transmit': facilitate, develop, co-construct, teach, etc.

[3]BODMAS is a mnemonic for remembering: Brackets, Of, Division, Multiplication, Addition, Subtraction

[4]Transmission in this sense does not necessary mean that the Grade 6 teacher transmitted the proficiency to retrieve simple information from text, but that one or more teachers, since Grade 1, have successfully brought most learners to the point where they can successfully complete this task.

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Chapter 9

Learner age and performance

Jennifer Shindler and Double-Hugh Marera

Introduction

South African children enjoy substantial access to basic education with nearly 99% of children aged seven to 15 attending an educational institution (Department of Basic Education: 2011). Despite this achievement, large numbers of children are not the correct age and only about 88% of youth currently complete Grade 9, the end of the basic education phase (calculated from Statistics South Africa, 2011).

A child's age in a particular grade is determined by two factors: the age when s/he enters school and the rate at which s/he progresses from grade to grade. Large numbers of underage children in the early grades used to be a problem in the South African system, particularly prior to 2000, although with the phasing in of a pre-school year (Grade R) and the enforcement by government of minimum age regulations, this problem has reduced to some extent. But, as with many poor and middle-income countries, South Africa has a high rate of grade repetition in Grade 1 (Department of Education, 2008), and therefore over-age enrolment is prevalent from the first grade.

Progress is determined by the extent to which the child repeats any grade. Repetition of school years is understood by teachers and principals as an effective remedial mechanism, giving learners an opportunity to 'catch up'. However, the benefits of repetition are questioned by many, who have argued that that repetition often has a negative psychological impact on children, has been found to be a strong predictor of later school dropout and is usually not an effective way of improving children's learning, especially if it involves the child repeating exactly those activities which proved to be so unproductive the first time round (Kenny, 1991; Jimerson et al, 2002; Jimerson et al, 2006; McGrath 2006; and Verspoor, 2006). Nevertheless, repetition is part of South Africa's

education policy, and research has shown that repetition, and its concomitant over-agedness has a persistent association with poverty (Social Surveys, 2010).

The aim of this chapter is to examine the relationship between age and achievement. This is looked at for learners in Grades 3, 4 and 5, using data from the National School Effectiveness Study. The chapter looks at the relative proportions of children who are the right age or either over- or under- aged for their grade. It looks at each of these age groups in terms of gender balance, socio-economic status, province and former department, and their respective performances in literacy and numeracy. Other chapters in this book reveal that meaningful learning is not taking place in many South African classrooms, resulting in basic skills not being mastered and a high number of learners not progressing through the grades at appropriate ages, as this chapter confirms. This phenomenon of not progressing through grades at the appropriate age has a cumulative effect, with lower levels of learning differentially affecting over-age learners, resulting in further slowing progress.

Why does age matter?

Age-grade enrolment impacts considerably on the quality of education that learners have access to. Learners who are not in the correct age range for their grade are likely to be struggling with their work and may be more vulnerable to dropping out (Motala et al, 2009).

Children who start school late, miss learning experiences at a time when they are most receptive to learning basic skills and establishing foundations for cognitive development (CREATE, 2011). Wide age ranges that are a consequence of over-age entry into school and repetition also raise questions about appropriate pedagogy and cognitive strategies in the curriculum. CREATE (2011) notes that children of different ages reason in different ways: in classes where there is a wide range in age, the distribution of capability that occurs in any age groups 'will be overlaid by the spread of capability related to age' and mono-grade pedagogy and curricula are not suited to wide ranges in reasoning capability. Martin (2009) noted that the increased heterogeneity in classrooms with a range of ages, made it more difficult for teachers to teach the class. In an analysis of data from 14 developing countries from two waves of the Trends in International Mathematics and Science Study (TIMSS), Wang (2011) found that an increased classroom age variation was detrimental to learners' achievement in mathematics and science in the fourth grade and that this variance also seemed to impede learner achievement as they progressed to the eighth grade.

Another concern that arises is that there may be social and behavioural consequences that stem from having a wide age range in a class. CREATE (2011)

found that where older learners are taught in class groups with younger ones there might be psychological issues such as self-esteem, bullying and sexual harassment as well as problems of matching learning to cognitive capabilities.

Retaining over-age learners in the system is also a cause for concern. Jimerson et al (2002), in a review of literature on dropping out of school, found that grade retention was 'the strongest predictor of later dropout status'. For Lewin (2007), '… over-age entry and progression delays primary school completion to ages where boys and girls may be subject to growing pressures to contribute to household income and to enter into marriage'.

Defining appropriately aged, over-aged and under-aged learners

Education in South Africa is compulsory from the year in which a child turns seven (Republic of South Africa, 1996). However, a child can be admitted to Grade 1 if the child is five turning six by 30 June in the year of admission (Republic of South Africa, 2002) or wait until the following year to be admitted to Grade 1. A child who turns six after 30 June does not have a choice and must wait until the following year to be admitted to Grade 1. As a result of these policies, the appropriate age range for children entering Grade 1 at the beginning of the official school year in January can range between five years six months and seven years old. Because of this, for the purpose of this chapter, at the beginning of the school year the appropriate age for learners in Grade 3 is between seven years six month and nine years old; in Grade 4 it is between eight years six months and ten years, and in Grade 5 it is between nine years six months and 11 years. Learners whose ages fall outside of these age ranges in these grades will be over or under aged for their grade.

The occurrence of over age arises when a child enters school for the first time at the age of eight or older and/or through learners not keeping pace with their peers in progressing from one grade to the next, generally through grade repetition or retention. Norms for grade repetition have also been regulated, allowing for learners to repeat a grade once per phase. A phase occurs in three-year cycles making it possible for a learner to repeat four times in his or her school career. The four phases in the 12-year school period are, therefore: the foundation phase (Grades R to 3), intermediate phase (Grades 4 to 6), senior phase (Grades 7 to 9) and the further education and training phase (Grades 10 to 12).

Under-age learners occur in the system when learners enrol in school for the first time when they are younger than the appropriate age. This is permissible:

(i) if it can be shown that exceptional circumstances exist, which necessitate the admission of an under-age learner because admission would be in his or her best interest;
(ii) the refusal to admit that learner would be severely detrimental to his or her development. (Republic of South Africa, 2002:4).

While regulations make this provision, it is highly unlikely that learners, who enrol in Grade 1 when they are younger than the appropriate age, are subject to this type of assessment.

Over- and under- age enrolment and survival rates in South Africa

Historically under-age enrolment in Grade 1 was a huge problem in South Africa (Taylor, 1989:5; Crouch, 2005; Perry and Arends, 2004) particularly in areas where there was no access or very limited access to early childhood development opportunities. These features are apparent when comparing school enrolment by grade with the population of each respective age cohort: in 1995, the number of learners in school exceeded the population by some margin for the first few grades, most notably in Grade 1, where over-enrolment stood at 165% of the age cohort (see Figure 1).

The main source of this problem was that, in the absence of preschools in the eighties and nineties, parents would 'park' their five, four and even three year olds in primary schools, using these as cheap baby-sitting facilities. Many of these children, not ready to benefit socially or intellectually from schooling, would 'churn' in and out of the system for two or three years. Besides diverting valuable resources away from improving the quality of schooling for those children mature enough to benefit from it, these under-age learners clogged up the pipeline, making teaching and learning even more difficult. It was only towards the middle and top end of high school that the number of enrolments dropped below the age-appropriate population in 1995.

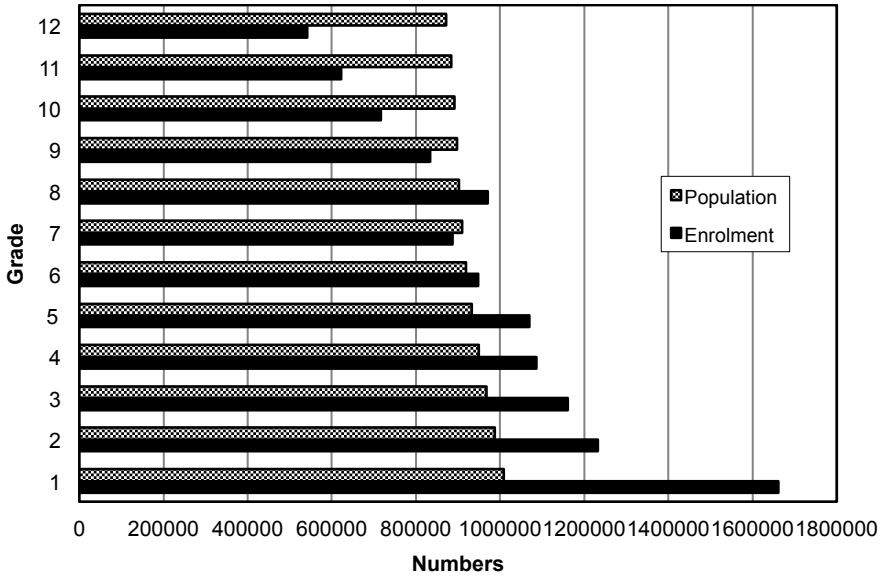

Figure 9.1: School enrolment by grade versus grade appropriate age population, 1995

Source: Crouch, 2010

By the end of the first decade of the 21st century, the picture is quite different. With the phasing in of a pre-school year (Grade R) and the enforcement by government of minimum age regulations (Department of Education 1998a and 1998b), the problem of underage enrolment has greatly diminished, although some 17.5% of children were found to have entered Grade 1 too early in 2008 (Gustafsson, 2010). At the same time, the numbers of learners who continue their schooling into secondary school and complete nine years of schooling have increased markedly from 72% to 86% (Department of Education, 2008), another important achievement for the post-apartheid government.

An interesting characteristic of South African education is that, unlike many other developing countries, access to schooling in South Africa has been achieved equally for male and female children. With an overall gender parity index (GPI) of 1.01 across the schooling system, there is very little difference in the rate at which males and females of official school-going age participate in schooling (Department of Education, 2010:8). Gender Parity Index (GPI) refers to the ratio of female to male values of a specified indicator. A GPI of 1 indicates that parity between females and males has been achieved. A GPI between 0 and 1 indicates a disparity in favour of males, while a GPI greater than 1 indicates a disparity in favour of females (UNESCO Institute for

Statistics, 2009, 49). However, according to UNESCO a GPI of between 0.97 and 1.03 is considered as reflecting gender parity (UNESCO, 2003:287).

However, research by Shindler and Fleisch (2007) and the Department of Education (Department of Education, 2009) has found that the throughput of male learners is slower than that of females, and this is evident in the shift in the GPI from primary to high school. For example, in 2008 the Gross Enrolment Ratio (GER) was higher for males (100%) than for females (98%) in primary school, giving an overall GPI of 0.97. In secondary school, the situation was reversed and while the GER for females was 92%, it was only 84% for males, giving a GPI of 1.06, indicating that a larger proportion of male than female learners were not participating in secondary schooling (Department of Education, 2010). Gross enrolment rate (GER) measures enrolment, regardless of age, in a specific level of education as a proportion of the appropriately aged population for the given level of education. A GER of over 100% can be recorded. A GER that is greater than 100% or one that is greater than the net enrolment rate is usually due to the inclusion of over-age and under-age learners in the system, either as a result of early or late entrance into the education system or as a result of repetition (UNESCO, 2009, 9).

A high rate of learners dropping out in the last three grades of high school remains a problem for both genders, despite improvements in the throughput rate at the top end of secondary school. The Report on Learner Retention in the South African Schooling (Department of Education, 2008) has shown that repetition is high in Grade 1 and in senior grades, especially in Grade 11 (possibly due to pressure on schools to increase National Senior Certificate pass rates, and the 'culling' of high-risk learners at this level). During the first eight years of school, the dropout rate is minimal, and the survival rate of those completing Grade 9 has improved substantially over time, currently standing at over 85%. Of those children born between 1985 and 1989 just over 86% completed Grade 9 compared to 81% of the 1980 to 1984 birth cohort, 79% of the 1975 to 1979 birth cohort, and 72% of the 1970 to 1974 birth cohort (Department of Education, 2008:24). However, after Grade 9 the survival rate drops substantially and although the percentage completing Grades 10 and 11 has risen slightly in recent years, only about 40% of youth successfully complete Grade 12 and this figure has not improved in recent years (Gustafsson, 2011). The term 'survival rate' here refers to a specific cohort of population born at a certain time who are expected to reach a specified grade regardless of repetition (Department of Education, 2008:4).

A survey conducted by Social Surveys and the Centre for Applied Legal Studies in 2007 (Social Surveys, 2009) found that learners were experiencing 'school delays' and were, therefore, over age for three reasons. Firstly, children were not entering school at the right age. Social Surveys (2009) found that 7% of children started after the age of seven while Gustafsson (2011) found that around

17% of children enrolled after this age. Secondly, learners were experiencing long-term absences from school with some 4% of learners at school at the time of the survey having missed a year or more of schooling; 3.6% of those still in the Basic Education Phase (Grades 1–9) and 6.4% in the Further Education and Training (FET) Phase (Grades 10–12) (Social Surveys, 2010).

However, the primary reason for school delays in South Africa is due to grade repetition, with one-third of learners registered in 2007 having repeated a year at some time in their school career: 21% in the Foundation Phase had repeated, while 52% of learners had repeated by the time they were in the FET Phase (Social Surveys, 2009).

The Survey found that there were a large number of over-age learners in the schooling system. Thirty-eight percent of Grade 12 learners were two or more years above their age-grade norm: one of the reasons for learners experiencing 'school delays' is long-term absence from school. The survey concludes that every second learner in Grade 12 in 2007 had repeated a year, and that grade repetition is associated with poverty: rurality, race and parental education all proxy for poverty. Most worrying is the conclusion that being over age and having repeated a number of times, may increase vulnerability to leaving school before completion of secondary school:

> Many children in South Africa travel slowly through the education system, with significant cost implications for the state, for the household and possibly, psychologically for many of the over-age learners themselves. The age-grade norms act as an important benchmark for South Africa, but the gap between this ideal and reality is stark. (Social Surveys, 2010:15).

It seems obvious that a large part of the inefficiency at the top end of the high school is the result of the poor preparation of learners in the rest of the system, and in particular, of the very poor foundation laid in the early years, and it is the association between age and performance that is the primary focus of the present paper.

The good news is that the proportion of overage learners in the system appears to be diminishing rapidly. SACMEQ III found that the average percentage of learners across the 14 participating countries in Grade 6 who had repeated a grade at least once was 40.3% in 2007, significantly down from the 48.1% recorded in 2002 by SACMEQ II; in South Africa the comparable figures declined from 42.3% to 28.5%. Similarly, the SACMEQ figures show that the incidence of late enrolment is relatively low and diminishing in South Africa compared with its neighbours, where the rate is also improving in all countries except Zambia and Swaziland.

The SACMEQ figures also show that, regarding inter-provincial comparisons within the country, grade repetition is particularly high in the Eastern Cape, Mpumalanga, Northern Cape and Free State, where it is

concentrated in the lowest performing quartile of schools. To illustrate the levels of inequity in this regard, Eastern Cape schools performing amongst the top 25% of South African schools had higher repetition than low-performing schools in Gauteng. Furthermore, the correlation between school mean maths achievement and school repetition rate was low in the Eastern Cape (0.15) and in Limpopo (0.31) compared with values of between 0.43 and 0.64 in the other provinces. This indicates that in those two provinces repetition was very weakly related to performance and appears to be largely random. This confirms other research that has shown repetition to be a 'lottery' in many of the schools that African learners attend (Lam, Ardington and Leibbrandt, 2010).

Data

Data used in this chapter are from the National School Effectiveness Study (NSES), collected from Grade 3 learners in 2007, Grade 4 learners in 2008 and Grade 5 learners in 2009 from a sample of 268 schools in eight of the nine provinces, as described in Chapter 1. Our data below applies to every learner who participated in the survey each year and not just the cohort of learners who participated in all three waves of the study.

Of the 16 503 learners surveyed in 2007, date of birth data was available for 15 239 learners while 1 264 learners did not give a date of birth. In 2008, of the 15 698 learners surveyed, information on date of birth was available for 14 980 learners, and in 2009, of the14 396 learners surveyed, information on date of birth was available for 14 185.

Methodology

In this chapter, we show the relationship between a learner's age, on the one hand, and gender, poverty and test scores in literacy and numeracy, on the other.

Although the NSES took place in the latter part of each year (8–19 October 2007; mid-August to mid-September 2008; 14 August to 17 September 2009), for the purpose of this report actual age of each learner was calculated at the beginning of the school year (as at 1st January) in which the test took place, in order to assess if the learner was appropriately age, over aged or under aged for the grade.

Profile of Grade 3, 4 and 5 learners

Age

Only about half of the learners in Grades 3, 4 and 5 in the respective years were appropriately aged for their grade. This applied to 53% of Grade 3 learners in 2007, 51% of Grade 4 learners in 2008 and 50% of Grade 5 learners in 2009. Only around 3% of the Grade 3, 4 and 5 learners were under aged for their grade, while 36%, 41% and 46% of learners in Grades 3, 4 and 5 respectively were over aged. Our data is in line with data from the National Income Dynamics Study conducted in 2008, which found that 39% of learners in Grade 4 were over aged and 54% were appropriately aged. (Note that this is based on unweighted data. The proportion of over-aged learners in the NIDS data decreases (to 36%) and appropriately aged learners increases (to 57%) when the data is weighted. The variability is likely explained by the fact that the NIDS survey is based on a small sample of Grade 4 learners (n=708), while the NSES is based on a sample of 15 698 Grade 4 learners.)

The expansion of pre-school educational opportunities especially in Grade R (Department of Basic Education, 2011) together with the school admissions policy would appear to be succeeding in preventing under-aged children from enrolling in schools. It is very concerning, however, that in only the fifth grade of schooling, as many as 46% of learners were already over aged for that grade. Some of these learners may be over aged as a result of starting school late, while others are over aged as a result of repeating a grade at least once.

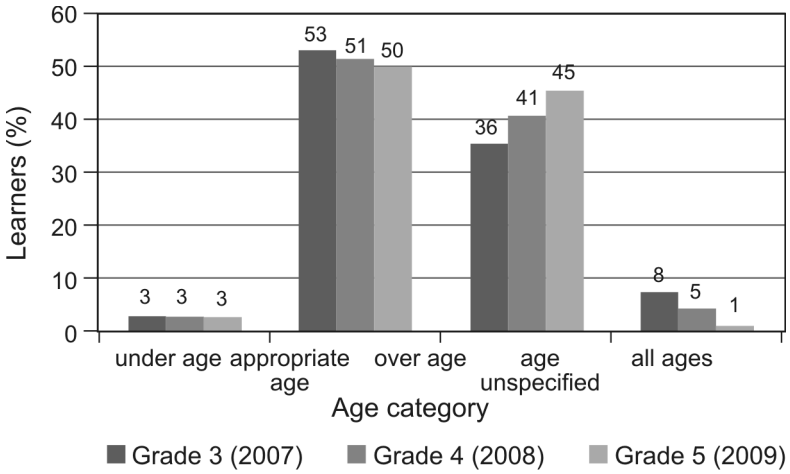

Figure 9.2: Distribution of learners by age, 2007–2009

Distribution of learners by gender and age

While male learners constituted a small majority in each grade, females generally tended to be more age appropriate (see Table 1). More than half of all female learners were age appropriate in each grade, but this applied to less than half of all male learners. Male learners were, on average, about four months older than female learners in Grade 3; by Grade 5, the gap has widened to six months. It is, therefore, not unsurprising that boys substantially outnumber girls in the over-aged category in each grade and by Grade 5, more than 50% of boys are over age compared to 37% of girls. The predominance of over-aged boys occurs mainly as a result of the much higher repetition rate among male learners than female learners (see Department of Basic Education, 2011). While the reasons for this have not been investigated in South Africa, research from other countries indicate that the higher repetition rate among males than females could be attributed to a number of factors including some evidence that girls are better at collaboration, talk and sharing, they mature earlier, they use more effective learning strategies, and boys are generally more defiant of authority and have less enthusiastic attitudes towards school work (the Department for Education and Skills in the United Kingdom, cited in UNESCO, 2003).

Table 9.1: Distribution of learners by age appropriateness and gender, Grade 3/2007, Grade 4/2008 and Grade 5/2009

	Grade 3/2007		Grade 4/2008		Grade 5/2009	
Age category	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Under age	3%	4%	2%	4%	2%	4%
Appropriate age	50%	61%	44%	58%	43%	58%
Over age	43%	30%	48%	34%	53%	37%
Unspecified	5%	5%	6%	4%	2%	1%
Total	100%	100%	100%	100%	100%	100%

Note: Excluding learners who age was not specified

Distribution of learners by socio-economic status and age

A socio-economic status (SES) index for each learner was developed using data supplied by the child on the availability of household assets and the presence of books and newspapers in the home. The index was then divided into quintiles, with SES category 1 being the poorest and SES category 5 being the least poor. It is evident from Figure 3, which shows the proportion of learners in each SES quintile who were the appropriately age for their grade, that the more affluent learners were more likely to be appropriately aged than poor learners. Fewer

than 40% of learners in the poorest SES category were appropriately aged. Most of the other learners who were not appropriately aged were over aged.

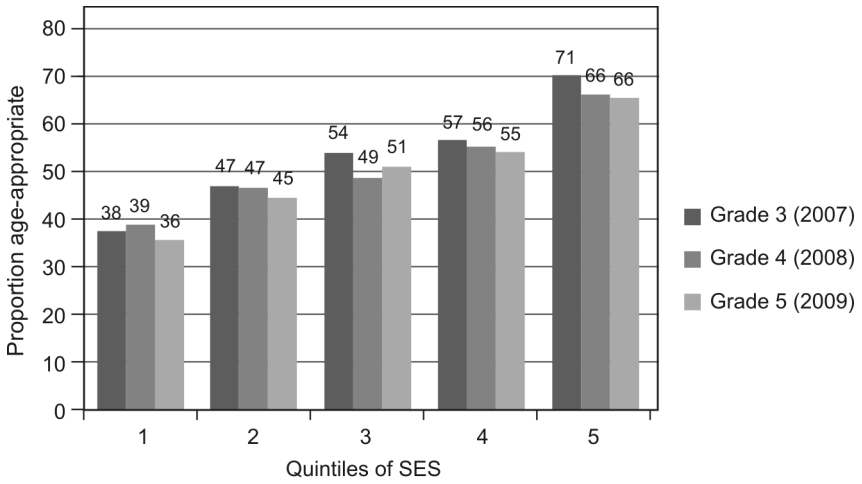

Figure 9.3: Proportion of learners in each quintile of SES that were appropriately aged

Distribution of learners by former education department and age

During the apartheid period, education was administered and controlled by racially based education departments as well as departments in the so-called African homelands. The departments and authorities responsible for education during the apartheid period were as follows: Department of Education and Training (DET) was responsible for African education outside of the homelands; the House of Assembly (HoA) was responsible for education for white children; the House of Delegates (HoD) was responsible for the education of Indian children; and the House of Representatives (HoR) was responsible for the education of coloured children. Ten homeland authorities were responsible for the education of learners in their respective territories.

An analysis of the learner distribution by former education department and age shows that the inequities and inefficiencies inherent in apartheid education were still evident more than a decade after apartheid had ended, with fewer appropriately aged children in former DET and homeland schools than in HoA (white), HoD (Indian) and HoR (coloured) schools (Table 2). In Grade 5 in 2009, for example, only 47% of learners in former homeland or DET schools were appropriately aged compared to 60% of children in former HoR schools, 65% in former HoD schools and 76% in former HoA schools.

Table 9.2: Percentage of learners in schools according to their former administration during apartheid and by age category: Grade 3/2007, Grade 4/2008 and Grade 5/2009

Grade/Year	Former Education Department	Under age	Appropriate age	Over age	Total
Grade 3/2007	Homelands or DET	3.7	49.8	38.0	100
	HoR	1.6	66.2	28.3	100
	HoD	5.6	74.4	15.0	100
	HoA	1.0	78.3	18.5	100
	ALL	3.4	53.3	35.7	100
Grade 4/2008	Homelands or DET	3.5	48.0	43.5	100
	HoR	1.3	61.1	35.3	100
	HoD	7.4	69.1	17.9	100
	HoA	1.3	75.6	20.9	100
	ALL	3.1	51.3	41.0	100
Grade 5/2009	Homelands or DET	3.3	46.8	48.4	100
	HoR	1.2	59.7	37.8	100
	HoD	8.0	65.0	21.5	100
	HoA	0.7	76.0	22.6	100
	ALL	3.0	50.1	45.5	100

Note: Excluding learners who age was not specified

Distribution of learners by province and age

A provincial analysis shows that the distribution of learners according to age category differs substantially between the eight provinces that participated in this study. The Eastern Cape, in particular, had a large number of over-aged learners enrolled in each grade – 51% in Grade 3 rising to 62% in Grade 5 in 2009. In contrast, 37% of learners in the Western Cape and 39% in Limpopo were over aged by Grade 5. Of all the provinces, KwaZulu-Natal, which is the province with the largest number of former HoD schools, has the highest proportion of under-aged learners, with 6% of learners in each grade in each year being under aged.

Distribution of learners by province and age category: Grade 3/2007, Grade 4/2008 and Grade 5/2009

Grade/Year	Province	Under age	Appropriate age	Over age	Total
Grade 3/2007	Eastern Cape	3.3	36.3	50.7	100
	Free State	3.1	55.9	31.2	100
	KwaZulu-Natal	6.2	50.0	38.7	100
	Limpopo	3.3	57.7	24.3	100
	Mpumalanga	3.5	56.3	38.0	100
	North West	1.8	55.4	33.9	100
	Northern Cape	0.6	63.2	32.1	100
	Western Cape	1.1	67.1	26.5	100
	ALL	3.4	53.3	35.7	100
Grade 4/2008	Eastern Cape	2.7	34.3	59.6	100
	Free State	3.0	56.1	36.3	100
	KwaZulu-Natal	6.0	48.2	39.7	100
	Limpopo	3.5	57.3	31.7	100
	Mpumalanga	2.9	51.7	42.6	100
	North West	1.7	52.7	40.9	100
	Northern Cape	0.8	58.8	36.6	100
	Western Cape	1.1	63.3	33.9	100
	ALL	3.1	51.3	41.0	100
Grade 5/2009	Eastern Cape	3.0	34.1	61.6	100
	Free State	2.7	51.0	45.9	100
	KwaZulu-Natal	5.6	46.4	44.1	100
	Limpopo	3.0	58.0	38.6	100
	Mpumalanga	2.5	50.3	46.3	100
	North West	1.5	50.2	46.8	100
	Northern Cape	1.1	57.7	40.2	100
	Western Cape	1.0	61.2	36.9	100
	ALL	3.0	50.1	45.5	100

Note: Excluding learners who age was not specified

Literacy scores

Overall literacy scores by age

The data in Figure 4 show an improvement of the learners' average performance in literacy over time. The overall mean literacy scores of 23% for Grade 3 learners in 2007 rose to 31% for Grade 4s in 2008 and to 37% in Grade 5 in 2009. However, the literacy levels among learners remain very low. While learners in all age categories do poorly, appropriately aged learners perform much better than those learners who are either under- or over aged. As the numbers of under-aged learners is very small, care must be taken in interpreting under-aged scores at low levels of disaggregation.

As learners progress from one grade to the next, an improvement in reading and writing does seem to occur, as the mean literacy scores improve for learners in all age categories. However, over-aged learners seem to fall more and more behind their age appropriate peers with each grade. In Grade 3 in 2007, the difference in the mean literacy score between appropriately and over aged learners was five percentage points. This grew to eight percentage points in Grade 4 in 2008 and to ten percentage points in Grade 5 in 2009. The gap between under-aged learners and appropriately aged learners remained consistent at six percentage points in all three grades.

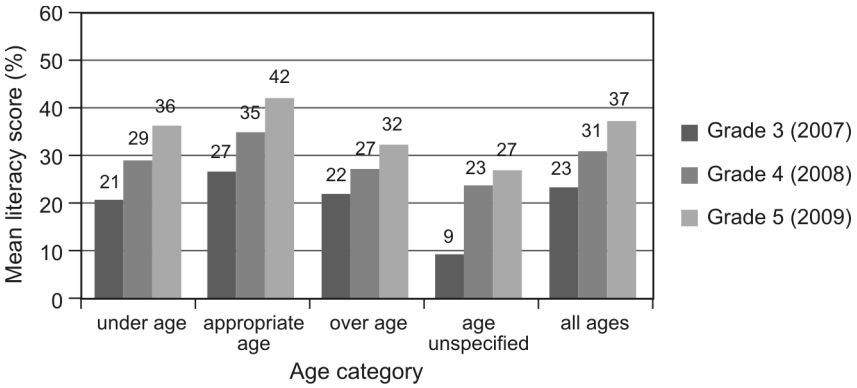

Figure 4: NSES literacy scores by age in Grade 3/2007, Grade 4/2008 and Grade 5/2009

Literacy performance by gender and age

In all three grades, girls outperform boys and this occurs among under-aged, appropriately aged and over-aged learners. The gap between male and female learners is slightly bigger among under-aged learners than among those who are appropriately aged or over aged.

Table 9.3: Mean literacy score by age group and gender, Grade 3/2007, Grade 4/2008 and Grade 5/2009

Grade/Year	Gender	Under age	Appropriate age	Over age	Total
Grade 3/2007	Male	18.9	25.6	21.4	23.1
	Female	22.1	27.9	23.1	25.6
	Unspecified gender	9.7	5.6	4.7	1.9
Grade 4/2008	Male	26.5	33.4	25.9	29.0
	Female	30.3	36.0	28.3	32.7
	Unspecified gender	24.7	33.4	31.6	32.4
Grade 5/2009	Male	34.0	40.6	31.2	35.2
	Female	36.9	42.8	33.9	39.1
	Unspecified gender	46.9	34.4	23.1	26.8

Note: Excluding learners whose age was not specified.

Literacy performance by former department and age

Learners attending schools that were formally reserved for white learners (former HoA schools) generally achieved much higher average scores in literacy than learners attending schools that were formally reserved for African (DET and homelands), Coloured (HoR) and Indian (HoD) learners. In Grade 3 there was very little difference in the mean score between the age groups for children attending former African-only schools, but by Grade 4 the mean score of appropriately aged learners overtakes that of their under and over-aged peers and by Grade 5 the gap widens further. In former coloured, Indian and white schools appropriately aged learners achieved significantly higher scores than under-aged or over-aged learners. Within each of the former departments, over-aged learners perform poorly compared to appropriately aged and even under-aged learners.

Table 9.4: Mean literacy score by age group and former apartheid-era education department –controlled schools: Grade 3/2007, Grade 4/2008 and Grade 5/2009

Grade/Year	Former Education Department	Under age	Appropriate age	Over age	Total
Grade 3/2007	Homelands or DET	20.0	22.9	21.0	20.9
	HoR	28.5	32.3	25.9	29.2
	HoD	28.2	32.9	23.6	30.5
	HoA	28.2	51.1	35.1	47.0
Grade 4/2008	Homelands or DET	27.9	30.5	25.9	28.0
	HoR	34.4	44.3	35.8	40.9
	HoD	41.4	48.3	35.3	44.4
	HoA	40.3	56.0	35.4	51.1
Grade 5/2009	Homelands or DET	34.8	37.5	31.0	34.1
	HoR	42.4	49.2	38.7	44.9
	HoD	50.9	59.0	40.7	52.8
	HoA	59.3	66.2	49.3	62.3

Note: Excluding learners whose age was not specified.

Numeracy scores

Overall numeracy scores by age

As with literacy, there does appear to be an improvement over time in learners' average performance in numeracy. The overall mean numeracy scores of 26% for Grade 3 learners in 2007 rose to 33% for Grade 4s in 2008 and rose again to 45% in Grade 5 in 2009.

Appropriately aged learners performed much better than those who were under aged or over aged in all three grades, and each year, in each progressive grade, the gap in achievement between appropriately aged learners and their peers widens. In Grade 3 in 2007 the differences in the mean literacy score between appropriately and over-aged learners were five percentage points. This grew to nine percentage points in Grade 4 in 2008 and to 12 percentage points in Grade 5 in 2009.

While under-aged learners performed the worst in Grade 3 (achieving a score of 22% compared to 24% for over-aged learner and 29% for appropriately aged learners), in Grade 4 under-aged learners began to surpass their over-aged peers in terms of achievement (with under-aged learners achieving a mean score of 30%

and over-aged learners achieving 29%) and this continued in Grade 5 in 2009. Again, remember that as the numbers of under-aged learners is very small, care must be taken in interpreting under-aged scores at low levels of disaggregation. With a mean score of just over 50% in 2009 compared to under 40% for the over aged learners and slightly over 40% for the under aged learners.

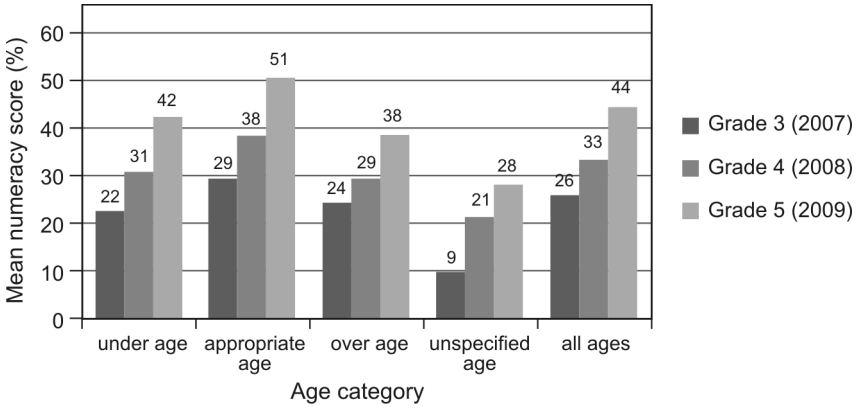

Figure 9.5: Mean numeracy score by age, 2007, 2008 and 2009

Performance by gender and age

There was little difference in the numeracy performance of learners when looked at by gender and age. Females did, however, appear to perform slightly better than males and this was the case among under-aged, appropriately aged and over-aged learners. Furthermore, the gap between male and female learners narrows as the grades progress for under-aged, over-aged and appropriately aged learners.

Table 9.5: Mean numeracy score by age group and gender: Grade 3/2007, Grade 4/2008 and Grade 5/2009

Grade/Year	Gender	Under age	Appropriate age	Over age	Total
Grade 3/2007	Male	19.6	28.8	23.8	25.7
	Female	24.6	30.6	25.2	28.1
	Unspecified gender	8.7	6.0	3.7	1.9
Grade 4/2008	Male	30.2	37.8	28.3	32.1
	Female	30.8	38.6	29.6	34.6
	Unspecified gender	29.7	37.3	34.6	35.9
Grade 5/2009	Male	40.3	50.7	38.3	43.5
	Female	43.3	50.5	38.9	45.7
	Unspecified gender	56.6	38.5	26.6	31.0

Numeracy performance by former department and age

As with literacy, learners attending schools that were formally administered by the former House of Assembly (for White learners) achieved substantially higher average scores in numeracy than learners attending schools that were formally reserved for African (DET and homelands), coloured (HoR) and Indian (HoD) learners.

In Grade 3 there was very little difference in the mean score between the age groups for learners attending former African-only schools, but by Grade 4 appropriately aged learners overtake their under and over-aged peers in terms of mean score and by Grade 5 the gap widens further. In former coloured, Indian and white schools appropriately aged learners achieved significantly higher scores than under-aged or over-aged learners. By Grade 5, regardless the type of school they are at, over-aged and under-aged learners perform poorly compared to appropriately aged. In former African, coloured and Indian schools, under-aged learners generally achieve better than their over-aged peers. The reverse is true in former white schools where over-aged learners perform much worse than those who are over aged.

Table 9.6: Mean numeracy score by former department and age group: Grade 3/2007, Grade 4/2008 and Grade 5/2009

Grade/Year	Former Education Department	Under age	Appropriate age	Over age	Total
Grade 3/2007	Homelands or DET	21.9	25.0	23.1	22.9
	HoR	25.8	34.2	26.7	30.7
	HoD	38.7	37.5	20.5	34.5
	HoA	28.1	62.7	45.0	58.0
Grade 4/2008	Homelands or DET	29.3	31.2	27.5	28.9
	HoR	36.6	46.9	36.7	42.9
	HoD	51.1	57.9	45.5	53.8
	HoA	46.3	72.2	55.3	69.0
Grade 5/2009	Homelands or DET	41.2	45.7	36.9	41.0
	HoR	51.6	59.6	45.8	54.0
	HoD	62.0	68.7	45.7	61.1
	HoA	47.2	77.5	61.0	73.5

Conclusion

An analysis of learner age in the national school effectiveness study shows that being appropriately aged for the grade is not the norm in South Africa. Already

by Grade 3 only 50% of learners are the appropriate age using our definition of an18-month age range for age appropriateness, and by Grade 5, 46% of learners are over age.

Having learners with a wide age range in a grade is caused by learners progressing through school at very different rates due to late enrolment and/or repetition. It is evident from the NSES findings that the variable progression through school, which is resulting in such large numbers of over-age learners, has distinct socio-economic, gender and geographical characteristics, with over-age learners more likely to be boys, poor, in schools that under apartheid were designated for African learners, and living in the Eastern Cape.

The analysis of learner assessment results indicates that learners, whether they are under-, over- or appropriately aged, perform at an unacceptably low level and generally appear to perform at a level that is one or two grades below the level required by the curriculum for the grade they are in. Over-aged learners, though, achieve much worse than their under- and appropriately aged counterparts in literacy and numeracy, and this occurs regardless of grade, gender, province, socio-economic status, or former department. Despite the overall poor achievement, learner performance does seem to improve over time, even for over-aged learners. However, the gap in achievement grows as the grades progress, with over-aged learners, in particular, falling further and further behind.

While the NSES shows the extent of over-agedness in Grades 3, 4 and 5, it does not provide evidence as to why these learners are over aged. However, research by Gustafsson (2010 & 2011), SACMEQ and Social Surveys (2009) indicate that a fair number of learners are enrolling in school late and that large numbers are repeating grades. The poorer performance of over-aged learners is not surprising as these are learners who would most likely have repeated a grade and are, therefore, most likely to be learners who struggle with their schoolwork. However, as they continue to do worse than their under- and appropriately aged peers, clearly grade repetition is not serving them well. It is evident that grade repetition that involves 'doing the same thing over and over again and hoping that what did not work the first time somehow will work the second time' (Denton, 2001) is not successful and the fact that over-age learners are falling further behind their peers shows that they are gaining less from learning from one year to the next. It seems likely that this situation reinforces the learning difficulties and substantially affects learners' self-esteem. The ineffectiveness of repetition as a strategy to assist weak learners is confirmed in numerous international studies. Jimerson et al (2006:87) reporting on three meta analyses undertaken on 83 studies published between 1925 and 1999 examining the efficacy of retention, noted that '[o]verall, the convergence of research does not demonstrate academic advantages for retained students relative to comparison groups of low-achievement promoted peers'. The meta-analyses also found that grade retention had a detrimental impact on socio-emotional and behavioural adjustment with retained students displaying

poorer social adjustment, more negative attitudes towards school, less frequent attendance and more problem behaviours in comparison to groups of matched controls (Jimerson, 2006)

The NSES study provides evidence that the inefficiencies and low performance in the South African education system begin in the early grades. Although learners persist in school education way beyond the age of 18 trying to complete their schooling, eventually the futility of continuing and/or economic or personal demands result in large numbers of learners dropping out of school without completing their education in the last three years of secondary school; only 44% of 24-year olds have completed Grade 12 (Department of Basic Education 2011:42).

The very poor learner performance, the slow progress of learners, the large number of over-aged learners and high rate of dropout after Grade 9, is of great concern, and requires explicit attention at the levels of policy, school leadership and classroom practice. Three options present themselves for reducing the causes and alleviating the effects of the overage phenomenon. First, learners repeating a grade should not be expected to show improved progress the second time around if they follow the same programme. They require specialist attention, be it in reading, maths or both, whether their slow progress arises from an identifiable gap in foundation knowledge or stems from an identifiable physical (such as poor eyesight) or cognitive (such as dyslexia) condition. However, it is difficult to see how schools that are not teaching reading, writing and arithmetic adequately will manage to mount such sophisticated programmes, and the highest priority needs to be accorded the third option described below. Only once schools have reached a reasonable standard of basic teaching, can they be expected to devise remedial programmes for learners with learning difficulties.

Second, in the interests of reducing the proportion of learners who are over-aged, parents need to be encouraged to enter their children for school at the age stipulated in the relevant legislation. Late enrolment in Grades R and 1 accounts for some 15-20% of learners being over age. Third, but most important, improving the quality of teaching and learning is essential if learners are to master basic skills, and hence progress through the grades at the appropriate rate. The preceding eight chapters give ample evidence that poor systems management, lack of school leadership that promotes learning, and inappropriate teaching practices combine to produce learning outcomes, which are well short of what the country should expect, given the level of resourcing and public attention focused on schooling. Improving all three aspects of the school system represents the long-term solution to the problem of learner overage.

Acknowledgements

The authors are indebted to Stephen Taylor for the analysis of the SACMEQ III data in the section headed Data.

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Chapter 10

Where to from here? From fact to act

Martin Gustafsson and Thabo Mabogoane

Introduction

The foregoing chapters have touched on the matter of policy implications. This chapter brings these implications together and expands on them to provide an overall sense of how the research from the previous chapters could influence actions aimed at improving South Africa's schooling system. But before that, how the relationship between researchers and policymakers, or the research-policy nexus, might be understood in a context like the South African one is discussed, through reference to selected strands in the literature dealing with this topic, which has become a research area in its own right. This will help to structure the policy implications discussion and to tease out patterns of a more universal nature that might be relevant to researchers and policy people beyond South Africa. As will be seen below, this structure is necessary if we are to try and avoid typical failings in the formulation of policy recommendations. A key message of this chapter is that the art of formulating these recommendations from research is an art in need of refinement.

The difficulty of linking research to policymaking

The strands of the literature on this topic that we have decided to focus on here deal with improving the two-way communication of relevant knowledge between researchers and policymakers, where the latter are people taking decisions at some stage in the generation of government policies, projects, programmes and plans. This focus seemed most appropriate, given partly that this is where much of the research-policy nexus debate lies in South Africa.

Yet this is just a part of a broader debate that covers a range of topics, seen for instance in Weiss's (1979) widely referenced taxonomy. In particular, it should not be forgotten that a key audience of education research is teachers themselves, who are likely to encounter texts such as this book whilst engaged in pre- or in-service training at a university and may find that it influences their practices directly.

The strands from the literature that this section does deal with are, firstly, practical steps that can get researchers and policymakers to understand each other better, secondly, the sharing of data, thirdly, the upholding of research standards and, fourthly, not overselling the value of any single piece or type of research. This leads to a few conclusions on how the research-policy link can be strengthened in South Africa, based partly on the authors' own experiences.

As pointed out by Bailey (2010), the literature from the United States predominates in research on the policy-research nexus. Yet many of the dynamics found within the United States are fairly common to the Western world and should not sound foreign to, say, South Africans. At the same, one should guard against forgetting local specificities, or that the United States has its own idiosyncrasies that are not replicated elsewhere.

The literature from the United States points to a troubled relationship between social researchers and policymakers. This is despite the fact that for at least a century that country has devoted considerable effort to building this relationship. That this should be the case should be sobering for South Africans hoping to see a happy marriage between the two sides after less than a couple of decades of democracy. Much of the divide can be attributed to different institutional cultures. As Golden (2007: 29) puts it, 'different perspectives of researchers and policymakers can be a recipe for mutual frustration'. Ginsburg and Gorostiaga (2001), and others, express this within the 'two communities theory'. A somewhat crude view sees researchers coming from institutions where appearing clever is rewarded most, with being right coming second and social or policy relevance perhaps coming in at third place. Of course, social research should be factually correct and is more readable if clever, but these characteristics on their own are not a sufficient guarantee that the research will help policymakers solve problems. On the other hand, those working in government, including policymakers, are under pressure to make things happen in a way that minimises risks, and political embarrassments. The daily pressures they must deal with, often of a magnitude and type that researchers would be unfamiliar with, leave little time for intellectual journeys, especially into untested waters, and lead to impatience with a maze of research pointing in many directions at once, reminiscent of the profusion of positions held by the lobby groups that policymakers must continually deal with. The result of all this is, firstly, an insufficient quantity of research that is capable of guiding policy and, secondly, policymakers who have become sceptical about the

benefits of research. Fixing an education system is partly about correcting this state of affairs.

If many of the underlying causes are institutionally created attitudes and practices, then there is a chance that some of the remedies can be found in institutional re-arrangements. Golden (2007) points to the need for more formal arrangements whereby researchers and policymakers get to talk to each other. Governments and universities need to 'struggle with the discomfort and challenges of partnership'. If they loan their staff to each other one result is 'people whose experiences bridge the worlds of research and practice' (Golden, 2007: 38). The benefits of this exceed the costs quite easily. Gruendel and Aber (2007: 55) recommend that researchers devote some time to 'opposition research', or understanding how the other side (the policymakers) think and behave. Ginsburg and Gorostiaga (2001) see such reciprocal learning as a necessary injection of a degree of Paulo Freire's pedagogy in the researcher-policymaker conversation. Such exercises in empathy are likely to make researchers more aware of the very rigid planning cycles within which policymakers work and the fact that the responsiveness of government to research varies according to the time of the year and the point within the electoral cycle. This knowledge can help researchers time key events in their projects in ways that maximise impact. It can also help researchers understand why policymakers are often dismissive of research that lacks a sense of the magnitudes of problems and effects. Policymakers must inevitably think in terms of large and complex systems, where numbers are key to understanding what to worry most about and what solutions are most likely to work. This is not to say that research without numbers (one of several definitions associated with the term 'qualitative research'), such as much ethnographic analysis, is not useful to policymakers. Prejudice against qualitative research amongst policymakers, which undeniably exists, often stems from experiences with poor qualitative research and, in Psacharopoulos's view, a peculiar tendency towards 'classificatory mystification', or too much emphasis on pushing the same old information through new exercises in term-coining and framework construction (Psacharopoulos, 1990: 380). Chapter 4 in this book illustrates, we believe, how qualitative research can be of value to policymakers, particularly in an area such as school management, which often defies easy quantification.

If there are custody battles between researchers and policymakers, the object of such battles must surely be electronic datasets. Usually it is government that refuses to share data with non-government research bodies, but the converse is also known to occur. Partnerships between institutions can facilitate data sharing. Ultimately, however, trust is needed between the sharing parties and this is often best built through adherence to good quantitative analysis practices, as discussed below. Put differently, if sufficient capacity, both in terms of data analysis and policy knowledge, is built up within research institutions,

government will tend to want to share its data as a matter of self-interest. These are key matters in developing countries, where research practices are not always what they should be. Notably, a lack of trust over research capabilities is not the largest reason why governments in the United States refuse to share data. Rather, the concern is usually that releasing the data would infringe on privacy laws, often because the data processing steps required to protect privacy were not initially budgeted for (Viadero, 2003). These may sound like obscure concerns to those of us in developing countries, where these kinds of privacy laws are often under-developed or non-existent. Yet they do point towards coming issues that must be thought about, and which become more pressing with time, for instance in relation to the use of potentially sensitive teacher opinion surveys or teacher testing, as occurred in the National School Effectiveness Study (NSES).

Once researchers have access to the data they need, the focus needs to be on avoiding abuse and the consequences of this, including a breakdown of trust. Bales (2003) provides a concise discussion of the worst transgressions in quantitative analysis in the social sciences. For instance, she bemoans crisis-obsessed quantitative analysis, or analysis aimed at outdoing previous analysis in proving how shockingly bad the situation is, without any relief in the form of proposed solutions. Many South African policymakers would instantly sympathise with her position. Just painting crises cannot be enough. As difficult as it may be, the analyst should attempt to use the data as a basis for exploring feasible ways out of the crisis, including ways of altering the current policy architecture without creating unnecessary instability. Such analysis must be cost-sensitive, meaning it must recognise that there are constraints with respect to public funding, but also with respect to expertise within the country and the level of volunteerism one can expect from people such as parents and teachers. Cost-sensitivity may take the form of formal models with prices. However, even rudimentary cost-sensitivity of the kind found in many of the chapters in this book (for instance the comparison of the magnitudes of different effects in Chapter 3) helps to instil a necessary level of realism and guard against so-called wish lists.

McCartney and Weiss (2007: 63) remind us of an important element of good research: humility. Deifying individual studies or single methodologies, reduces research to fads and fashion. Methodological innovation and elegance are of course valuable, but on their own they are not a signal of exceptional policy relevance. Moreover, not having 'fair and reasonable scientific expectations' of what a single analysis or model can achieve leads to inefficiencies and disappointments. How many education policymakers have

not had whirlwind romances with education production functions, hoping that one such analysis would unlock a Pandora's Box of truths about how schools work, only to be dismayed by what these analyses do not tell us and, worse still, the fact that different ones yield contradictory policy information (Gustafsson and Mabogoane, 2010)? Randomised control trials (RCTs) have gained in stature in recent years, for good reason. Their strength lies not only in their ability to investigate rigorously the impact of specific interventions. More broadly, they alert policymakers to the sobering fact that even interventions that at face value appear to bear all the right attributes, often do not have the intended impact. Yet each individual RCT can only investigate a narrow range of interventions and subjecting all education interventions to RCTs would be costly and impractical (McCartney and Weiss, 2007).

There is no support in the literature for the single heroic study, especially where the policy issues are complex, as they normally are in education. Rather, it is a question of incremental growth in the stock of policy information. This has a couple of important institutional implications. Firstly, it is necessary to commission good meta-studies from time to time aimed at policymakers who will never have enough time to digest all the individual studies, even the good ones. Secondly, having different analysts analyse the same datasets from different angles, and sometimes even from the same angle, is important. Producing just one analysis out of one dataset, a common ratio in practice, can be compared to publishing a book for only one reader. This book in fact illustrates how having different analysts, from a variety of backgrounds, analyse a single dataset such as the NSES, results in an especially rich combination of knowledge that can inform policy.

If the relationship between researchers and policymakers is a troubled one, is there one side that carries a greater responsibility to fix the relationship? The US literature seems to point the finger at researchers who, according to Gruendel and Arbor (2007: 44) should become more adept at moving from 'fact to act'. Weiss (1979: 431) supports this view:

> There has been much glib rhetoric about the vast benefits that social science can offer if only policy makers paid attention. Perhaps it is time for social scientists to pay attention to the imperatives of policy-making systems and to consider soberly what they can do, not necessarily to increase the use of research, but to improve the contribution that research makes to the wisdom of social policy.

These are apt reminders, especially considering that the predominant view, at least amongst researchers, is probably that the problem is mainly one of

unreceptive policymakers. This is not to deny the fact that some policymakers would undoubtedly take better decisions if they were more receptive to good research. But the solutions lie on both sides of the relationship.

How could one sum up what South African researchers and policymakers – who think about the relationship – say about improving it? Apart from the points already made above, there appear to be some South African specificities. Researchers could perhaps spend more time adapting the best theory and policy advice emerging from other developing countries to the local context. For historical and practical reasons, the influence of education research from the United States and the United Kingdom have been and will continue to be highly influential. Yet those countries experience very different contexts in terms of poverty and fiscal space. The criticism that South Africa has too easily adopted policies not appropriate in a developing country context is often heard. Better and more widespread use of datasets in the South African education research community is believed to be a factor that could improve the policy relevance of local research, apart from making the research environment more diverse and exciting. In this regard, the merits of getting postgraduate education students to spend considerable time collecting their own data, often with minimal budgets, need to be weighed against the merits of getting these same students to hone their analytical skills using existing, often high quality datasets, such as that of the NSES, compiled at great expense by government or NGOs. A partial shift towards the latter seems necessary. The bulk of empirical analysis undertaken by education researchers in South Africa focuses on what is happening in the school and how practices within schools can improve. Obviously, this is important research. However, there is too little emphasis on the schooling system as a whole, specifically the demographics, economics, politics, history and geography of that system. These are topics of great value to policymakers. Finally, South Africa is a country with an uneasy history where ideological differences run deep and can easily derail relationships. One way of maintaining the peace is to ensure that research which is packaged as policy advice is solidly informed by existing socio-economic realities, such as poverty and linguistic complexity, and is sensitive to the country's resource constraints. In a country such as South Africa a major part of the policymaking challenge is to establish what the facts are about the schooling system and to see through the numerous myths. This suggests that any research that brings new facts about the system onto the table is likely to be welcomed, no matter what the ideological undertones.

What can policymakers do to improve ties with the research community? The relationship is at its healthiest when it is seen to be an equal relationship between professionals. This is often not the case. Researchers like to see themselves as custodians of a higher truth, as members of the priesthood (Bailey, 2010), as *the* professionals in the relationship. Policymakers tend to

respond, defensively, by resorting to their political and budgetary power. A key to establishing a more equal and thus effective relationship lies in strengthening the sense of professionalism amongst the policymakers. The professional identity of education planners is a topic about which not enough has been written, though Curle's 1969 booklet is still relevant. Curle (1969) argued that, amongst other things, education planners should consider their need to be multi-disciplinary not as a burden but as an opportunity to enlighten, and that the planner should moreover pay special attention to the topic where he or she is indeed the expert, namely techniques of social change. This professional identity requires a basic, though not necessarily in-depth, familiarity with research concepts, including sampling, epistemology, the elusiveness of causality and typical problems in the data generation process (Hite, 2001). Policymakers' understanding of how research does and should feed into policy should be sufficiently developed to allow them to teach the researchers a thing or two. And, of course, they need to have access to the basic tools of their trade, including the internet and online academic journals.

An important task allocation question that is too often forgotten is who should write the policy briefs, or policy-oriented meta-analyses. Who is responsible for the translation and mediation (Ginsburg and Gorostiaga, 2001)? Researchers tend to assume that there are people in government who systematically read through the research being produced and tease out what this means for the future design of specific policies. Policymakers, on the other hand, often see this as the job of the researchers. Clearly, if neither side undertakes this task there is a vital missing link in the chain. Both sides should invest in this type of work. In this book, this work is largely reflected in the next section, which summarises the policy implications of the earlier chapters.

The key policy messages from this book

Before highlights from the foregoing chapters are discussed, this section provides a very high level overview of South Africa's basic education policies, with a focus on where policy is (or should be) most dynamic, or responsive to pressure for change, and what kind of research seems necessary to guide the required changes. Note that references for the various policies discussed are not listed at the end of the chapter, but they are all available at http://www.education.gov.za.

Thereafter the discussion proceeds through six critical policy areas:

(1) teacher capacity
(2) classroom practices
(3) teacher accountability
(4) learner access to texts

(5) grade promotion
(6) management and governance of schools and the system.

For each, there is some separation between understanding the problem and understanding the solutions, given how easy it is for the latter to fall off the research agenda. This section is informed by the foregoing chapters themselves, but also conversations with the authors. Two prominent meta-analyses with a developing country focus that seemed particularly valuable were chosen to provide a sense of what recent research from around the world is suggesting to policymakers. The one is the 2005 Education for All *Global monitoring report*, sub-titled 'The quality imperative', which has references to around 600 studies (UNESCO, 2005). The other is the more economically focussed *Making schools work: New evidence on accountability reforms* by Bruns, Filmer and Patrinos (2011).

The shadow of South Africa's apartheid brand of colonialism still looms large. The country's current education policies, virtually all written after the advent of democracy in 1994, focus strongly on the re-invention of South Africa as a single society, both with respect to how education is organised and what is taught. The uniqueness of South Africa's basic education policy challenges is often emphasised. Apartheid created a schooling system explicitly aimed at keeping standards, including teacher-training standards, low through most of the system and controlling the population. This lies behind the combination of relatively high access and low quality currently. The fact that schools, in particular secondary schools, became a locus for opposition to apartheid, starting with the 1976 uprisings, left a culture, which remains strong today, of resistance to authority and controls, amongst both learners and teachers. Political interest, both under apartheid and currently, in keeping with most schooling in the public sector results not only in a very small private school sector (officially around 4% of learners) but also very large inequalities within the public system, made possible currently by policy allowing rich parents to contribute privately towards their children's public schools. Historically white public schools (accounting for around 10% of total enrolments, with about 40% of learners enrolled being white currently) are often considered the standard by parents towards which government should strive, although these schools' high per learner spending levels (when both public and private funding is counted) make them an unsustainable model for the country as a whole. The dismantling of apartheid in the years preceding and following 1994 created new job opportunities, in particular for black South Africans. This, combined with a general skills shortfall in the country, has made it difficult to attract black youths with the required school qualifications into the teaching profession. One symptom of this is a shortfall of teachers fluent in the indigenous African languages spoken at home by around 83% of school learners. The average age of teachers in the public sector is now about 43 and continues to rise. The

political strength of the largest teacher union, built up during the struggle against apartheid, ensured that the determination of teacher salaries became a national responsibility. At the same time, compromises in the talks that led to the democratic constitution resulted in schooling becoming a responsibility of the nine provinces. The mix of provincial bureaucratic control and budgets and nationally determined salaries brings with it inevitable tensions.

The uniqueness of South Africa's history and circumstances should not be over-stated. In many ways South Africa's education development issues are typical for a developing country and there is perhaps an insufficient appreciation of how lessons emerging from elsewhere can benefit South Africa. Areas where more such learning is needed include multi-lingual classes (other African countries face very similar challenges, as seen in Chapter 5), information on pupil performance (Latin American countries such as Chile and Brazil have made tremendous strides forward here) and the legacy of a large number of insufficiently or inappropriately trained teachers (Brazil) (Bof, 2004).

Much of the policy emphasis in South Africa during the decade or so following 1994 was on unifying and equalising the highly fragmented and unequal public education system that had existed previously. This involved developing a system of education policies basically from scratch. Here the government achieved considerable success. By around 2003 public spending per learner in schools had more or less become equalised and with respect to some programmes it was clearly pro-poor (Gustafsson and Patel, 2006). Around 2005, the emphasis began shifting to what learners learn in schools as it became increasingly clear from international testing programmes such as SACMEQ that learner performance was well below what it should be, even when controlling for factors such as socio-economic disadvantage. The absence of national examinations below Grade 12 had in many ways kept learning standards in earlier grades off the policy radar. To some extent, there had been an implicit assumption that correcting the resourcing inequities of apartheid would address educational standards. Sample-based testing within both the national testing programme (the Systemic Evaluation) and international testing programmes revealed that this assumption was a false hope. More direct action to address under-performance was needed.

Starting around 2007, when the Foundations for Learning programme was introduced, improving learner performance moved to centre stage in the policy debates. In 2010 it became first priority in a new government planning system centred around twelve national development outcomes (Department of Basic Education, 2011a).

The broad strategy of the national government for improving learning outcomes is clear. A sector plan introduced in 2010 places much emphasis on a new testing system, the Annual National Assessments, or ANA, as a tool for assessing where to target particular kinds of support but also as a means for

improving the accountability of schools towards the administration and parents with respect to their results. ANA, unlike the earlier Systemic Evaluation, tests all Grades 1 to 6 learners, though a sample is used for verification purposes. Apart from a new emphasis on standardised testing, there has been a fairly radical policy shift from a large degree of professional freedom for teachers, including freedom in selecting materials for learners, to a high degree of methodological prescription, in particular as far as teachers with weak results are concerned. In 2011 standardised workbooks for primary level learners were distributed for languages and mathematics. To provide a picture, the Grade 6 mathematics workbook (downloadable from http://www.education.gov.za) is illustrated in full colour, consists of almost 400 pages, with exercises allocated to each week of the school year. Learners write directly in the workbooks and become the owners of these books. The plan is to repeat the distribution of workbooks every year. The ambitious workbooks programme is expected to bring needed stimulation and standardisation in classrooms. The fact that in 2009, according to the NSES data, only around two-thirds of Grade 6 learners had access to a mathematics textbook provides an idea of the opportunities created by the current policy shifts. In fact, it is important to bear in mind that the data used in the analysis of the previous chapters pre-dates both the introduction of national workbooks and the full-scale introduction of ANA, which also occurred in 2011. These analyses thus constitute an important backdrop against which one can attempt to interpret subsequent policy interventions.

The country's overall strategy to improve literacy and numeracy follows what is often considered best practice elsewhere. Yet as the discussion below emphasises, the issues are far from straightforward, there are several technical pitfalls and what the available evidence points to is not always clear. One question that will undoubtedly be debated for many years is how to balance monitoring (or accountability) and support. This question is a recurring theme currently in South Africa's education policy debates, in particular in the context of the introduction of the new national testing system. There is a strong expectation that the authorities should provide support to schools, in the form of teacher in-service training but also school-level 'turnaround interventions'. There is moreover a sense that on the whole the authorities have failed in this task. At the same time, there is uneasiness around the possibility that monitoring and accountability mechanisms, such as ANA, are being introduced without support, or as a replacement for support, despite government's arguments to the contrary.

What does the evidence suggest should be done to deal with these tensions? What seems obvious, namely that interventions such as teacher in-service training are good for improving learning, is confirmed by closely monitored and experimental interventions such as the Liberian early grade reading assessment

project discussed by Bruns et al (2011). In this intervention, providing parents with information about how well their children learnt, but providing no support to schools, was associated with very low performance benefits relative to the control group where no intervention occurred at all. However, combining the information for parents with two weeks of face-to-face training for teachers outside the school in the year, as well as monthly visits of support experts to schools, resulted in improvements that were large. As discussed in Chapter 1, there is one South African study, dealing with the teacher training interventions offered by the Cape Teaching and Leadership Institute, which provides an analysis of impact, using retrospective techniques, and finds a positive impact on teacher knowledge and learning. Unfortunately, studies of this kind in developing country contexts are still rare, though their availability is likely to improve. Very importantly, the exiting literature suggests there is a considerable risk that any support initiative will not be properly designed and will not have the desired impact. In particular, where teacher development initiatives have been evaluated, their results have mostly been disappointing. Real opportunities thus exist, though the policymaker only reaches them after crossing a number of design hurdles. Policy on support should be carefully designed, the use of formal impact evaluation techniques should be seriously considered but, failing that, a combination of alternative evaluation methods should be built into the intervention. No support initiative should proceed without a monitoring and evaluation component. Unfortunately this rule is too often broken.

What is also too often ignored, or left too late, is a proper consideration of cost. Cost influences the support debate in a number of ways. The influence is larger in developing countries, not only because of budgetary constraints but also because having a majority of schools facing problems of severe under-performance, and not a minority of schools, as is generally the case in developed countries, creates special planning challenges. Dealing with these challenges means paying close attention to cost-effective interventions such as distance learning initiatives and the stimulation of local action through grants and incentives. In South Africa the cost-effectiveness of whole-school turnaround interventions that make use of external agents is an important concern. The National Planning Commission, in its 2011 national plan, proposes a turnaround intervention where three to five change experts would spend half a year in a school. Variations of this type of intervention have been promoted and to some extent pursued for some years. Yet the possibility of taking them to scale in a context such as the South African one seems small. Cost constraints suggest that this type of support is perhaps best used as an action research initiative to uncover the dynamics of school under-performance, rather than as a system-wide school change intervention.

Accepting that support needs to be offered in phases and inevitably with less frequency and intensity than one would ideally want, raises important monitoring questions. Does monitoring have a role whilst schools are still waiting their turn for support? How do monitoring and support complement each other? There is some evidence that the introduction of test-based accountability systems can trigger learning improvements, perhaps because they in turn trigger new demands for support on the part of schools. Hanushek and Raymond (2005) found that average pupil performance improvements in individual states in the United States, as measured in the sample-based National Assessment of Educational Progress (NAEP) programme, were correlated with the timing of the initial introduction of state-level test-based accountability systems. Brazil, a country which in many aspects is similar to South Africa, but which has seen exceptionally strong improvements in its average scores in the Programme for International Student Assessment (PISA) testing programme, used to a large degree enhancements in its national standardised testing programme to bring about educational improvement, according to a recent report by the Organisation for Economic Co-operation and Development (OECD) (2012). But the same report also outlines a variety of support strategies that have been prioritised by state governments in Brazil. For instance, the state of Ceará decided to deal with learning deficits in earlier grades by taking all Grade 9 teachers, regardless of subject, through intensive training aimed at getting learners to improve their reading skills.

Uneasiness around new monitoring and accountability initiatives can be reduced if these initiatives are well designed and properly communicated to stakeholders. Whilst the broad intentions of ANA expressed in existing policies are in line with good practice elsewhere, evidence points to a number of pitfalls that must avoided. The South African approach of allowing teachers themselves to mark tests in schools that are not part of the verification sample is unusual. A possible advantage with such an approach is that it promotes teacher ownership of the programme and could lead to better formative assessment throughout the school year, a practice that is too often overlooked according to researchers such as Black and Wiliam (1998). However, a likely disadvantage is that even with external moderation of the marking, there is a risk that results cannot be used to compare schools and that the system may be manipulated and gamed, in particular if targets are set for schools. In the United States, Jacob and Levitt (2003) and others have analysed patterns within the test data and arrived at alarming findings around the extent of cheating by teachers. In South Africa a key challenge will be to migrate from classical scoring methods to methods using item response theory (IRT) within the national testing programme. The migration is required in order for results to be properly comparable over time.

The shift in emphasis towards providing good standardised textbooks to learners finds support in the literature. The 2005 EFA report refers to the

repeated finding amongst analysts of the International Association for the Evaluation of Educational Achievement (IEA) data that in developing countries textbooks are an important counterweight to poverty and a lack of educational stimulation in the home (UNESCO, 2005).

Teacher capacity

Everything begins with the teacher. In South Africa, for reasons explained above, one key policy challenge is to improve the capacity of teachers who have already worked for many years. A recently published policy (Department of Basic Education, 2011b) envisages greater accountability through professional development points earned by teachers, which would be captured in a national database. It also sees a partial shift away from a history of top-down training workshops towards more locally driven 'professional learning communities'. As with ANA, what is now needed is more certainty and knowledge with respect to specific tactics, for instance relating to the points system and the use of e-learning, an under-explored technology in the area of teacher capacity building (Unwin, 2005). Moreover, whether enough training in the country can be provided to satisfy the needs of the points system, even with growth in the distance education and e-learning industries, is a question that has been insufficiently analysed. The fact that building up a critical mass of formal in-service training programmes of the desired quality will take many years, underlines the importance of promoting less formal and more locally driven capacity development through mechanisms such as the professional learning communities. Working examples of this mechanism need to be nurtured and best practices publicised. One way of incentivising teachers themselves to initiate capacity building is to reward teachers financially for attaining critical levels of subject content knowledge in standardised teacher tests. This has been implemented in Chile (Bruns et al, 2011), and South Africa's National Planning Commission has expressed interest in such rewards. Whilst the Funza Lushaka bursary programme for new teachers has a sound focus, a comprehensive strategy for tackling the under-supply of new entrants into the profession seems absent. Probably the most critical solution in this regard is to improve the quality of schooling so that more youths leaving school qualify for university studies.

The NSES teacher tests described in Chapter 3 are limited by their shortness, yet they provide a rare glimpse into the state of teacher knowledge. The only other national results of their kind are those of SACMEQ 2007, which were analysed in Chapter 8. The input-output analysis presented in Chapter 3, using the NSES data, confirms that teacher knowledge must comprise a key aspect of teacher capacity building. This has not always been accepted. The analysis finds that there is a threshold. Mathematics teachers should respond

correctly to no fewer than all questions in a test such as the one used in order for there to be an impact on learner performance. The examination in Chapter 8 of teacher performance on specific questions in the SACMEQ teacher tests, which contain relatively basic questions, points to the magnitude of the problem. Even basic arithmetical conventions such as the impact of brackets on the order of operations are not properly understood by half of primary school mathematics teachers. The threshold at which teacher knowledge starts to make a difference is thus not necessarily a very high one. It goes without saying that teachers need to understand what their learners are expected to understand, at a minimum.

The NSES data provide a few pointers regarding the solutions. As many as 80% of teachers reported that they had experienced capacity building of some kind conducted by a person external to the school in the past year. It cannot be said that the system is ignoring teacher in-service training. Moreover, SACMEQ 2007 data indicate that in the case of those teachers who did receive training, on average ten days in the previous three years had been received. This duration does not seem insignificant. The problem, however, is that only around half of teachers find the training they have received useful (according to SACMEQ). As argued in Chapter 1, there appears to be a problem with the quality of training currently. The fact that this type of feedback data should be very scarce is itself a part of the problem. Solutions should include adapting the existing, and not insubstantial, system of short training workshops using well-structured feedback from teachers. Analyses of teacher test results, such as those presented in Chapter 8, are also crucial for fine-tuning the focus of teacher capacity building. Differentiating between what was referred to as a knowledge blockage and a pedagogical blockage in that chapter should lead to better designed training materials. Chapter 6 illustrates how useful simply analysing texts written by teachers undergoing training can be. That analysis, combined with an analysis of the structure of the training provided, led to the conclusion that far more time should have been devoted towards getting teachers to understand the elements of good writing.

In the preliminary multivariate analysis that led to Chapter 3, teacher age was not found to be a reliable predictor of better performance in the learner or teacher tests. Ideally, one would expect the changes that have occurred to pre-service teacher training since 1994 to be reflected in greater effectiveness amongst younger teachers. That this should not be seen in the data is worrying. The policy pointers emerging from this book, for instance with respect to the importance of teacher subject knowledge, should inform both in-service and pre-service training. Fixing deficiencies in the pre-service training system through in-service training is an inefficient approach to achieving quality teaching in schools.

Classroom practices

A large part of improving the capacity of teachers is about improving teacher practices within the classroom, but also practices beyond the classroom relating to preparation, evaluation and reporting. Since a landmark review of curriculum implementation, released in 2009 (Department of Education, 2009), there has been a noticeable policy shift towards greater clarity on what must be taught, minimum time requirements, appropriate use of good materials, ensuring that teachers pace their progression appropriately through a clear annual teaching plan and an emphasis on learning between teachers to improve classroom methodologies (Department of Basic Education, 2011a). At least at a strategic level, South Africa is pursuing solutions advocated by many education researchers in the country and beyond (See Van der Berg, Burger, Burger, De Vos et al, 2011). For instance, the focus on better time management flows from research indicating that in developing countries the ratio of teacher time spent on actual educational activities to the time teachers are physically present in the classroom can be as low as half (Bruns et al, 2011). Improving teacher attendance at school is important, but so is ensuring that unproductive time in the classroom is minimised.

New curriculum guides, the Curriculum and Assessment Policy Statements, or CAPS, were published in 2011 and are being phased in during the 2012 to 2014 period. Officially, it is not a new curriculum, yet the new requirements usher in what is potentially a very different set of classroom practices. The scope for differing interpretations of the curriculum by different teachers is substantially reduced. For example, whereas the earlier curriculum documents, about as long as the new ones, described what had to be taught in the Grade 4 English second language classroom in largely functional terms, and included virtually no concrete references to sentence structure, the new document specifies around three sentence structure topics that should be covered in each week of the year and illustrates the topics with examples of the correct structure. The specificity within the CAPS is intended to counteract the production of provincial and district-level clarification documents, often of a poor quality, which according to the 2009 review proliferated under the old system and made it difficult for teachers to know what the official policy was. The CAPS instructions are based on an explicit understanding of the time constraints affecting teachers, and to some degree the implications of South Africa's relatively large class sizes. Thus for instance the requirement that the teacher maintain a physical portfolio of work submitted by each learner was dropped. The recent curriculum reforms in South Africa might offer a salutary indication to other developing countries of what to avoid and what to strive for in curriculum design.

The 2009 review found the previous approach to assessment overly complex and insufficiently standardised. The CAPS simplify schools-based assessments and introduce a year-end examination for every subject from Grade 4. One intended area of impact of the Annual National Assessments is to expose teachers to well-designed tests set at an appropriate level in order to improve tests developed by teachers themselves.

The method used in the NSES, and described in Chapter 3, to measure how well teachers were able to pace themselves through their yearly programme, is an important innovation in the South African context. The government plans to monitor systematically curriculum pacing in schools, but the approach that will be followed is still not clear. The NSES, through the sampling of the writing books of the best performing learner per class, illustrates an approach that is far preferable to one where teachers themselves report on what they have covered in each week. This latter approach runs the risk of creating a tick-box culture that does little to improve what learners learn. Yet, if the NSES approach were widely institutionalised, it risks bringing about perverse outcomes, such as a focus on just the top learners in class. A combination of the purposive sampling of the best learner and the random sampling of one additional learner seems preferable.

Whilst the policy shifts described are in line with what has been seen in other countries, the usual questions around the detail must be asked. Specifically, what seems needed is a clearer statement by the employers of teachers, in other words the state, of what the evidence says about their poor and good practices. Should there be less group work in the class, for instance, as suggested by UNESCO (2005)? How important is reading out aloud by individual learners? Some of these types of questions have been answered in the foregoing chapters. For instance, Chapter 7 pointed to problems associated with the widespread practice amongst learners of using inefficient counting techniques when performing arithmetic operations, instead of the required algorithmic techniques. Chapter 3 suggested that formal assessment should be prioritised if mathematics scores are to be improved. Chapter 6 has argued that higher-order writing skills are dependent on learners' having internalised basic writing and spelling rules to a sufficient degree and on whether they are explicitly guided in strategising how a text will be written. Whilst these details are important, it is also important for policymakers to assist teachers and others to bring them together into a coherent philosophy and praxis of teaching. The extent to which the new CAPS succeed in doing this needs to be monitored closely.

Teacher accountability

South Africa is not unique in its concern with service delivery failure as a fundamental social and political problem. The literature points to a worldwide crisis with respect to service delivery (Bruns et al 2011). For economists and others, better accountability systems is the solution that is too often under-rated or postponed. In education, it is not enough to know what the desired classroom practices are, or to offer teacher capacity building programmes. Teachers themselves should be subject to incentives and disincentives that encourage them to be agents of change. The typical approach is probably to appeal to teachers' sense of professional duty or nation-building. Whilst such appeals can be important, in the absence of good accountability systems they are unlikely to be enough. Within a good accountability system, teachers will know that effort and commitment are recognised and that failure to meet reasonable minimum standards will not only be noticed but will have negative consequences.

Why are teacher accountability systems so often under-developed? Technically, effective incentives for teachers, of a monetary or non-monetary nature, are difficult to design largely due to complexities around measuring teacher effectiveness. For instance, as seen in Chapter 3, the socio-economic background of learners is a causal factor in the learning process over which even the best teachers have little control. Teacher unions are acutely aware of the measurement difficulties and will often oppose new accountability systems on technical grounds. Sometimes these objections by unions are reasonable ones. Importantly, however, the last ten years have seen the emergence of workable teacher incentives in a number of developing countries, meaning this policy area has become a far more compelling and evidence-based one.

In South Africa, the labour relations regime for teachers, as for others in the labour market, is highly formal and strongly focussed on protecting the rights of the employee. However, rules to deal with teacher misconduct are used and constitute the foundations for an accountability system. Every year around 350 publicly employed teachers, or 0.1% of the total, are dismissed for misconduct. (These figures are based on our own analysis of the Persal payroll database). The rules require careful management of each case and provinces vary in their ability to apply them. Gauteng, a relatively well performing province, has a dismissal rate of around 0.12%, against 0.03% in the case of Limpopo, the worst performing province in terms of learner scores (see Chapter 2). What these figures suggest is that a part of the teacher accountability challenge is simply to apply existing rules more effectively and to build up the management culture and capacity to do so.

With respect to financial incentives for good teacher performance, developments in South Africa from around 2006 are instructive for any

country wishing to strengthen teacher accountability systems. There has been success in implementing a system of small salary increments for teachers, of 1% per year, based on evaluations by the school principal and peers of inputs such as the quality of class preparation. However, these increments are virtually universal. According to DBE officials, only around 0.5% of teachers do not receive the increments. Moreover, the high ratings given to most teachers are out of step with the realities of insufficient teacher capacity and poor discipline. In the context of the widespread teacher under-performance described in this book, the current system of annual increments clearly lacks sufficiently rigorous measurement of even basic matters such as attendance. In 2008, an agreement between the employer and unions was concluded whereby larger increments, of up to 9% in one year, would be awarded to teachers considered outstanding not just by the school principal, but also evaluators external to the school, on the basis of evidence of good practice (such as good class preparation). Moreover, the 2008 agreement included an in principle acceptance that at some point financial rewards for teachers would be linked to learner performance. This agreement, widely hailed as a step forward for teacher accountability, was abandoned by unions in 2009, partly due to uncertainty around the measurement mechanisms to be used. Both sides in the central bargaining process claim continued commitment to stronger teacher incentives. Yet the 2008-2009 experience was ultimately a setback for this process and underscores the importance of having sufficient research, clarity and buy-in before ambitious teacher incentives are introduced.

What does the literature on experiences in other countries suggest for South Africa? Firstly, it is important to learn to walk before one learns to run. There are compelling arguments for viewing particular improvement strategies as being appropriate at particular levels of development, both with respect to the schooling system as a whole (Mourshed, Chijioke and Barber, 2010) and with respect to individual schools, whose receptiveness for different interventions varies within the system and over time (Hopkins and Harris, 1997). Chapter 3 pointed to important improvement strategies at low levels of institutional development. For instance, very simple accountability tools such as a properly functioning teacher attendance register in the school are associated with better teacher attendance, which in turn appears to be a particularly strong predictor of learner performance. Yet, as emphasised in Chapter 4, time management improvements cannot occur in isolation from instructional leadership improvements. It is not just a matter of securing more time for the educational process, teachers must be guided so that this time is effectively used. Linking teacher incentives to learner performance, often considered the ideal in the teacher accountability debates, is possible, but great care must be taken. It is important to recognise that group-based teacher incentives paid to whole schools, as opposed to incentives paid to individual teachers, tend to be more

practical (Bruns et al, 2011). There has in fact been little exploration of group-based incentives in South Africa. A programme such as ANA can form the measurement basis for group-based incentives, but only if its controls and the reliability of its data are strengthened beyond what was seen in the inception of ANA in 2011. Brazil offers an example of an approach where the tendency of schools to respond to performance incentives by promoting fewer learners to the next grade is counteracted by means of a school performance index that considers both learner test scores and grade promotion (Bruns et al, 2011).

Learner access to texts

As mentioned above, and as argued in Chapter 1, the availability of quality textbooks in socio-economically disadvantaged schools is particularly important as these books can to some degree compensate for a lack of education resources in the home. The way policy has dealt with textbooks in South Africa has been widely criticised, yet this is also an area that illustrates how difficult it can be to establish what policy actually says. The 2009 review of curriculum implementation indicated that textbooks were undermined and their use discouraged in schools as part of an anti-textbook legacy brought about by the curriculum reforms of the late 1990s. The 1995 White Paper on Education and Training, which in many ways laid the foundations for post-apartheid schooling in the country, emphasised the importance of textbooks for schools. It is difficult to find explicit discouragement of textbooks in any of the curriculum documents. Yet teachers have widely reported that this discouragement occurred in the form of advocacy of alternative texts developed or sourced by teachers themselves. Under-spending on textbooks by the state up to at least 2004 would have reinforced this message. As argued by the 2009 review, the undermining of textbooks deprived teachers and learners of a coherent guide to the knowledge and skills that had to be learnt.

The NSES data on textbooks, though not ideal as the data are based on aggregate impressions by the school principal, offer a rare picture of the extent of access to textbooks amongst Grades 1 to 7 learners in the 2007 to 2009 period. One of the symptoms of the marginalisation of textbooks has been very poor monitoring of access to books. The new sector plan for basic education pays considerable attention to closing this information gap. The NSES data indicate that the average learner/textbook ratios with respect to language and mathematics at the primary level grades lie between 3 to 2 and 2 to 1 (the latter would mean two learners share one book). Very similar figures are found for Grade 6 using SACMEQ 2007 data, which are more reliable as learners themselves were the source of the information. Clearly this picture falls well short of what is now considered the ideal in policy, namely that every learner should have a textbook in every subject. Moreover, as discussed

in Chapter 7, SACMEQ data indicate that access to textbooks has in many respects been worse in South Africa than in neighbouring countries. Yet that textbook access, according to the NSES, should be about the same in Grades 1 to 3 as in Grades 4 to 6 is surprising given that it is believed that textbook use was especially undermined in the first three grades. It is moreover noteworthy that around one-third of learners in Grades 1 to 3 whose home language is an African language have access to English language textbooks, according to the NSES. The baseline for realising the additive bilingualism described in Chapter 5 and promoted by the most recent curriculum documents, may not be as low as had been suspected.

It is difficult to imagine that the national workbooks introduced in 2011 and referred to earlier would not have significantly improved learner access to texts. In 2012 the programme was expanded to encompass Grades 1 to 9 and to include English additional language workbooks for all learners with an African language as their home language. The official policies indicate that textbooks and workbooks are complementary. Exactly how they should complement each other is a matter where teachers probably require better guidance. Whether schools and provincial authorities use the presence of the national workbooks to spend less on textbooks, and whether such behaviour would be detrimental to learning, are matters that policymakers and researchers will need to watch closely. Given that the workbooks explicitly pace topics by the weeks of the school year, they provide a tool not just for better time management within the classroom, but also better monitoring of teacher performance. How this latter monitoring should occur, for instance by the school principal, is an area where better guidance is needed. Over-simplifying the task would be dangerous. The current problem of poor curriculum coverage should not simply be replaced by a 'tick-box culture' where the teacher's professional judgment around the differentiated pacing required by specific classes and learners is ignored.

Concerns with the numbers of textbooks (or workbooks) available should not detract from the importance of ensuring that widely used texts are of a high quality and educationally appropriate. ANA is one feedback mechanism that should inform textbook developers of the areas of the curriculum where better pedagogical approaches are needed. Chapter 6 has emphasised the importance of ensuring that language textbooks guide teachers and learners in specific ways to promote good writing of multi-paragraph narratives. Such narratives do receive attention in the national workbooks for languages, at least in Grade 6. Researchers should find ways of testing the effectiveness of the methodologies put forward in the workbooks. Brazil offers an example of how education researchers and policymakers can collaborate to promote quality texts and appropriate usage. Since 2007, the Brazilian Ministry of Education, through their Programa Nacional do Livro Didático (PNLD), in collaboration with a number of universities, has been releasing annual reviews of approved

textbooks. These reviews are largely aimed at advising schools and teachers on which books are most suitable for specific groups of learners and specific teaching styles. (For more details, see http://www.mec.gov.br.)

Grade promotion

As explained in Chapter 9, restrictions on grade repetition state that a learner may only repeat one grade in every three-grade phase. Grade promotion is a difficult policy issue, partly because the question of who should repeat a grade and what to do with repeaters spans so many policy areas. It is worth noting where policy is largely silent in South Africa. There is no guidance to schools on more or less the percentage of learners who could be repeating at any point in time. This percentage for the schooling system as a whole is 8% (according to our own analysis of 2010 General Household Survey data (Statistics South Africa)), though figures vary greatly from school to school. Guidance in this matter could help to reinforce best practices and counteract the 'lottery effect' whereby one's chances of repeating a grade depend to a large degree on which school one is enrolled in. The current restrictions, focussing on the individual learner, in fact allow for an average level of repetition as high as 25%, assuming that all learners repeated every fourth year. The current wisdom on grade repetition in developing countries does not support a blanket application of automatic grade progression (Brophy, 2006). However, if some repetition is acceptable, then how much?

A more serious policy gap is the absence of clear signals to teachers on what classroom practices to employ to assist grade repeaters, or struggling learners who are likely future repeaters, in the difficult context of South Africa's classes, which even by developing country standards are large (Gustafsson and Mabogoane, 2010). More broadly, evidence-based advice on how to deal with classes where learners are at different ability levels is needed. This includes advice on how to teach multi-grade classes, a matter that has received increasing attention amongst South African policymakers in recent years. By default the current policy position is that in single-grade classes stragglers must mostly take responsibility themselves for catching up, an approach that is clearly inadequate.

Research points to a strong association between being a grade repeater, or having repeated grades in previous years, and poor performance in tests (Brophy, 2006). In Chapter 9 it was shown that over-aged learners, who would mostly be over-aged due to grade repetition, performed around 6 percentage points lower than correctly aged learners in the NSES tests, a difference that amounts to around one-third of a standard deviation across all learners. As pointed out in Chapter 3, it is important not to view the relationship, or draw policy conclusions, simplistically. Grade repetition does not necessarily cause

poorer performance. One repeats because one's performance was poor in the first place. If there is an effect of grade repetition that policymakers should worry about, it is that grade repetition appears to predict early dropping out as learners become discouraged at school. This is the key reason why grade repetition should be reduced, not through blunt solutions such as automatic grade progression, but through a combination of approaches. Improving the quality of learning and teaching in general means fewer learners fall below critical thresholds that result in repetition. As mentioned above, informed advice on assisting those who do fall behind is needed, as well as specific materials to facilitate the required activities. Very importantly, assessment systems need to apply standards within and between schools more rigorously so that one avoids repeating learners who ought not to repeat and so that the lottery effect is diminished. This is one reason why ANA is a necessary intervention.

The fact that grade repetition seems to be falling in South Africa (see Chapter 9) and in developing countries generally (UNESCO, 2005) raises a fascinating monitoring question. Are schooling systems not becoming more efficient, even if, as has been the case in South Africa, average scores in tests are not rising? And if this applies to systems, does it not apply to individual schools too? Just as it is important to ensure that accountability pressures linked to test scores do not result in more grade repetition (Bruns et al, 2011), efficiency gains reflected in less grade repetition should not be overlooked.

Management and governance of schools and the system

Much of the post-apartheid policy emphasis with respect to the way schools are run has been on a specifically South African version of the worldwide trend towards decentralisation. High-level policies, like the South African Schools Act of 1996, have emphasised the importance of the school as a level of decision-making, with strong accountability to the local community. District offices, on the other hand, have enjoyed little autonomy and are to a large degree controlled by the nine provincial authorities. The ideal of relatively autonomous but provincially funded schools as catalysts of educational change has in some respects been a successful pursuit. Parent participation in school governing bodies (SGB) is relatively high, especially if one considers the low levels of educational attainment of parents in the poorest communities. A 2009 survey of 500 nationally representative schools, focussing on school management, found that in around two-thirds of households someone had participated in the SGB elections, held every four years across the country and accompanied by considerable advocacy and training by the authorities. The establishment of an equitable and relatively transparent school funding system, an obvious prerequisite for effective school management, has proceeded relatively well

(Gustafsson and Patel, 2006). Yet critical problems have weakened school management. On the one hand, as admitted within the NPC's national plan, the selection, management and capacity building of school principals by the provincial authorities have often been weak or corrupt. Chapter 1 explained how the state and teacher unions are often complicit in encouraging or turning a blind eye to corruption. Clearly, no matter how well-designed the management and governance structures of the system, poorly selected or trained school principals will undermine the functionality of schools. On the other hand, interference by the provincial authorities in school management, often as a response to the weak capacity of many school principals, has made it difficult for better school principals to manage their schools well. The selection of teachers and the way public funds transferred to the school are spent are two critical areas where principals have complained of too much red tape and insufficient space to take decisions in the interests of better schooling. Finally, a virtual absence of reliable learner performance information below Grade 12 made it difficult for managers or parents on the SGB to drive performance improvements.

Chapter 4 referred to six dimensions against which to gauge management and governance improvements: clear educational goals; an orderly and supportive environment; appropriate management of education resources, especially books; instructional leadership, including the promotion of ethical and professional behaviour; and appropriate use of the official languages in the education process. To what extent do the recent policy shifts bode well for improvements against these dimensions?

One thing the current policy does not promote is fundamental change to the model of decentralisation described above (Department of Basic Education, 2011a). Whilst arguments could be made for such change, for instance in relation to the legal powers of districts, the approach taken currently follows the advice of, for instance, a recent OECD (2008) review of South Africa's schooling, which pointed to a need for structural stability after many years of adjustment and change. If there is any fundamental structural change affecting school management, it is the addition of ANA, a move which has the potential for stimulating educational improvements if, as discussed above, certain pitfalls are avoided. Specifically, educational goals set by school principals (or their managers) will be less avoidable if a reliable and standardised testing system is realised. Parent participation in school governance, a phenomenon generally associated with better functioning schools, as seen in Chapter 4, could become more specifically focussed on educational outcomes if reliable measures of school performance exist.

One of the ways policymakers in South Africa hope to bring about more orderly schools is through a stronger focus on the presence and use of basic management tools (Department of Basic Education, 2011a). It is acknowledged

that these tools have often been cumbersome in their design and that the consequences of not performing basic management tasks, such as maintaining attendance registers, have been too light. The NSES has proven to be an exceptional and valuable source on whether key management tools are used in schools and whether their use is associated with better learner performance. The finding in Chapter 3 that the utilisation of specific documents such as attendance registers, a school timetable, a register of educational resources owned by the school and proper records of schools-based assessments should be associated with better learning outcomes is important and supports the current policy emphasis. As Chapter 4 reminds us, the thread running through these tools is their importance for improving the use of time at a school. The effective management of time should feature prominently in the training of school principals.

The pursuit of more ethical and professional values amongst school managers and governors is being tackled on two levels. The very cultural nature of the challenge makes political leadership and alliances especially important. For this reason it is significant that leaders both in government and in the teacher unions have decided to collaborate on a joint teacher training programme. This collaborative focus on professional matters has largely been absent in South Africa, where historically government-union interactions have focussed almost exclusively on teacher remuneration issues. Similar developments in other countries have, it has been argued, contributed towards quality improvements in the schooling sector (Crouch, 2005).

At another level, 2011 saw negotiations between the employer and unions occurring to establish clearer performance contracts and incentives for school principals. (See for instance the Education management service (EMS) proposal at http://www.naptosa.org.za/ downloads/EMS_S_PA_Aug_ web.pdf.) Here it is important that lessons from recent attempts to introduce stronger performance incentives for teachers be considered carefully. Measuring effective school management is at least as difficult as measuring effective teaching. Above all, new accountability policies should not lead to manipulation of data, or the gaming of the system through perverse practices such as the pushing out of worse performing learners through grade repetition and hence the discouragement of learners. A large part of the challenge lies in aligning the design and controls of the measurement system with its intended impact on behaviour. As Taylor (2009) and Ravela (2005) have argued, in the contexts of South Africa and Uruguay respectively, maximising the controls and the stakes of a testing system is not necessarily the optimum approach. Less than maximum stakes and controls, apart from reducing costs, can encourage a more professional approach to teaching and school management. A testing system that is seen to create unnecessary stress and that treats schools

as factories is unlikely to lead to the desired changes. Rather, a testing system needs to be a tool used by professionally minded school and district managers.

Conclusion

This chapter has discussed the relationship between education research and policy in the South African context. Improving this relationship is an essential part of the larger education improvement project. Some of the challenge lies in changing attitudes. The notion of the researcher as member of a priesthood handing down recommendations to expectant policymakers is not a helpful one. Professionalism amongst researchers and policymakers implies a relationship of equals, and one of trust. Trust is built through regular contact as well as the production of policy-focussed and high-quality research on the part of the researchers. Trust leads to easier sharing of data and can facilitate better funding of and growth in the research sector, something we need if policy is to be based on a critical mass of research and not one or two supposedly heroic studies.

The chapter has also provided a snapshot of the South African education policy trajectory, in particular as it relates to the quality of learning in schools. Movement along this trajectory is fast and there are critical opportunities for researchers to make a contribution. It has been argued that certain initiatives seem well placed to tackle the educational ills analysed in the previous chapters. In particular, the Annual National Assessments programme provides a basis for much better incentives and decision-making and the recently developed workbooks and Curriculum and Policy Assessment Statements support better teaching and learning insofar as they provide specific guidance to teachers that was previously in short supply. But the risks should not be under-estimated. The design of ANA must match its intended purpose. Under-utilising or misusing ANA would be a terrible waste or perhaps disastrous. ANA and other sources of information should inform teacher development. If ANA is used as a basis for incentives and sanctions, the risks of dishonest reporting and the exclusion of weaker learners from schools should be addressed upfront.

A large part of the challenge of supporting schools lies in clarifying, on the basis of research of the kind found in this book, what best practices in the classroom and school management are. For this, more work with panel datasets such as the NSES and case studies of the kind found in Chapter 4 are needed. The current chapter has moreover argued that there are valuable lessons to be learnt from other developing countries that went through similar educational soul-searching some years ago. Several of those lessons have to do with better ways of measuring the impact of what we do when we try to improve schooling.

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