

Longitudinal Surveys of Australian Youth

Research Report 36

Influences on Achievement in Literacy and Numeracy

Sheldon Rothman
Julie McMillan

October 2003

This report forms part of the Longitudinal Surveys of Australian Youth:
a research program that is jointly managed by ACER and the
Commonwealth Department of Education, Science and Training (DEST).
The views expressed in this report are those of the authors and not necessarily of the
Department of Education, Science and Training.

Published 2003 by
The Australian Council for Educational Research Ltd
19 Prospect Hill Road, Camberwell, Victoria, 3124, Australia.

Copyright © 2003 Australian Council for Educational Research

ISSN 1440-3455

ISBN 0 86431 793 X

Contents

TABLES	iv
FIGURES	iv
APPENDIX TABLES	iv
APPENDIX FIGURES	iv
EXECUTIVE SUMMARY	v
1 INTRODUCTION.....	1
The Importance of Literacy and Numeracy	1
Policy Context.....	2
Differences in Literacy and Numeracy Achievement.....	3
The Present Study	10
2 RESEARCH DESIGN, DATA AND METHODOLOGY	12
Research Design.....	12
Data	12
Methodology	16
3 ANALYSIS.....	18
Literacy	18
Numeracy.....	24
Summary of Analyses	29
4 DISCUSSION.....	32
Implications for Policy and Further Research.....	34
REFERENCES.....	36
APPENDIX 1: VARIABLES USED IN THE ANALYSES	39
Student-level variables.....	39
School-level variables.....	40
APPENDIX 2: SUMMARY STATISTICS.....	41
APPENDIX 3: RAW SCORE TO SCALED SCORE CONVERSION TABLES.....	43
APPENDIX 4: DISTRIBUTION OF SES WITHIN SCHOOLS	44
Y95 Cohort.....	44
Y98 Cohort.....	44

Tables

Table 1	Null model and the influence of explanatory variables, Y95 reading comprehension	19
Table 2	Null model and the influence of explanatory variables, Y98 reading comprehension	20
Table 3	Null model and the influence of explanatory variables, Y95 mathematics	25
Table 4	Null model and the influence of explanatory variables, Y98 mathematics	26
Table 5	Significant variables in final models, all analyses.....	30

Figures

Figure 1	General theoretical model of factors influencing achievement in literacy and numeracy	13
Figure 2	Operational model of factors influencing achievement in literacy and numeracy.....	13

Appendix Tables

Table A 1	Weighted and unweighted counts, mean scores and standard errors for selected subgroups on reading comprehension and mathematics tests, LSAY 1995 (Y95) cohort	41
Table A 2	Weighted and unweighted counts, mean scores and standard errors for selected subgroups on reading comprehension and mathematics tests, LSAY 1998 (Y98) cohort	42
Table A 3	Raw score to scaled score conversion tables for reading comprehension and mathematics tests, LSAY 1995 (Y95) and LSAY 1998 (Y98) cohorts	43

Appendix Figures

Figure A 1	Distribution of school mean SES, showing 95% confidence intervals, Y95 cohort	44
Figure A 2	Distribution of school mean SES, showing 95% confidence intervals, Y98 cohort	44

EXECUTIVE SUMMARY

This report examines the influence of a range of factors on the literacy and numeracy achievement levels of Year 9 students in Australia. The data are from the Longitudinal Surveys of Australian Youth (LSAY), which studies the progress of cohorts of young Australians as they make the transition from school to work and further education and training, beginning in Year 9. Previous reports from LSAY have shown that strong skills in literacy and numeracy assist young people in making successful transitions from school. This report examines what factors influence levels of achievement in literacy and numeracy in Year 9, by examining data on students and schools.

Three sets of questions form the basis of this report:

- What factors contribute to differences in literacy and numeracy achievement among Year 9 students in Australian schools? Are these factors the same as factors that have been found to contribute to literacy and numeracy achievement in other studies, from Australia and overseas?
- How much of the variation in student achievement in literacy and numeracy can be attributed to differences between students and how much can be attributed to differences between schools?
- How much of the overall variation in student achievement in literacy and numeracy can be explained at both the student and school levels?

The data used in this report were obtained from students in the first wave of LSAY, when Year 9 students took a reading comprehension test and a mathematics test, and completed a questionnaire that provided other student background information. The data were analysed using hierarchical linear modelling to account for the sample design of LSAY. Modelling procedures followed a theoretical construct, incorporating variables believed to be important influences on achievement in literacy and numeracy. In addition, variables were selected to ensure consistency between cohorts and between literacy and numeracy. Included in the analyses were variables relating to students (gender, Indigenous background, language background, home location), their parents (education level, occupation, birthplace), attitudes toward school, aspirations and self-concept.

Influences on Literacy and Numeracy

Approximately one-sixth of the variation in achievement scores on both the reading comprehension tests and the mathematics tests could be attributed to differences between schools. This finding is similar to findings for Australian students who participated in TIMSS and PISA, two recent international studies of student achievement. A little more than one-half of this between-schools variance could be explained by differences in the student composition—school socioeconomic status (SES) and the proportion of students from language backgrounds other than English in the school—and the school climate.

At the student level, there were similarities and differences between literacy and numeracy findings across the cohorts. Similarities include influences of SES, students' aspirations and students' attitudes, although there were some differences in the strength of each influence. Gender was shown to influence both literacy and numeracy achievement levels, but in opposite directions: Males scored higher than females in mathematics, and females scored higher than males in reading comprehension. For Indigenous students, achievement scores were significantly lower on the reading comprehension tests and significantly lower on the mathematics tests. Students with plans to attend university scored significantly higher on both the reading comprehension tests and the mathematics tests.

A number of variables were shown to influence achievement in literacy but not in numeracy. Students had lower reading comprehension scores if they were born in a non-English-speaking country or their mothers were born in a non-English-speaking country. Students whose fathers had completed some form of post-secondary education scored higher in reading comprehension. Finally, among the Year 9 class of 1998, students whose mothers had completed secondary education scored higher on the tests of reading comprehension. The statistically significant influences on literacy and numeracy achievement represented a little more than 10 per cent of the student-level variation.

Implications

Previous LSAY reports have identified the importance of achievement in literacy and numeracy. Lower achievement has been associated with lower engagement with school, lower participation in Year 12, lower tertiary entrance scores and less successful transitions from school. The identification of influences on literacy and numeracy achievement levels among Year 9 students can assist schools and education systems to develop appropriate responses to reduce the incidence of low achievement in literacy and numeracy.

The magnitude of the differences in achievement test scores for Indigenous students indicates that much work is still required to increase literacy and numeracy achievement among Indigenous Australians. Literacy and numeracy programs, such as the Commonwealth Government's National Indigenous English Literacy and Numeracy Strategy, are required to increase achievement in these areas, not only in the early years but through the middle years as well.

Gender is a factor that influences both literacy achievement and numeracy achievement, with females scoring higher on tests of reading comprehension and males scoring higher on tests of mathematics. While early school programs focus on the needs of boys in literacy and girls in numeracy, the middle-school years also require the exploration and implementation of gender-relevant programs designed to ensure all students achieve appropriate levels in reading comprehension and mathematics.

This report has shown a strong link between SES and student achievement in both literacy and numeracy, consistent with other research in LSAY and other studies. The link was found to influence differences in achievement levels between students and differences in achievement levels between schools. It is suggested that further research be conducted to examine the nature of this link, to investigate how SES influences individual student achievement and how a school's average SES influences achievement.

Influences on Achievement in Literacy and Numeracy

1 INTRODUCTION

Literacy and numeracy have been central to the Australian school curriculum since permanent European settlement. Within two years of the establishment of the penal colony at Sydney Cove, schools were operating to provide basic reading, writing and arithmetic skills to children of convicts and soldiers. These schools were fee-paying, with some variation in the fee based on the curriculum, although those unable to pay were not required to do so. Children learning to read were charged four pence per week; those learning writing or arithmetic were charged six pence. Even as other subjects were added to the curriculum, reading, writing and arithmetic—the so-called 3 Rs—remained the basis for primary schooling throughout the nineteenth and twentieth centuries (Burnswoods & Fletcher, 1980; Marsh 1984; Turney, 1975).

Secondary (post-primary) schooling developed through the nineteenth and twentieth centuries, and with it came the further development of subjects other than the 3 Rs. ‘Young gentlemen’ were taught ‘to read, speak, and write the English tongue with accuracy and propriety, Book keeping, Geometry, Trigonometry, and Mensuration, practically applied in Navigation, Surveying, Gauging, &c’, and received a general education in geography, history and astronomy. Young women learned needlework, morals, manners and ‘virtuous precepts’, as well as reading, writing and arithmetic (Turney, 1975, pp. 24-25).

Today, there is still much focus on the literacy and numeracy skills of students in Australian schools. In New South Wales, for example, it is recommended that students in primary schools spend 90 minutes per day on literacy activities (NSW Department of School Education, 1997). At the secondary level, all States require students to take a course in English to receive a Year 12 certificate, and to study Mathematics through Year 10. In 1999, Australian 15-year-olds reported that they studied an average of five periods of Mathematics per week (Lokan, et al., 2001). States and Territories conduct annual programs to monitor their students’ progress in literacy and numeracy, with students in Years 3, 5 and 7 being tested.

Regardless of State requirements or curriculum history, the acquisition of adequate literacy and numeracy skills is a vital educational outcome for young people. Such skills have consequences for further study, labour market experiences and, more generally, social wellbeing. Consequently, a central policy goal for the Australian government has been to maximise the proportion of young people achieving acceptable levels of literacy and numeracy, and to ensure that all groups in society are able to achieve literacy and numeracy benchmarks appropriate to their age. The characteristics, attitudes and aspirations of students and their families, as well as the student intake characteristics, policies and resources of schools, are potentially important influences on literacy and numeracy development. An understanding of what factors influence achievement in literacy and numeracy, and the relative effects of student- and school-level factors, can inform education policies.

The Importance of Literacy and Numeracy

Achievement in literacy and numeracy has been shown to be a key determinant of educational outcomes. For example, students who achieve high levels of literacy and numeracy during the compulsory years of schooling are more likely than lower-achieving students to stay on to complete Year 12 and enter higher education (Marks, et al., 2000), and to obtain higher tertiary entrance scores (Marks, et al., 2001).

Achievement in literacy and numeracy has also been linked to a range of labour market outcomes. Making a successful transition from school to full-time employment, the type of occupation obtained, and earnings are positively related to literacy and numeracy. Conversely, persons with lower literacy and numeracy levels are more likely to be outside the labour force or unemployed, and to experience longer periods of unemployment. Furthermore, recent studies, both in Australia and internationally, have demonstrated that the relationship between literacy and numeracy achievement and each of these labour market outcomes remains significant after controlling for the individual's educational attainment (Green & Riddell, 2001; Lamb & McKenzie, 2001; Lee & Miller, 2000; McMillan & Marks, 2003; OECD & Statistics Canada, 2000; Tyler, et al., 2000). The demands in the workplace for, and rewards associated with, increasing levels of literacy and numeracy are likely to continue due to factors such as globalisation, technological change, and changes in employment and work organisation (OECD & Statistics Canada, 2000).

On a broader level, literacy and numeracy are essential ingredients for effective communication and participation in adult life. They have been linked to social outcomes such as community participation, engagement in lifelong learning, and health (OECD & Statistics Canada, 2000; Roberts & Fawcett, 1998).

The central role of literacy and numeracy are also reasons these and other educational outcomes are monitored regularly by countries and groups of countries. American students' academic achievement is monitored periodically through the National Assessment of Educational Progress (NAEP), which comprises tests in reading, mathematics and science administered to samples of nine, thirteen and seventeen year-olds in each state. Student progress in writing, history, geography and other fields is less frequently monitored. Two major international studies of student achievement are currently in progress, with more than 30 countries participating in the Trends in International Mathematics and Science Study (TIMSS) in 1995, 1999 and 2003, and 32 countries in the Programme for International Student Assessment (PISA) in 2000, 2003 and 2006. TIMSS concentrates on achievement in mathematics and science, while PISA focuses on three types of 'literacy'—reading, mathematics and science.¹

Policy Context

Recognising the importance of literacy and numeracy achievement for a wide range of educational, labour market and social outcomes, all Australian education Ministers agreed to a National Literacy and Numeracy Plan in 1997. Included in this plan are the following elements:

- assessment of all students by their teachers as early as possible in the first years of schooling;
- early intervention strategies for those students identified as having difficulty;
- the development of agreed benchmarks for years 3, 5, 7 and 9, against which all children's achievement in these years can be measured;
- the measurement of students' progress against these benchmarks using rigorous state-based assessment procedures;

¹ Future references to the Trends in International Mathematics and Science Study (TIMSS) will include the year of the study, using the Northern Hemisphere year (1995, 1999, 2003). TIMSS 1995 was originally referred to as the Third International Mathematics and Science Study, and TIMSS 1999 as the Third International Maths and Science Study–Repeat (or TIMSS-R). Six countries in the Southern Hemisphere, including Australia, test between October and December of the previous year. All references to the Programme for International Student Assessment (PISA), which had its first cycle of testing in 2000, will also include the year. Participating countries in the Southern Hemisphere test their students early in the same calendar year as countries in the Northern Hemisphere.

- progress towards national reporting on student achievement against the benchmarks; and
- professional development for teachers (MCEETYA, 1999, p.11).

Australia is not alone in such initiatives. For example, in the United States, the *No Child Left Behind Act of 2001* requires States to

...implement statewide accountability systems covering all public schools and students. These systems must be based on challenging State standards in reading and mathematics, annual testing for all students in grades 3-8, and annual statewide progress objectives ensuring that all groups of students reach proficiency within 12 years. Assessment results and State progress objectives must be broken out by poverty, race, ethnicity, disability, and limited English proficiency to ensure that no group is left behind. (US Department of Education, n.d., Increased Accountability, para. 1)

Regardless of the major technological changes that are affecting communications and other aspects of social interactions, literacy and numeracy are still fundamental to governments' education policies.

Differences in Literacy and Numeracy Achievement

Given the importance of students' achievement in literacy and numeracy for a wide range of education, employment and social outcomes, it is important to understand what background factors influence achievement so that appropriate policy responses can be developed. It is not just overall levels of literacy and numeracy, but the distribution of these skills within the population as well, which is of importance. Analyses of Australian and international survey data suggest that literacy and numeracy skills are not evenly distributed among population subgroups. This section provides an overview of past research on differences by gender, socioeconomic background, ethnicity, Indigenous status, geographic location and schools in both literacy and numeracy. Research examining the influence of attitudes and aspirations is also reviewed.

Gender

Literacy. Gender is associated with differences in literacy achievement, with females achieving slightly higher levels of literacy than males across a range of studies conducted in a range of countries. For example, the Early Childhood Longitudinal Study (ECLS-K) showed that some small gender differences are evident in the United States even before children enter school (Coley, 2002). In later years of school, the same gender differences have been reported across all racial and ethnic groups on the NAEP tests in reading and writing (Coley, 2001). PISA 2000, which measured reading literacy among 15-year-olds in 32 countries, found that girls outperformed boys on all aspects of reading in all of the participating countries (Lokan, et al., 2001). Similarly, women outperformed men in prose literacy in eight of the eleven countries that participated in the International Adult Literacy Survey (OECD & HRDC, 1997).

In Australia, there were no measurable gender differences in the percentage of Year 3 students achieving the national reading benchmark in 1999 and 2000, but gender differences among Year 5 students were evident (MCEETYA, n.d.). In a range of other Australian studies, gender differences in literacy have been consistently documented among primary school students (Bourke, et al., 1981; Keeves & Bourke, 1976; Masters & Forster, 1997), junior secondary school students (Bourke, et al., 1981; Keeves & Bourke, 1976; Lokan, et al., 2001; Marks & Ainley, 1997; Rothman, 2002) and adults (ABS, 1997b).

In 2000, the gender gap in reading literacy among 15-year-olds in Australia was similar to the OECD average (Lokan, et al., 2001, p. 34). There are indications, however, that the gender gap in reading comprehension among junior secondary school students in Australia increased

between 1975 and 1995 (Marks & Ainley, 1997) and again in 1998 (Rothman, 2002). Further research is required to assess whether this gap has continued to widen in recent years, and to determine if the gap is widening because of a decrease in boys' literacy achievement or an increase in girls' literacy achievement.

Numeracy. Past research has yielded less consistent results regarding gender differences in numeracy among children, but suggests that the relationship between gender and numeracy may strengthen with age. Among kindergarten children, small conflicting gender differences in numeracy have been documented. In an American study (ECLS-K), girls were less likely than boys to be proficient in addition, subtraction, multiplication and division, but more likely than boys to be proficient in recognising numbers and shapes (Coley, 2002).

Very few gender differences are evident in the middle years of primary school. The Australian Studies of School Performance assessed the numeracy of 10-year-olds in 1975 and 1980, finding small gender differences favouring girls (Bourke, et al., 1981; Keeves & Bourke, 1976). In contrast, there was no measurable difference between the percentage of males and females achieving the numeracy benchmarks for Years 3 and 5 in Australia in 2000 (MCEETYA, n.d.). Similarly, TIMSS 1995 did not find gender differences in mathematics among nine-year-olds in Australia, or in most of the other participating countries. In those countries where a significant gender gap was evident, boys had higher average levels of mathematics achievement (Lokan, et al., 1997; Mullis, et al., 1997). NAEP tests in the United States also show some gender differences among nine-year-olds, but not among older students (Coley, 2001).

Studies focusing on the junior secondary school years have also noted very few gender differences in numeracy achievement. Australian data collected in 1975, 1980, 1989, 1995 and 1998 suggest that males have marginally higher levels of numeracy than females, and that the magnitude of the gender gap has not changed throughout this period (Bourke, et al., 1981; Keeves & Bourke, 1976; Marks & Ainley, 1997; Rothman, 2002). In contrast, the results of three cross-national studies (TIMSS 1995, TIMSS 1999 and PISA 2000) suggest that in junior secondary school there are no significant gender differences in numeracy in Australia (Lokan, et al., 1996; Lokan, et al., 2001; Mullis, et al., 2000b; Zammit, et al., 2002). Gender differences were also negligible in the majority of other participating countries in TIMSS 1995 and TIMSS 1999 (Lokan, et al., 1996; Mullis, et al., 2000b; NCES, 2001), and in half of the participating countries in PISA 2000 (Lokan, et al., 2001). In the countries where a significant gender gap was found, the difference always favoured boys.

In older age groups, gender differences in numeracy are more evident. Males displayed significantly higher levels of mathematics literacy than females in the TIMSS 1995 sample of students in the final year of secondary school in Australia (Lokan & Greenwood, 2001), and this result was echoed in nearly all of the other countries participating in that study (Mullis, et al., 1998).² Similarly, in the International Adult Literacy Survey, males displayed higher quantitative literacy than females across all ages in Australia (ABS, 1997b), and in all other participating countries (OECD & HRDC, 1997).

Socioeconomic background

Socioeconomic background, or socioeconomic status, is a broad concept that comprises three main dimensions: occupation, education and wealth/income (Ainley, et al., 1995). These dimensions may influence the acquisition of literacy and numeracy skills in different ways. For example, parental occupational status and education may be related to different attitudes

² Among those enrolled in advanced mathematics, males outperformed females in the advanced mathematics test in some countries, but not in Australia (Lokan & Greenwood, 2001; Mullis, et al., 1998).

and expectations about education from early childhood onward. Different levels of family income and wealth, on the other hand, may be more closely related to the ability to purchase educational resources and access particular schools. Studies of literacy and numeracy achievement have most commonly used measures relating to parental occupation (either occupational group or occupational status) and parental education. The influence of family wealth is less commonly analysed due to difficulties associated with the collection of income and wealth measures. Nevertheless, past research suggests that each of these dimensions of socioeconomic background has a positive association with achievement in literacy and numeracy.

Literacy. Socioeconomic background has been associated with literacy skills across all age groups. Even before reaching compulsory school age, significant socioeconomic differences in literacy skills are evident among children in North America (Coley, 2002; OECD & HRCD, 1977, p. 62). Similarly, in Years 3 and 5 in Australia, parental occupation has been associated with various aspects of literacy. Children of parents with upper professional and managerial occupations have significantly higher average achievement levels than the children of parents in clerical and skilled manual occupations, who in turn have higher average levels of literacy achievement than the children of parents from unskilled manual occupations (Masters & Forster, 1997). In adulthood, the relationship between parental socioeconomic characteristics and literacy remains. For example, the International Adult Literacy Survey found a significant positive association between parental education and prose literacy in 11 of the 13 countries surveyed, including Australia (OECD & HRDC, 1997).

In junior secondary school, the focus of this report, a number of studies have noted a relationship between literacy and socioeconomic background. In the PISA 2000 study, higher levels of parental occupation, parental education, family wealth and school socioeconomic status were associated with better student performance in reading literacy, although the strength of the association between socioeconomic background and student performance varied from country to country (Lokan, et al., 2001; OECD, 2001). Data collected in 1975, 1989, 1995 and 1998 suggest that the influence of a student's socioeconomic background on achievement in reading comprehension may be declining in Australia, at the same time that the influence of the school's socioeconomic level is increasing (Marks & Ainley, 1997; Rothman, 2002). On an international basis, the socioeconomic gradient in reading performance in Australia was significantly steeper than the OECD average in 2000, indicating a higher level of socioeconomic inequality in literacy achievement in Australia than in other countries (OECD, 2001, pp. 191, 213).

Numeracy. Socioeconomic background is also associated with numeracy. Studies have employed a range of indicators of socioeconomic background, including parental occupation, parental education, wealth and possessions in the home, and composite socioeconomic indices. Irrespective of the dimension of socioeconomic background examined, persons from lower socioeconomic backgrounds display lower average levels of numeracy achievement in kindergarten (Coley, 2002), in primary school (Lokan, et al., 1997), in junior secondary school (Beaton, et al., 1996; Lokan, et al., 1996; Lokan, et al., 2001; Marks & Ainley, 1997; Mullis, et al., 2000b; Rothman, 2002; Zammit, et al., 2002), in the final year of secondary school (Lokan & Greenwood, 2001), and in adulthood (OECD & Statistics Canada, 2000).

The strength of the relationship between socioeconomic background and numeracy is not fixed. For example, while family background has a positive association with numeracy across a range of countries during junior secondary schooling, it is more strongly associated with numeracy in some countries than others (Lokan, et al., 2001). Among Australian secondary school students in TIMSS, socioeconomic status is one of the strongest sociodemographic predictors of numeracy achievement (Lokan & Greenwood, 2001). Data collected in 1975, 1989 and 1995 suggest that the influence of parental occupation on the numeracy achievement of junior secondary school students has declined in recent decades in Australia

(Marks & Ainley, 1997), although in 1998 this trend has reversed (Rothman, 2002). Australian data from the PISA 2000 study also suggest that the relationship between socioeconomic background and mathematics is weaker than the relationship between socioeconomic background and reading literacy (Lokan, et al., 2001).

Ethnicity

Just as there are a number of ways of conceptualising and measuring socioeconomic status, various indicators of ethnicity are available. For example, the Australian Bureau of Statistics (1999) *Standards for Statistics on Cultural and Language Diversity* include four core indicators (country of birth of person, main language other than English spoken at home, proficiency in spoken English, Indigenous status) and eight non-core indicators (ancestry, country of birth of father, country of birth of mother, first language spoken, languages spoken at home, main language spoken at home, religious affiliation, year of arrival in Australia). These indicators represent various aspects of cultural or language diversity, some of which may be more salient than others for describing and understanding differences in literacy and numeracy achievement. Empirical studies of literacy and numeracy achievement have typically employed a range of measures relating to country of birth, language background and/or Indigenous status. Results relating to country of birth and language background are described below, and results pertaining to Indigenous status are presented in the following section.

Literacy. A recent report on the PISA 2000 study examined the relationship between students' or parents' country of birth and literacy achievement. Students were categorised into three groups: 'non-native' students (those not born in the test country and whose parents were also born in another country); 'first generation' students (those born in the country of the test, but whose parents were born elsewhere); and 'native' students (those who were born in the country of the test, and who had at least one parent also born in that country).³ The results suggest that in most countries 'non-native' students have the lowest average level of reading literacy, and that 'native' students have the highest average level of literacy. However, this was not the case in Australia, where neither the student's nor the parents' migrant status was related to reading performance (OECD, 2001).

A range of studies shows that differences are apparent in Australia, however, when language background rather than migrant status is examined. Persons from language backgrounds other than English have lower levels of literacy, on average, than persons from English-speaking backgrounds. For example, in the mid-1970s, 10-year-olds whose home language was English (or a Northern European language) had higher levels of reading comprehension than other language groups (Keeves & Bourke, 1976). More recently, a relationship between language spoken in the home and literacy levels has been noted among students in Years 3 and 5 (Masters & Forster, 1997), among junior secondary school students (Lokan et al., 2001; Marks & Ainley, 1997; Rothman, 2002), and among adults (ABS, 1997b). A similar association has been noted in a range of other countries. For example, in all countries participating in PISA 2000, 15-year-olds whose home language was the language of the test country displayed higher levels of literacy (OECD, 2001).

Using multivariate techniques, Marks and Ainley (1997) found that the relationship between home language and reading comprehension among junior secondary students in Australia was partly attributable to socioeconomic differences between the English-speaking and non-English-speaking groups. They also argued that the gap in reading comprehension between

³ The use of the term 'native' to describe students who were born in the country and had at least one parent born in the country should not be confused with the term 'Indigenous', which is used to describe populations who were present in a country before colonisation, even though Indigenous persons are, by this definition, 'native' persons.

students with English and other home languages narrowed between the mid-1970s and the mid-1990s due to the changing socioeconomic profile of the two groups.

Numeracy. Results pertaining to the relationship between language background and numeracy are less consistent, but taken together suggest that persons whose home language is mainly English may also have slightly higher average numeracy scores than other persons. For example, some Australian studies have found that a non-English-speaking background is associated with lower levels of numeracy among junior secondary school students (Keeves & Bourke, 1997; Marks & Ainley, 1997; Rothman, 2002). In contrast, PISA 2000 data suggest that differences between language background and the mathematics achievement of 15-year-old students are not significant in Australia⁴, nor in most of the other countries participating in that study (Lokan, et al., 2001). TIMSS 1995 and TIMSS 1999 data suggest that students whose main home language is the test language have higher mathematical literacy than other students in middle primary and junior secondary school in most countries, but not in Australia (Mullis, et al., 1997; Mullis, et al., 2000b). The TIMSS data do, however, show language background differences in numeracy in the senior secondary years in Australia, with students from English-speaking backgrounds displaying higher average levels of mathematics literacy in Year 12⁵ (Lokan & Greenwood, 2001). Similarly, there are language background differences in quantitative literacy among adults in Australia (ABS, 1997b).

Marks and Ainley (1997) used multivariate techniques to examine the relationship between language background and numeracy among junior secondary school students in Australia in 1975, 1980 and 1995. They found that those from English-speaking backgrounds have higher average levels of numeracy, but the association between language background and numeracy was weaker than the association between language background and reading comprehension. Furthermore, the strength of this association declined marginally between 1975 and 1995. In 1975, the language background differences were largely due to the socioeconomic characteristics of the English-speaking and non-English-speaking groups. In 1995, about half of the difference in numeracy achievement between the two groups could be attributed to their socioeconomic characteristics.

Indigenous Australians

Literacy. Throughout the life course, the average literacy level of Indigenous Australians is substantially lower than that of other Australians. For example, in the National School English Literacy Survey, Year 3 and Year 5 Indigenous students had lower literacy levels than students in the main sample.⁶ These differences were substantial: Indigenous students were an average of three to four year levels below students in the main sample (Masters & Forster, 1997). More recently, the national benchmark results for reading in Years 3 and 5 in 1999 and 2000 revealed a gap between the performance of Indigenous students and all students (MCEETYA, n.d.). Lower average literacy levels of Indigenous Australians have also been documented in junior secondary school (Lokan, et al., 2001; Marks & Ainley, 1997) and adulthood (ABS, 1997b).

⁴ There was also no significant relationship between migrant status and mathematics literacy in the PISA data relating to Australia (OECD, 2001).

⁵ In terms of advanced mathematics, this relationship is reversed in the Australian TIMSS data. Students from English-speaking backgrounds are less likely to undertake advanced mathematics and physics in the final year of secondary school, and of those who do enrol in advanced mathematics, students from English-speaking backgrounds display lower levels of performance in advanced mathematics tests (Lokan & Greenwood, 2001).

⁶ The Special Indigenous Sample is not representative of all Indigenous students. It was drawn by randomly sampling all Australian schools with five or more Indigenous students in classes in Years 3 and 5. At the time the sample was drawn, approximately 60 per cent of Indigenous students attended such schools (Masters & Forster, 1997).

Marks and Ainley (1997) conducted multivariate analyses of data on students in junior secondary school in 1975 and 1995. In their 1975 sample, over half of the gap in reading comprehension between the Indigenous and non-Indigenous students could be explained by socioeconomic, language and school differences between the two groups. The *net* gap in reading comprehension between Indigenous and non-Indigenous junior secondary school students in the 1975 and 1995 samples was similar.

Numeracy. Past research has been consistent in showing that Indigenous Australians have lower levels of numeracy than non-Indigenous Australians. These differences are evident in primary school (Lokan, et al., 1997; MCEETYA, n.d.), junior secondary school (Lokan, et al., 1996; Lokan, et al., 2001; Marks & Ainley, 1997) and adulthood (ABS, 1997b). There is some evidence that between 1975 and 1995 the gap in numeracy achievement reduced among junior secondary school students (Marks & Ainley, 1997).

*Geographic location*⁷

Literacy. Small or negligible differences in average literacy achievement have been found among students attending school in different geographic locations in Australia. For example, in primary school, metropolitan 10-year-old students in the Australian Studies of Student Performance (ASSP) displayed marginally higher levels of reading comprehension than non-metropolitan students in 1975 (Keeves & Bourke, 1976), but not in 1980 (Bourke, et al., 1981). More recently, Masters and Forster (1997) found that students in Years 3 and 5 in major urban areas had higher levels of literacy achievement than students in small rural centres, but the differences were not large.

In junior secondary school similar results are evident. Fourteen-year-old metropolitan students in the ASSP study performed slightly better than their non-metropolitan counterparts on reading comprehension tests in 1975 (Keeves & Bourke, 1976), but not in 1980 (Bourke, et al., 1981). In PISA 2000, few differences were found among 15-year-olds attending schools in major cities, other urban areas and provincial cities. These students did, however, have higher reading literacy than students attending schools in outer regional and remote areas (Lokan, et al., 2001).

Multivariate analysis of data on Year 9 students participating in the Longitudinal Surveys of Australian Youth (LSAY) showed that students from remote areas had lower average test scores than other students in both 1995 and 1998, but these differences were not substantial. Furthermore, after taking into account the sociodemographic characteristics of students in different geographical categories, regional differences in reading comprehension were 'barely significant', and there were inconsistencies in the results pertaining to students who were in Year 9 in 1995 compared with those who were in Year 9 in 1998 (Jones, 2002, pp. 13-14).

Numeracy. Similar to the findings for literacy, there are only small or negligible differences in the average numeracy achievement levels of students attending primary and secondary schools in different regions in Australia. In the ASSP studies, very small differences favouring metropolitan students were found among 10-year-olds in 1975 and among 14-year-olds in both 1975 and 1980, but no differences were evident in the 1980 sample of 10-year-olds (Keeves & Bourke, 1976; Bourke, et al., 1981). More recently, only slightly lower numeracy levels were found among remote Year 9 students participating in LSAY in 1995

⁷ In LSAY, the student's home postcode is assigned a score derived from the Accessibility/Remoteness Index of Australia, or ARIA; these scores are then assigned a geographic classification as recommended by Jones (2002). This classification schema considers access to and remoteness from major population centres and their facilities. The term does not imply any reference to State or Territory. Earlier LSAY work uses a two-level classification schema, Metropolitan/Non-metropolitan; however, this has been refined with the introduction of ARIA.

and 1998 (Jones, 2002). Similarly, Australian data from PISA 2000 show that there are few differences in the mathematical literacy of 15-year-olds attending schools in different areas. In PISA 2000, two methods were used to classify Australian students into geographical groupings. Under one classification, students in major cities and larger provincial centres outperformed students in smaller provincial centres, but under another classification metropolitan students did not appear to be advantaged in relation to mathematical literacy. Under both classifications, students attending schools in major cities, other urban districts and provincial cities did not differ in their average levels of achievement (Lokan, et al., 2001).

Attitudes and aspirations

Students' attitudes and aspirations are also associated with achievement, although the nature of causal links is not straightforward. Attitudes, aspirations and achievement develop throughout young people's schooling. Attitudes and aspirations at one point in time may influence achievement at a later time point. Similarly, early achievements may shape later attitudes and aspirations. As each of the studies reviewed here are cross-sectional, they are unable to assess the direction of causality. They do, however, provide some indication of the range of attitudes and aspirations that are related to achievement in literacy and numeracy.

Literacy. A number of aspects of students' attitudes and aspirations have been linked to literacy levels. For example, enjoyment of reading has been associated with the literacy levels of students in primary school (Masters & Forster, 1997) and junior secondary school (Lokan, et al., 2001). Similarly, higher levels of determination to do well, confidence and self-efficacy have been associated with higher average levels of reading literacy among 15-year-olds in Australia (Lokan, et al., 2001). Homework is one manifestation of a positive attitude toward school, and has been related to higher literacy levels, as well as higher numeracy levels. The frequency and amount of homework done by students is one aspect of this relationship. Students who regularly do their homework score higher on tests of reading literacy in PISA 2000 and NAEP, although this finding may be confounded by other factors, including the type of homework assigned, student ability and family background (OECD, 2000; NCES, 2001).

Numeracy. Students' attitudes and aspirations are also related to the numeracy levels of school students in a range of countries, including Australia. Higher self-efficacy has been associated with higher levels of numeracy in primary school (Lokan, et al., 1997), junior secondary school (Lokan, et al., 1996; Lokan, et al., 2001; Mullis, et al., 2000b), and the final year of schooling (Lokan & Greenwood, 2001; Mullis, et al., 1998). Aspirations for further education, especially university study, have been associated with higher levels of numeracy in both junior secondary school (Mullis, et al., 2000b) and senior secondary school (Lokan & Greenwood, 2001; Mullis, et al., 1998). Similarly, preference for a job involving mathematics has a moderate positive correlation with mathematics literacy among junior secondary school students (Lokan & Greenwood, 2001). PISA 2000 and NAEP reported a positive relationship in a number of countries, including Australia and the United States, between mathematics achievement levels and the amount of mathematics homework (OECD, 2001; NCES, 2000). The relationship, however, is not linear: In the American state of Massachusetts, Year 10 students who reported doing more than five hours of homework per week performed as well on state mathematics tests as those who reported doing between three and five hours per week. This finding is consistent across the racial and ethnic groups included in the study (Massachusetts Department of Education, 2001).

Schools

Schools influence their students' academic achievements, but to what extent they do so is open to debate. Research in the 1960s and 1970s concentrated heavily on the socioeconomic composition of the school, especially in English-speaking multicultural societies such as

Australia, Great Britain and the United States (Coleman, et al., 1966; Jencks, et al., 1972; Interim Committee, 1973; Commission of Inquiry, 1976). The authors of these reports concentrated on school characteristics, but assigned their effects to students. As newer techniques of statistical analysis became available, researchers began to disentangle the role of schools and their place in student achievement. By the 1980s, ‘school effectiveness’ studies were examining student effects and school effectiveness, developing a new literature and a new language (e.g., Rutter, et al., 1979; Raudenbush, 1984; Goldstein, 1987). The statistical techniques most often used to examine school-level and student-level effects are ‘hierarchical linear modelling’ (Bryk & Raudenbush, 1992) and ‘multilevel modelling’ (Goldstein, 1987).⁸

Literacy. Hierarchical linear modelling has been used to assess the proportion of variation in literacy that is associated with differences between schools. Results from PISA 2000 suggest that differences in performance between schools account for much of the variation in students’ literacy in some countries, but not in others. A relatively small proportion of the variance in 15-year-olds’ reading literacy was attributed to between-school differences in Australia (17%). This is substantially below the OECD average (36%), and suggests that in Australia, differences within schools tend to be greater than differences between schools (Lokan, et al., 2001).

Factors contributing to between-school variance in reading literacy have also been identified in the PISA 2000 data. The socioeconomic composition of the school explained nearly 14 per cent of the between-school variance in reading literacy of 15-year-olds in Australia. Other significant school-level factors included student perceptions of class disciplinary climate, teacher morale and school size (Lokan, et al., 2001).

Numeracy. Hierarchical linear analyses of the PISA 2000 data were conducted in relation to mathematical literacy as well. The proportion of variation in mathematics that was associated with differences between schools was 18 per cent in Australia. As for the case of reading literacy, this was substantially below the OECD average of 34 per cent (G.N. Marks, personal communication, 31 October 2002). In Australia, factors such as mean school socioeconomic status, disciplinary climate, teacher support and teacher morale accounted for nearly 89 per cent of the between-school variance in mathematics (Lokan, et al., 2001).

The Present Study

The literature reviewed here does not close the debates on how various factors contribute to the development of literacy and numeracy. This brief summary does, however, highlight specific areas in which to continue examining their development, and how the various factors, at the student level, the school level and beyond, operate together. This report examines the influence of a range of student- and school-level factors on the literacy and numeracy achievement levels of Year 9 students in Australia. The data are from the Longitudinal Surveys of Australian Youth (LSAY), which studies the progress of cohorts of young Australians as they make the transition from school to work and further education and training, beginning in Year 9. Rothman (2002) used these data to examine changes in the literacy and numeracy achievement of 14-year-olds in Australian schools between 1975 and 1998, but was limited to using only the variables that were measured in a comparable manner across five separate cohorts. By restricting attention to the 1995 and 1998 LSAY cohorts—referred to as Y95 and Y98, respectively—the present study allows use of a wider range of variables.

⁸ Within this report, the term ‘hierarchical linear modelling’ will be used, consistent with the computer software HLM 5 (Raudenbush, et al., 2001) used for the analyses.

For the present study, the following questions are of greatest interest:

- What factors contribute to differences in literacy and numeracy achievement among Year 9 students in Australian schools? Are these factors the same as factors that have been found to contribute to literacy and numeracy achievement in other studies, from Australia and overseas?
- How much of the variation in student achievement in literacy and numeracy can be attributed to differences between students and how much can be attributed to differences between schools?
- How much of the overall variation in student achievement in literacy and numeracy can be explained at both the student and school levels?

These questions are addressed in the following chapters. Chapter 2 describes the research design, data and methodology used in this report. Chapter 3 presents an examination of the influence of selected characteristics of students and schools on the literacy and numeracy achievements of Year 9 students in 1995 and 1998. Results pertaining to reading comprehension are presented first, followed by results pertaining to mathematics test scores. The chapter ends with a summary and comparison of the results for these two aspects of literacy and numeracy. Implications of the research findings are discussed in Chapter 4.

2 RESEARCH DESIGN, DATA AND METHODOLOGY

Research Design

Literacy encompasses many aspects, including the recognition of words and other visual stimuli, the extraction of meaning from these stimuli, the production of meaning, and the appreciation of products. While there may be continuing discussion to define 'literacy', one aspect remains constant within the language of the school. Reading comprehension is fundamental to the curriculum; we expect students to understand—to comprehend—what they read. Reading comprehension is the basis for testing programs, especially for senior secondary school certificates, regardless of the subject or course studied. As such, reading comprehension is an appropriate aspect of literacy on which to concentrate.

Numeracy in the secondary years of school tends toward specialisation and application. The 'basic' aspects of mathematics—addition, subtraction, multiplication and division—are extended into algebra, geometry, trigonometry and calculus. Senior secondary students may not necessarily study mathematics, but they do use mathematics in economics, chemistry, physics and other school studies. A test of mathematics is appropriate to represent a student's achievement in numeracy, because it looks at how well students can apply mathematical concepts in solving problems outside the mathematics classroom.

As part of the LSAY program, students in Year 9, when they enter the study, are administered tests of reading comprehension and mathematics. The tests were developed by the Australian Council for Educational Research (ACER) and incorporate items which have been used and validated in previous studies of young Australians, including the Australian Studies in School Performance (Bourke & Lewis, 1976). Twelve of the 20 items on the reading comprehension test in 1995 were also used on the test in 1998. Ten of the 20 items on the mathematics test were common to both tests. These tests serve as the measures of literacy and numeracy for the LSAY program.

Using scores on these tests as measures of literacy and numeracy, this report examines how literacy and numeracy are influenced by characteristics of the student and the school. Based on the literature reviewed in the previous chapter, it is assumed for the present study that student achievement is influenced by a number of factors, some related directly to the student, some related to the student's parents and/or carers, and some related to the student's school career, including feedback on their previous achievements. These influences on achievement are summarised in Figure 1.

The LSAY sampling design is a two-stage cluster sample, with schools randomly selected in each State or Territory, and whole classes of students randomly selected within each participating school. With this design, it is important to account for the effects of clustering of students within schools, and for the combination of factors that influence student achievement. The analyses, presented in Chapter 3, use hierarchical linear modelling as described by Bryk and Raudenbush (1992). Sampling for the LSAY Y95 cohort is described by Long (1996), and for the Y98 cohort, by Long and Fleming (2002). Weighting accounts for under-sampling in larger States and over-sampling in smaller States and Territories, as described in detail by Marks and Long (2000).

Data

It is not possible to obtain measures on all factors believed to influence school achievement, and it is not always possible to obtain measures at the appropriate points in time. LSAY begins its data collection when students are in Year 9, using a questionnaire designed to obtain information on student background and some psychological factors, including a

number of items relating to aspirations for further study. This precludes the incorporation of data relating to the early years of schooling and earlier school achievement. The general theoretical model of Figure 1 is therefore simplified to account for data available in LSAY, and is represented in Figure 2. The most significant changes are the elimination of the feedback loops and the joining of student attitudes and aspirations with student background factors on the left of the model. All data used in this report come from the data collected as part of the first wave of each cohort.

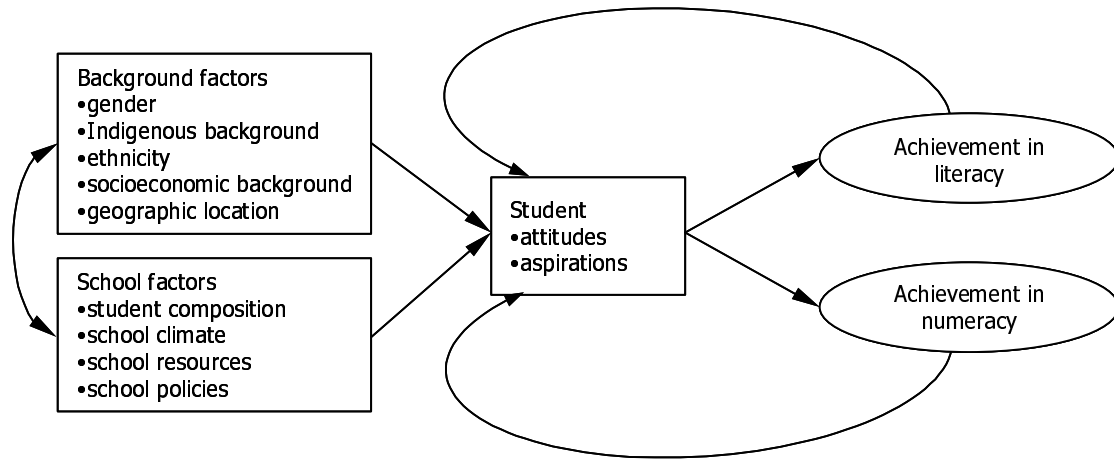


Figure 1 General theoretical model of factors influencing achievement in literacy and numeracy

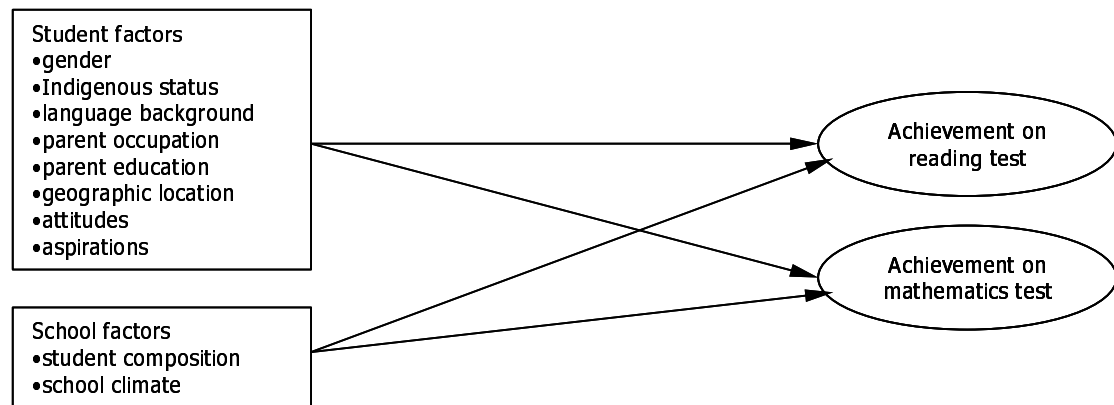


Figure 2 Operational model of factors influencing achievement in literacy and numeracy

Achievement measures

The scores on the reading comprehension and mathematics tests are used as outcome variables in models with student- and school-level measures as explanatory variables in the hierarchical linear models. In order to make the analyses of the two cohorts equivalent, it was first necessary to use item response theory to equate the tests administered in 1998 with the tests administered in 1995.⁹ The two tests were equated using a common-item nonequivalent

⁹ When the mathematics tests were equated, one item performed differently between the two cohorts, unlike the nine other items. This item was removed from the equating group.

groups design, with the resultant scales then calibrated using the mean/sigma method (see Kolen & Brennan, 1995). After calibration, a new scale was developed, using a mean of 50 and a standard deviation of 10. Each student was assigned a scaled score based on the number of items they answered correctly. Mean scores on the tests for selected subgroups used in the analyses are provided in Appendix Table A 1 (Y95) and Appendix Table A 2 (Y98). A table for converting raw scores to scaled scores is in Appendix 3.

*Student-level variables*¹⁰

Information on student background includes gender, Indigenous Australian status, country of birth, year of arrival in Australia (if appropriate), languages spoken at home and home address. Background information on each parent includes occupation, country of birth, level of education, and type of qualifications. Students also responded to 30 items from the *Quality of School Life* scales developed by Williams and Batten (1981) and items about their post-school plans (their own plans and what they believe their parents would like them to do). Details on each data item are presented below.

Gender. Students were asked their gender. For all analyses, male was coded as 0 and female coded as 1. Among the Y95 cohort, 49 per cent were male and 51 per cent were female. Among the Y98 cohort, 51 per cent were male and 49 per cent were female.

Indigenous Australian status. Students were asked the following question: ‘Are you an Aboriginal person or Torres Strait Islander person?’ For all analyses, non-Indigenous was coded as 0, and Indigenous coded as 1. For both cohorts, 3 per cent of students identified as Indigenous Australians, slightly higher than the proportions of Indigenous Australians enrolled in Year 9 in 1995 (2.4%) and 1998 (2.7%) (Australian Bureau of Statistics, 1996, 1999).

Language background. The determination of a student’s language background is not as simple as it may appear at first glance. Children may be born in Australia but speak a language other than English in the home. In some homes, English and another language are spoken interchangeably, and children become fluent in both. Some children are born overseas in a country that uses another language as its main language and English as a second language. As a result, it is difficult to determine how to define language background for research studies.

For the present study, a number of options were available. Respondents were asked if the main language spoken at home was English or another language. They were also asked if they were born in Australia or overseas. For those born overseas, the country of birth was classified into ‘other English-speaking’ (such as the United States, Scotland, New Zealand) or ‘not English-speaking’ (such as Italy, Morocco, Thailand). After each of the options for language background was examined for its relationship with achievement in the present study, two dichotomous variables relating to place of birth (English-speaking or non-English-speaking) were shown to provide the most information in subsequent models relating to literacy, one for both the student’s place of birth (7% of both cohorts born in a non-English-speaking country) and one for the student’s mother’s place of birth (19% of Y95 and 17% of Y98 born in a non-English-speaking country). No other measure of language background or ethnicity was used.

Socioeconomic status (SES). The measure of socioeconomic status used in this report is based upon occupational data. Respondents were asked to report the occupations of their father (or male guardian) and mother (or female guardian), and to describe their work. If a

¹⁰ Details of all variables available for this study, including those that were eliminated from the models, are contained in Appendix 1.

parent was not employed at the time of interview, respondents were asked to describe that parent's last job. Respondents were asked to provide information on both parents, even if their mother or father was not living with them. The information provided by respondents was coded to the four-digit level of the Australian Standard Classification of Occupations (ASCO) (ABS, 1997a).¹¹ For the present study, each ASCO code was then assigned an ANU4 score. The ANU4 is an occupational status scale ranging from 0 (low status) to 100 (high status). Examples of jobs at the bottom of the hierarchy are agricultural and related labourers, forklift drivers and various mining, construction and related labourers. Examples of jobs at the top of the status hierarchy are medical practitioners, legal professionals and university teachers (Jones & McMillan, 2001). For this study, the student's SES was assumed to be the father's ANU4 score. If there was no information available for the father's occupation, then the mother's occupation and associated ANU4 score were used.

Parents' education. A second dimension of SES, based upon parents' education, was also analysed. Students were asked, 'What is the highest level of education your father and mother have completed?' They were instructed to tick one box for their father's education level and one box for their mother's. The response options were:

No secondary school	Trade or technical qualification
Some secondary school	Degree or diploma
All years of secondary school	Don't know

For the analyses used in this report, four dichotomous variables were constructed, two for each parent. These variables indicated whether the parent completed secondary education, and whether the parent completed some form of post-secondary education, including trade and technical qualifications.

Geographic location. Postcodes were recorded as part of obtaining students' home addresses. Postcodes were then assigned a location based on the Accessibility/Remoteness Index of Australia (ARIA) (DHAC, 1999), and grouped as recommended by Jones (2002) in his analysis of the relationship between education outcomes and geographic location. The region of mainland State capital cities was used as a base, and each other region—major urban statistical districts, provincial city statistical districts, other provincial areas, and remote zones—was used independently to create separate dichotomous variables.

Attitudes. The amended *Quality of School Life* battery used with LSAY participants contains five subscales: Interest/Motivation, Achievement, Positive Affect, Teachers and Opportunity. Each subscale describes an aspect of school life, and each has been well defined in analyses of the components. Each subscale contains six items, about which students are asked their agreement using five-point scales. For the present study, negatively-worded items were reverse-scored. Each item was weighted equally, so that the minimum score was six (assuming students respond to each item), and the maximum score was thirty. Each subscale was used as a separate independent variable to test its influence on achievement.

Aspirations. Students were asked about their plans for completing Year 12 at school, and what they planned to do after leaving school. They were also asked if their parents had plans for them to complete Year 12. Preliminary analyses indicated that the students' responses to these items, regardless of their parents' plans, were adequate to explain variations in achievement scores. Two variables were used: one dichotomous variable that indicated if the student had plans to complete Year 12, and one dichotomous variable that indicated if the student had plans to attend university. As noted above, it is recognised that students' academic aspirations may be influenced by their past academic achievements, incorporating a

¹¹ For the Y95 cohort, occupations were coded using the first edition of ASCO. For the Y98 cohort, occupations were coded using the second edition.

feedback loop. For the present study, it is assumed that students' intentions to complete Year 12 and to attend university, while possibly supported by information received from earlier school assessments, serve as indicators of academic aspirations, which then influence achievement in literacy and numeracy.

School-level variables

Most of the school-level variables in the present study were obtained by creating composites of the student-level data, including the mean socioeconomic status (mean ANU4 score), the percentage of students from specific backgrounds (for example, speakers of languages other than English, Indigenous students), and average ratings on the *Quality of School Life* subscales. One non-constructed variable—school location—was used in preliminary analyses and shown to have no effect, especially when student's home location was included in the model. The variables described below were used in the final analyses.

Socioeconomic status (SES). For each school, an SES score was created using the ANU4 scores assigned to each student in the sample attending the school. The school SES score was calculated as the arithmetic mean. Appendix 4 contains information on the distribution of SES within and across schools.

Language background. It was noted earlier that student's birthplace and mother's birthplace were the most appropriate student-level variables to explain variation in achievement scores. At the school level, however, home language was found to contribute to a better measure. For the present study, the percentage of students in a school who indicated that their home language was a language other than English was used as a measure of school language background.

School climate. Five continuous variables were constructed from the five *Quality of School Life* subscales. The school score was calculated as the mean of scores recorded by students in the school.

Methodology

The analyses presented here use hierarchical linear modelling (HLM) and software developed for such analyses (Raudenbush, et al., 2000). Students are sampled in LSAY because they attend schools that are selected to participate in the study. Students within these schools have some common factors, such as shared learning experiences since entering secondary school, so that on some factors there may be little difference between students in the one school. HLM offers improved estimation of individual effects and better understanding of the sources of variation in achievement scores by separating student-level (within-school) and school-level (between-school) variances. Sampling in LSAY does not allow inclusion of a level to account for differences between classrooms, as only one or two classes per school were sampled.

Four separate analyses—Y95 literacy, Y98 literacy, Y95 numeracy, Y98 numeracy—were conducted, and each proceeded in a similar fashion. As the first step of each analysis, a 'null model' was created to determine the intra-class correlation, which is the distribution of the total variance into within-school (student-level) and between-school (school-level) components. Once the intra-class correlation was determined, each student-level variable and school-level variable was examined for its separate contribution to reducing the variance in scores. Significant variables were then added to the model to determine how they combine to explain the variation in achievement scores.

Explanatory variables were added to the models in groups, under the assumption that groups of variables work together to explain student achievement more fully. First, student-level

background variables were added, then measures of student attitudes and aspirations. Second, school-level variables were examined, independent of student-level variables. Finally, student-level and school-level variables were included, based on the student-level and school-level models. At each stage, results were analysed to ensure non-significant variables were eliminated for the next stage, although subsequent analyses incorporated some non-significant variables when theory suggested their inclusion, or when there was some instability in the variable in earlier analyses. Initially, each variable was tested to determine whether it varied across schools. Variables were fixed when repeated modelling indicated that these variables were constant across schools.

The goal of the modelling was to develop a parsimonious model for each of the four analyses, allowing for comparisons between cohorts and between learning areas where appropriate. It was believed that the consistency of the approach to all four analyses would yield similar findings, strengthening the findings from any one analysis, and identifying differences worth noting. The results of these analyses are presented in the following chapter. The findings are then discussed in Chapter 4.

3 ANALYSIS

This chapter focuses on the analysis of data from the LSAY collection. All analyses were conducted using HLM 5 software (Raudenbush, et al., 2000). The models describe influences on students' achievement in literacy and numeracy by examining how individual and family characteristics—gender, Indigenous status, language background, socioeconomic status (SES), parent education levels—and attitudes and aspirations—self-concept, achievement orientation and plans for the future—relate to performance on tests of reading comprehension and mathematics. Students' achievements in literacy and numeracy are also influenced by their schools, so characteristics of each school—socioeconomic status, ethnic composition and school climate—are considered.

For each analysis—literacy or numeracy—the final model is presented, with a discussion of the contribution of each explanatory variable at the student level (within schools) and the school level (between schools). Other variables that were considered but not included in the models are discussed briefly. Table 1 contains parameter estimates and within-school and between-school variances for successive models fitted in reaching the final model for Y95 literacy. Results for the null model are shown in Column 1. Column 2 shows parameter estimates for each variable when entered separately into the model. Column 3 shows the results for the background variables of gender, Indigenous status, SES and parents' educational attainment. Language background variables were added for Column 4, and attitudes and aspirations for Column 5. Separate school-level variables are shown in Column 6, then combined in Column 7. Estimates for the final model are presented in Column 8. Table 2 repeats the process for Y98 literacy; Table 3, for Y95 numeracy; and Table 4, for Y98 numeracy. A summary, which allows comparisons of the variables' influence on literacy and numeracy in both cohorts, is presented in Table 5. It should be noted that the final model, found in the right-hand column of each table, is the most appropriate model for discussion of the influence of each factor. The intermediate models assist in understanding how some factors influence and are influenced by other factors, and they should not be interpreted in any other way.

Literacy

Development of the hierarchical models indicated that among the Y95 cohort, 85 per cent of the variance could be explained by differences between students within schools, and 15 per cent of the variance could be explained by differences between schools. Among the Y98 cohort, 86 per cent of the variance was at the student level and 14 per cent at the school level. These results are similar to the results reported for Australia in PISA 2000 (Lokan, et al., 2001).

Influences on reading comprehension within schools

Gender. When only gender was added to the model, gender took a value of 1.6 in Y95 and 1.5 in Y98 (see Column 2 of Table 1 and Table 2), indicating that females scored 1.5-to-1.6 scaled score points higher than males on the reading comprehension tests. Alone, gender accounted for approximately 1 per cent of the variation in scores within schools. There was some interaction between gender and other background factors, as indicated by changes in the value of the estimate for gender in subsequent columns. There were minor changes from Column 2 to Columns 3 and 4, but Column 5, which incorporates students' attitudes and aspirations, shows that the effect of gender diminished. This suggests a small interaction between gender and attitudes or aspirations. Further analysis shows that there was little difference between males and females on the *Quality of School Life* Achievement subscale, but that more females than males planned to complete Year 12 and more females than males planned to attend university.

Table 1 Null model and the influence of explanatory variables, Y95 reading comprehension

Description	Column	Within schools				Between schools			
		Null model	Separate student-level variables	Background	Background + language	Background + language + attitudes	Separate school-level variables	Level 2 only	Final model
		1	2	3	4	5	6	7	8
Intercept		49.498 (0.24)		49.501 (0.24)	49.501 (0.24)	49.505 (0.24)		49.481 (0.16)	49.490 (0.17)
Gender			1.631 (0.21)	1.732 (0.20)	1.804 (0.20)	1.086 (0.19)			0.847 (0.15) <i>f</i>
Indigenous			-3.657 (0.45)	-3.729 (0.48)	-3.800 (0.47)	-3.357 (0.45)			-2.094 (0.34) <i>f</i>
SES			0.035 (0.00) <i>f</i>	0.021 (0.00) <i>f</i>	0.028 (0.00) <i>f</i>	0.017 (0.00) <i>f</i>			0.018 (0.00) <i>f</i>
Father Post-Secondary Educ			1.008 (0.24) <i>f</i>	0.741 (0.15) <i>f</i>	0.870 (0.15) <i>f</i>	0.442 (0.15) <i>f</i>			0.379 (0.15) <i>f</i>
NES-born			-2.830 (0.41)		-2.209 (0.42)	-2.466 (0.37)			-2.658 (0.40)
Mother NES-born			-1.947 (0.27)		-1.128 (0.25)	-1.602 (0.24)			-1.364 (0.22) <i>f</i>
Plans to complete Year 12			3.759 (0.20)			2.106 (0.19)			1.645 (0.17) <i>f</i>
Plan to attend university			4.104 (0.19)			2.673 (0.16) <i>f</i>			3.091 (0.20)
QSL: Achieve			0.420 (0.03)			0.245 (0.03)			0.186 (0.02) <i>f</i>
School SES							0.292 (0.02)	0.269 (0.02)	0.268 (0.02)
School QSL:P							0.840 (0.23)	0.692 (0.18)	0.688 (0.17)
School % LBOTE							-0.085 (0.01)	-0.079 (0.01)	-0.080 (0.01)
Within-schools variance		82.176		79.486	77.960	72.535		82.121	73.874
Between-schools variance		14.529		14.566	14.590	14.688		5.930	6.050

f The residual parameter variance of this within-schools coefficient was set to zero.

Note: All parameter estimates are significant at .05.

Table 2 Null model and the influence of explanatory variables, Y98 reading comprehension

Description	Within schools					Between schools		
	Null model	Separate student-level variables	Background	Background + language	Background + language + attitudes	Separate school-level variables	Level 2 only	Final model
	Column 1	2	3	4	5	6	7	8
Intercept	49.858 (0.25)		49.860 (0.25)	49.860 (0.25)	49.864 (0.25)		49.958 (0.16)	49.947 (0.16)
Gender		1.493 (0.19)	1.338 (0.14) <i>f</i>	1.368 (0.14) <i>f</i>	0.875 (0.14) <i>f</i>			0.819 (0.14) <i>f</i>
Indigenous		-4.447 (0.38) <i>f</i>	-4.123 (0.38) <i>f</i>	-4.119 (0.38) <i>f</i>	-3.821 (0.37) <i>f</i>			-3.873 (0.37) <i>f</i>
SES		0.033 (0.00) <i>f</i>	0.022 (0.00) <i>f</i>	0.021 (0.00) <i>f</i>	0.014 (0.00) <i>f</i>			0.015 (0.00) <i>f</i>
Father Post-Secondary Educ		2.347 (0.21)	1.399 (0.16) <i>f</i>	1.486 (0.16) <i>f</i>	0.642 (0.16) <i>f</i>			0.664 (0.16) <i>f</i>
Mother Secondary Educ		0.957 (0.13) <i>f</i>	0.659 (0.14) <i>f</i>	0.729 (0.14) <i>f</i>	0.423 (0.13) <i>f</i>			0.459 (0.13) <i>f</i>
NES-born		-1.410 (0.36)		-1.420 (0.26) <i>f</i>	-1.360 (0.30) <i>f</i>			-1.817 (0.38)
Mother NES-born		-0.700 (0.19) <i>f</i>		ns ^a	-0.917 (0.22) <i>f</i>			-0.966 (0.23) <i>f</i>
Plans to complete Year 12		3.863 (0.21)			1.405 (0.16) <i>f</i>			1.392 (0.16) <i>f</i>
Plan to attend university		4.351 (0.21)			3.141 (0.21)			3.199 (0.21)
QSL: Achieve		0.508 (0.03)			0.288 (0.02) <i>f</i>			0.294 (0.02) <i>f</i>
School SES						0.291 (0.02)	0.252 (0.02)	0.252 (0.02)
School QSL:P						1.406 (0.23)	0.913 (0.17)	0.915 (0.16)
School % LBOTE						-0.076 (0.02)	-0.067 (0.01)	-0.068 (0.01)
Within-schools variance	94.508		91.679	91.482	84.830		94.446	84.410
Between-schools variance	14.986		15.045	15.049	15.187		4.979	5.162

f The residual parameter variance of this within-schools coefficient was set to zero.

^a Not significant in the present model, but significant in subsequent models.

Note: All parameter estimates are significant at .05.

Column 8 shows the parameter estimates for all variables in the final model. Holding all other variables constant, gender had a small but significant effect on reading comprehension scores, equivalent to slightly more than 0.8 scaled score points in both cohorts. For both cohorts, gender was fixed across all schools, indicating that there was little or no variation among schools in differences between males and females.

Indigenous status. The effect of being an Indigenous student varied between the Y95 and Y98 cohorts on the reading comprehension tests. Among the Y95 cohort, Indigenous students scored 3.7 points lower than non-Indigenous students when Indigenous status alone was added to the model. Among the Y98 cohort, this difference was 4.4 points. By itself, Indigenous status accounted for approximately 1 per cent of the variation in scores within schools. When other background variables were added to the models (see Column 4), there remained differences of 3.8 points and 4.1 points in Y95 and Y98, respectively. The addition of attitudes and aspirations to the model (Column 5) decreased the effect of Indigenous status because of the relationship between Indigenous status and scores on the *Quality of School Life* Achievement subscale and plans for Year 12 and university.

In the final models, the effect of Indigenous status was different between Y95 and Y98 (see Column 8). For the Y95 cohort, Indigenous students scored 2.1 scaled score points lower than non-Indigenous students, when all other variables in the model were held constant. This difference was 3.9 points for the Y98 cohort. The effect of Indigenous status was fixed across schools. The general magnitude of the effect of Indigenous status did not change for the Y95 cohort until school-level factors were added to the model; for the Y98 cohort, the addition of school-level variables had only a small effect on the parameter estimate for Indigenous status.

Socioeconomic status (SES). In Y95, the parameter estimate for the influence of parent SES alone was 0.035, and in Y98 it was 0.033. Alone, parent SES accounted for approximately 1 per cent of the variation in scores within schools. Parent SES was measured on the ANU4 scale (Jones & McMillan, 2001), which ranges from 0 to 100, so the maximum difference between students was 3.5 scaled score points among Y95 and 3.3 points among Y98. When other student-level variables were added to the models, the effect of parent SES was reduced by at least one-half, to 0.017 for Y95 and 0.014 for Y98 (see Column 5). The addition of school-level variables (Column 8) brought no change. Analysis of the random effects of parent SES indicated that its influence was constant across all schools.

During the modelling, the parameter estimate for parent SES changed from 0.035 separately to 0.018 in the final Y95 model, and from 0.033 to 0.015 in the final Y98 model, indicating that when the other variables were considered, the influence of SES was reduced by about one-half. This change occurred during consideration of the within-schools (student-level) variance, not when school-level variables were added to the model. This suggests that the influence of SES diminished as other student-level variables were considered in the model, but that school-level variables did not change the effects of student-level SES.

Parents' education. For both cohorts, students whose fathers had obtained a post-secondary qualification had higher scores than those whose fathers had not obtained one. By itself, the dichotomous variable for father's post-secondary education accounted for less than 1 per cent of the variation in scores within schools. For the Y95 cohort, a student whose father had obtained a qualification scored 1.0 scaled score point higher than one whose father had not, when only this variable was included in the model. For Y98, this estimate was 2.3 points. For both cohorts, the parameter estimates for this variable decreased when other background variables were added, increased slightly when language background variables were added, then decreased again when attitudes and aspirations were added. In the final model, with student- and school-level variables fitted (Column 8), the estimates were 0.4 for Y95 and 0.7 for Y98, constant across schools. A similar variable for mother's post-secondary education was found not to contribute significantly to the models.

For only the Y98 cohort, a student whose mother completed secondary education scored higher than one whose mother did not. Alone, mother's secondary education accounted for less than 1 per cent of the variation in scores within schools. The parameter estimate for this variable was 1.0 when alone in the model (Column 2); it decreased when other variables were added at the student level, and was 0.5 in the final model (Column 8). The dichotomous variable for father's completion of secondary education was found not to contribute significantly to the models. The influence of parents' education diminished as other variables were entered into the models, indicating that parent education had some correlation with other variables, particularly SES.

Student's place of birth (NES-born). For the reading comprehension tests, language background was found to affect students' scaled scores in two ways. Students who were born in a country where the main language is not English scored lower than students who were born in a country where English is the main language, including Australia. For the Y95 cohort, the effect was 2.8 scaled score points; among the Y98 cohort, the effect was 1.8 points. On its own, student birthplace accounted for approximately 1 per cent of the variation in scores within schools. There were only small changes in the value for parameter estimate for this variable between Column 2 and Column 8, when all variables were included. For Y95, the estimate changed from -2.8 to -2.7; for Y98, it changed from -1.4 to -1.8. Among all student background and language variables, student birthplace was not constant across schools in the final model, indicating that the effect of a student's home language, as indicated by his or her birth in a non-English-speaking country, varied across schools. This may also indicate that the effect of language background varied by the language spoken, and that it may not be appropriate to treat all students from non-English language backgrounds as members of a homogeneous group.

Mother's place of birth (Mother NES-born). Students whose mothers were born in countries where the main language is not English also scored lower than other students in both cohorts, although in the model-building for the Y98 cohort, this variable was not significant when added with student birthplace to other background variables (Column 4). It was subsequently included in the student-level and full models, where it was significant. On its own, mother's birthplace accounted for approximately 1 per cent of the variance at the student level. In final models for both Y95 and Y98, the parameter estimate for mother's birthplace was approximately one-half the parameter estimate for student's birthplace.

Other variables relating to language background were explored, including father's birthplace and main language spoken at home (English or another language). Individually, these variables were found to be significant, but when combined with other variables, problems of multicollinearity were evident, indicating that the inclusion of additional variables did nothing to improve the explanatory power of mother's and student's birthplace. The two variables used here—student's birthplace and mother's birthplace—were found to have explanatory power individually and when used together, so they were retained.

Plans to complete Year 12. Year 9 students who had plans to complete Year 12 scored 3.8 points higher in Y95 and 3.9 points higher in Y98, when this dichotomous variable was the only independent variable in the model (Column 2). Alone, it accounted for approximately 4 per cent of the within-schools variance in both Y95 and Y98. In the final models (Column 8), the parameter estimate for this variable was 1.6 in Y95 and 1.4 in Y98, accounting for the inclusion of other measures of student aspirations and attitudes.

Plans to attend university. Year 9 students who planned to attend university after school scored, on average, more than 4 scaled score points higher than those with no such plans, when this dichotomous variable was the only independent variable in the model (Column 2). On its own, plans for university attendance accounted for 6 per cent of the within-schools variance in both Y95 and Y98. Holding all other variables—including school-level

variables—constant, the parameter estimates were still high, at 3.1 for Y95 and 3.2 for Y98 (Column 8). This ‘bonus’ is in addition to the higher scores attained by those with plans to complete Year 12, discussed in the previous paragraph. In both cohorts, the effect of university plans varied across schools, while the effect of plans to complete Year 12 was constant. Together, these aspiration variables accounted for approximately 7 per cent of the variance in reading comprehension scores.

Quality of School Life: Achievement (QSL:A). Members of both cohorts who scored higher on the Achievement subscale of the *Quality of School Life* measure also scored higher on the reading comprehension tests. When QSL:A was the only variable added to the null model, a one-point increase in the QSL:A subscale score was associated with an increase of 0.4 scaled score points among the Y95 cohort, and an increase of 0.5 scaled score points among the Y98 cohort. Alone, QSL:A accounted for approximately 3 per cent of the variation in scores within schools. In the final models, the effect of QSL:A was fixed across schools. Individually, other *Quality of School Life* subscales (Interest/Motivation, Positive Affect, Teachers and Opportunity) had some explanatory power, but they added nothing significant once the Achievement subscale was included in the model.

Geographic location. There were small differences in mean scaled scores by geographic location, using the five separate dichotomous variables representing differences from the Mainland State Capital Cities classification of ARIA. When included in the full models for both Y95 and Y98, there were no statistical differences among these variables, indicating that net differences in mean scores by geographic location were not significant.

Full within-schools model. There are many factors that influence a student’s score on a test of reading comprehension, but not all possible data are collected as part of LSAY. For both LSAY cohorts in this report, nine variables were determined to have a measurable influence on students’ scaled scores, with a tenth variable having a measurable, small effect for Y98. When all variables cited above were included in the model, the within-schools variance was reduced by 12 per cent for the Y95 cohort and 10 per cent for the Y98 cohort. These results are shown in Column 5 of Table 1 and Table 2.

Influences on reading comprehension between schools

School-level variables were added to the models following the steps used for student-level variables. First, each variable was added separately to the null model; the parameter estimate for each of these variables is shown in Column 6. Estimates for these variables together, with no student-level variables in the model, are shown in Column 7.

Socioeconomic status (SES). One variable—school mean SES—accounted for approximately one-half of the between-schools variance (49% in Y95, 58% in Y98). The value of the parameter estimate when only school SES was added to the model was 0.292 for the Y95 cohort, and 0.291 for the Y98 cohort. In other words, if two schools differed in mean SES by 10 points, the expected difference in mean score on the reading comprehension tests would be about 2.9 scaled score points. When other school-level variables were added to the null model, and no student-level data included (Column 7), the estimates for school SES decreased to 0.269 in Y95 and to 0.252 in Y98.

Quality of School Life: Positive Affect (QSL:P). Each of the five *Quality of School Life* subscales was fitted to the models to determine which best explained differences between schools on the reading comprehension tests. While the Achievement subscale had already been shown to explain some of the variance within schools, the Positive Affect subscale explained more variation at the school level than other subscales. In the final model, an increase of one point in the school QSL:P score was equivalent to an increase of 0.7 on the school mean reading comprehension scaled score for Y95, and 0.9 for Y98. By itself, school

mean QSL:P reduced the between-schools variance by 5 per cent among the Y95 cohort, and 15 per cent among the Y98 cohort.

Percentage of students from language backgrounds other than English (LBOTE). The parameter estimates were small but significant, and accounted for 11 per cent of the between-schools variance among the Y95 cohort and 7 per cent of the between-schools variance among Y98. The parameter estimates were fairly stable in both cohorts. In Y95, the separate estimate was -0.085, and -0.080 in the final model. In Y98, the separate estimate was -0.076, and -0.068 for the final model. In general, a difference of 12 to 15 percentage points in the proportion of LBOTE students in the school was equivalent to a difference of one point on the school mean reading comprehension score.

Full between-schools model. When the three school-level variables cited in this section are included in a model without student-level variables (Column 7), the unexplained between-schools variance is reduced by 59 per cent for the Y95 cohort and 67 per cent for the Y98 cohort. Differences are minimal between the parameter estimates in the full between-schools models and estimates in the final model, which includes within-school variables.

Influences on reading comprehension: final model

With all significant variables included in the final model and student-level variables fixed where appropriate, as shown in Column 8 of Table 1 and Table 2, 10.1 per cent of the within-schools variance and 58.4 per cent of the between-schools variance is explained for the Y95 cohort, and 10.7 per cent of the within-schools variance and 65.6 per cent of the between-schools variance is explained for the Y98 cohort. It is important to note how the contribution of each explanatory variable—within schools and between schools—changed as the final model was reached, indicating that variables may appear to have large effects when considered separately, but diminish in their contribution when other factors are considered.

Within schools, gender, family socioeconomic status, and the student's intention to attend university had similar effects on achievement on reading comprehension between the Y95 and Y98 cohorts. Between schools, mean school SES and percentage of students from language backgrounds other than English were relatively similar between the two cohorts.

Numeracy

Development of the hierarchical models indicated that among the Y95 cohort, 82 per cent of the variance could be explained by differences between students within schools, and that 18 per cent of the variance could be explained by differences between schools. Among the Y98 cohort, 85 per cent of the variance was at the student level and 15 per cent at the school level. Lokan, et al. (2001), in their analysis of PISA 2000 results for Australia, reported that the proportion of variance at the school level for mathematics literacy was greater than it was for reading literacy. Marks (personal communication, 31 October 2002) reported this figure at 18 per cent. The findings reported here also show more school-level variance in mathematics, and the differences for each cohort are small.

Influences on mathematics within schools

Gender. When gender was added to the null model with no other variables, females in the Y95 cohort scored 1.5 points lower than males, and 1.4 points lower in the Y98 cohort.¹²

¹² Coding for the dichotomous variable gender remained the same for the literacy and numeracy analyses. For literacy, positive parameter estimates indicate that females scored higher on the reading comprehension tests. For numeracy, negative parameter estimates indicate that males scored higher on the mathematics tests.

Table 3 Null model and the influence of explanatory variables, Y95 mathematics

Description	Within schools				Between schools		
	Null model	Separate student-level variables	Background	Background + attitudes	Separate school-level variables	Level 2 only	Final model
	Column 1	2	3	4	5	6	7
Intercept	49.692 (0.25)		49.701 (0.25)	49.719 (0.25)		49.645 (0.17)	49.675 (0.17)
Gender		-1.455 (0.21)	-1.404 (0.20)	-2.240 (0.19)			-2.199 (0.19)
Indigenous		-3.250 (0.43)	-3.140 (0.43)	-1.475 (0.46) ^f			-1.468 (0.34) ^f
SES		0.033 (0.00)	0.031 (0.00) ^f	0.016 (0.00) ^f			0.016 (0.00) ^f
Plans to complete Year 12		3.488 (0.20)		1.598 (0.16) ^f			1.579 (0.16) ^f
Plan to attend university		4.164 (0.21)		3.358 (0.16)			3.371 (0.21)
QSL: Achieve		0.469 (0.03)		0.316 (0.03)			0.315 (0.03)
School SES					0.326 (0.02)	0.317 (0.02)	0.315 (0.02)
School QSL:P					0.863 (0.26)	0.592 (0.19)	0.529 (0.17)
School % LBOTE					-0.063 (0.02)	-0.053 (0.01)	-0.041 (0.01)
Within-schools variance	78.903		76.820	70.087		78.878	70.074
Between-schools variance	16.767		16.782	16.963		6.482	6.690

^f The residual parameter variance of this within-schools coefficient was set to zero.

Note: All parameter estimates are significant at .05.

Table 4 Null model and the influence of explanatory variables, Y98 mathematics

Description	Within schools				Between schools		
	Null model	Separate student-level variables	Background	Background + attitudes	Separate school-level variables	Level 2 only	Final model
	Column 1	2	3	4	5	6	7
Intercept	49.537 (0.25)		49.542 (0.25)	49.557 (0.25)		49.644 (0.17)	49.648 (0.17)
Gender		-1.354 (0.18)	-1.292 (0.18)	-1.944 (0.18)			-1.866 (0.18)
Indigenous		-3.546 (0.39) <i>f</i>	-3.545 (0.37) <i>f</i>	-3.053 (0.36) <i>f</i>			-3.060 (0.36) <i>f</i>
SES		0.036 (0.00) <i>f</i>	0.033 (0.00) <i>f</i>	0.021 (0.00) <i>f</i>			0.021 (0.00) <i>f</i>
Plans to complete Year 12		3.364 (0.20)		1.472 (0.16) <i>f</i>			1.471 (0.16) <i>f</i>
Plan to attend university		3.946 (0.20)		3.009 (0.20)			2.990 (0.20)
QSL: Achieve		0.502 (0.03)		0.329 (0.03)			0.329 (0.03)
School SES					0.308 (0.02)	0.280 (0.02)	0.282 (0.02)
School QSL:P					1.373 (0.24)	0.703 (0.17)	0.656 (0.17)
School % LBOTE					-0.050 (0.02)	-0.035 (0.01)	-0.031 (0.01)
Within-schools variance	89.807		87.331	80.152		89.731	80.077
Between-schools variance	16.219		16.264	16.432		6.005	6.156

f The residual parameter variance of this within-schools coefficient was set to zero.

Note: All parameter estimates are significant at .05.

Alone, gender accounted for approximately 1 per cent of the variation in scores within schools. There was little change to the parameter estimates when other background variables were added to gender in the model, but when variables measuring attitudes and aspirations were included, the difference between males and females increased, to 2.2 in Y95 and 1.9 in Y98. For both cohorts, gender was not fixed, indicating that differences by gender varied across schools.

Column 7 shows the parameter estimates for all variables in the final model. Holding all other variables constant, gender had a significant effect on mathematics scores, equivalent to approximately 2.0 scaled score points in both cohorts. This finding is contrary to results reported for Australian schools in TIMSS (Mullis, et al., 2000b) and PISA 2000 (Lokan, et al., 2001).

Indigenous status. The effect of being an Indigenous Australian student varied between the Y95 and Y98 cohorts on the mathematics tests, with the final effect in the Y98 cohort double the effect in the Y95 cohort. With no other variables in the model, Indigenous students in Y95 scored 3.3 scaled score points lower than non-Indigenous students; this difference was 3.5 points in the Y98 cohort. By itself, Indigenous status accounted for less than 1 per cent of the variation in scores within schools. The effect of Indigenous status was fixed across schools. When combined with gender and socioeconomic status at the student level, there was little change in the parameter estimates for Indigenous status. When variables measuring student attitudes and aspirations were added, the magnitude of the associated parameter estimates for Indigenous status decreased in both Y95 and Y98.

Socioeconomic status (SES). In Y95, the parameter estimate for the influence of parent SES on its own was 0.033, and in Y98 it was 0.036. With a maximum SES scale range of 100, the maximum difference between students was 3.3 scaled score points among Y95 and 3.6 points among Y98. By itself, parent SES accounted for between 1 and 2 per cent of the variation in mathematics scores. When other background variables were added to SES, there was little change in the parameter estimates, but when variables representing aspiration and attitudes were added, parameter estimates for SES were 40 to 50 per cent lower than when SES was the only variable in the model. Analysis of the random effects of parent SES indicated that its influence did not vary across schools.

Parents' education. In the analyses of results on the reading comprehension tests, the dichotomous variables representing father's completion of post-secondary education and mother's completion of secondary education had small, significant effects on students' scores. The analyses of mathematics scores showed no such influence. Neither parent's educational level was significant in the models explaining influences on mathematics results when other variables were included.

Language background. There was no significant influence of language background—either student's or mother's place of birth—on tests of mathematics once other variables were included in the models.

Plans to complete Year 12. Members of the Y95 cohort who had plans to complete Year 12 scored 3.5 scaled score points higher than those with no such plans, when this dichotomous variable was added to the null model on its own; in the Y98 cohort, the difference was 3.4 points. Alone, planning to complete Year 12 accounted for approximately 4 per cent of the variation in scores within schools. When other student-level variables—especially plans to attend university—were added to the models, the parameter estimates dropped to 1.6 and 1.5 for Y95 and Y98, respectively; there was little change in the final models.

Plans to attend university. On its own, planning to attend university accounted for approximately 6 per cent of the within-schools variance. Students with plans to attend university scored higher than those with no such plans, with the difference 4.2 points in the

Y95 cohort and 3.9 points in the Y98 cohort. When added to other student-level variables, the parameter estimates dropped to 3.4 and 3.0, and there was no difference when school-level variables were added to the model. The changes in the parameter estimates were not as large as for students' plans to complete Year 12; thus, plans to attend university appear to have greater influence than plans to complete Year 12. In both cohorts, the effect of university plans varied across schools, while the effect of plans to complete Year 12 was fixed. Together, they accounted for approximately 7 per cent of the within-schools variance.

Quality of School Life: Achievement (QSL:A). Members of both cohorts who scored higher on the Achievement subscale of the *Quality of School Life* scales also scored higher on the mathematics tests. A one-point increase in the QSL:A subscale was associated with an increase of 0.5 scaled score points for both cohorts when this variable was the only one included in the model, and an increase of 0.3 scaled score points when other variables were included. The effect of QSL:A varied across schools. Alone, QSL:A accounted for approximately 4 per cent of the variation in scores within schools. Once the Achievement subscale was included in the model, no other QSL subscale (Interest/Motivation, Positive Affect, Teachers and Opportunity) significantly explained the variance in mathematics test scores.

Geographic location. There were small differences in mean mathematics scores by geographic location, using the five separate dichotomous variables representing differences from the Mainland State Capital Cities classification of ARIA. When included in the full models for both Y95 and Y98, there were no statistically significant differences among these variables, indicating that there was no difference in mean mathematics scores by geographic location.

Full within-schools model. Compared to the literacy analysis earlier in this chapter, fewer variables were used to explain the variance in student achievement within schools. For both LSAY cohorts' achievement in numeracy, six variables were determined to have a measurable influence on students' scaled scores. Absent from the numeracy models were the two variables relating to parent education and two variables relating to the birthplace of the student and the student's mother. When all variables cited above were included in the numeracy model, the within-schools variance was reduced by 11 per cent for both cohorts.

Influences on mathematics between schools

School-level variables were added to the models following the steps used for student-level variables, as done in the analysis of reading comprehension scores. Each variable was added separately to the null model; the parameter estimate for each of these variables is shown in Column 5. Estimates for these variables together, with no student-level variables in the model, are shown in Column 6.

Socioeconomic status (SES). As noted in the literacy analysis, one variable—school mean SES—accounted for most of the between-schools variance. Among the Y95 cohort, school SES alone accounted for 57 per cent of the variance in mathematics scores between schools, and among the Y98 cohort, 59 per cent. When only school SES was added to the null model, the parameter estimates were 0.326 for Y95, and 0.308 for Y98. In the final models, these values were 0.315 for Y95 and 0.282 for Y98. In other words, an increase of about three points in school mean SES was equivalent to an increase of about one point on the school mean mathematics score.

Quality of School Life: Positive Affect (QSL:P). Again, each of the *Quality of School Life* subscales was fitted to the models to determine which best explain the differences between schools on the mathematics tests. While the Achievement subscale was used to explain some of the variance within schools, the Positive Affect subscale explained more between-schools variance than other subscales. In the final models, an increase of one point in the school QSL:P score was equivalent to an increase of 0.5 points on the school mean mathematics

score for Y95, and an increase of 0.7 for Y98. By itself, school mean QSL:P reduced the between-schools variance by 4 per cent for the Y95 cohort and 13 per cent for the Y98 cohort.

Percentage LBOTE students. On its own, the percentage of LBOTE students in the school accounted for 5 per cent of the between-schools variance among the Y95 cohort and 3 per cent of the between-schools variance among Y98. In the final models, the parameter estimates were -0.041 for Y95 and -0.031 for Y98, indicating that an increase of 25 to 33 percentage points in the proportion of LBOTE students in the school was equivalent to a decrease of one point on the school mean mathematics score. Although they are significant, these estimates are much smaller than the estimates for the reading comprehension tests. In addition, language background did not influence student-level results in numeracy, while it did in literacy.

Full between-schools model. When the three school-level variables cited in this section were included in a model without student-level variables, they explained 64 percent of the between-schools variance in the Y95 cohort and 63 percent of the between-schools variance in the Y98 cohort.

Influences on mathematics: final model

The final models for the within-schools and between-schools effects on mathematics achievement are shown in Column 7 of Table 3 for the Y95 cohort and Table 4 for the Y98 cohort. With all significant variables included in the final model, and student-level variables fixed where appropriate, 11.2 per cent of the within-schools variance and 60.1 per cent of the between-schools variance was explained for the Y95 cohort, and 10.8 per cent of the within-schools variance and 62.0 per cent of the between-schools variance was explained for the Y98 cohort.

Within schools, parent socioeconomic status, gender, the student's intention to complete Year 12, and the student's achievement orientation had similar effects on achievement in mathematics between the Y95 and Y98 cohorts. Between schools, mean school SES and percentage of students from language backgrounds other than English were relatively similar in their influence between the two cohorts.

Summary of Analyses

This chapter presented details of the hierarchical linear modelling conducted on reading comprehension test scores and mathematics test scores for members of two LSAY cohorts, Y95 and Y98. The tests were administered as part of the first wave of cohort selection, and were accompanied by questionnaires that provided information on student background, home location, attitudes and aspirations. School-level information was developed by aggregating student-level information. Consistent modelling procedures were maintained to enable comparisons across cohorts, and across literacy and numeracy.

Table 5 contains a summary of the final hierarchical linear models. The bottom two rows of the table show the initial intra-class correlation—the percentage of variance at the school level with no explanatory variables (null models)—and the conditional intra-class correlation—the percentage of variance at school level, given the explanatory variables in the final model. In the null models, between 14 and 17 per cent of the variance was at the school level. In the final models, the conditional intra-class correlation indicated that between 6 and 9 per cent of the variance was at the school level. This reflects the finding that more of the school-level variance could be explained by the variables included in the models, and that student-level variance was more difficult to explain. This is balanced by the intra-class correlation, unconditional and conditional, which showed that school-level variance accounted for a much smaller proportion of the total variance.

Table 5 Significant variables in final models, all analyses

	Literacy		Numeracy	
	Y95	Y98	Y95	Y98
	<i>Estimate (s.e.)</i>	<i>Estimate (s.e.)</i>	<i>Estimate (s.e.)</i>	<i>Estimate (s.e.)</i>
Intercept	49.490 (0.17)	49.947 (0.16)	49.675 (0.17)	49.648 (0.17)
Student-level (within schools)				
Gender	0.847 (0.15)	0.819 (0.14)	-2.199 (0.19)	-1.866 (0.18)
Indigenous	-2.094 (0.34)	-3.873 (0.37)	-1.468 (0.34)	-3.060 (0.36)
SES	0.018 (0.00)	0.015 (0.00)	0.016 (0.00)	0.021 (0.00)
Father Post-Secondary Ed	0.379 (0.15)	0.664 (0.16)		
Mother Secondary Ed		0.459 (0.13)		
NES-born	-2.658 (0.40)	-1.817 (0.38)		
Mother NES-born	-1.364 (0.22)	-0.966 (0.23)		
Plan Year 12	1.645 (0.17)	1.392 (0.16)	1.579 (0.16)	1.471 (0.16)
Plan Uni	3.091 (0.20)	3.199 (0.21)	3.371 (0.21)	2.990 (0.20)
QSL: Achievement	0.186 (0.02)	0.294 (0.02)	0.315 (0.03)	0.329 (0.03)
School-level (between schools)				
Mean SES	0.268 (0.02)	0.252 (0.02)	0.315 (0.02)	0.282 (0.02)
Mean QSL: Positive Affect	0.688 (0.17)	0.915 (0.16)	0.529 (0.17)	0.656 (0.17)
Per cent LBOTE	-0.080 (0.01)	-0.068 (0.01)	-0.041 (0.01)	-0.031 (0.01)
Intra-class correlation (null model)	0.150	0.137	0.175	0.153
Conditional intra-class correlation (final model)	0.076	0.058	0.087	0.071

The major findings reported in this chapter were:

- Approximately one-sixth of the variation in scores on tests of reading comprehension and mathematics could be attributed to differences between schools, and the remaining five-sixths to differences between students. This is consistent with findings for Australian students who participated in international studies of student achievement.
- More of the between-schools variance could be explained than the within-schools variance. School-level variables in the models explained between 58 and 66 per cent of the between-schools variance, but student-level variables explained only 10 to 11 per cent of the within-schools variance.
- Gender had differential influences on student achievement. Females scored higher on tests of reading comprehension, while males scored higher on tests of mathematics.
- Indigenous Australian students in Year 9 scored consistently lower than non-Indigenous students on tests of reading comprehension and mathematics.
- The effects of socioeconomic status on student achievement were significant at two levels. There were small but significant effects of SES within schools, and there were larger significant effects of SES between schools. By far the greatest influence on between-school differences was the school's mean socioeconomic status.
- Parents' education levels had significant effects on reading comprehension scores, but not on mathematics scores. Year 9 students whose fathers had completed some form of post-secondary education had higher reading scores than those whose fathers did not. Students with mothers who completed secondary school had higher reading scores in the Y98 cohort only.

- Language background had differential effects on students' achievement scores. LBOTE students achieved lower scores than other students in reading comprehension, but in mathematics there were no significant differences. Both reading comprehension and mathematics scores were influenced by the percentage of LBOTE students in the school, although the effect for mathematics was about half the effect for reading.
- Students with plans to complete Year 12 achieved higher scores in both reading comprehension and mathematics. Students who planned to attend university achieved even higher scores on both tests, approximately twice the effect of plans for Year 12 completion.
- Students with higher scores on the *Quality of School Life* achievement subscale achieved higher scores on tests of reading comprehension and mathematics. The positive affect of the school, as measured on a subscale of the *QSL*, also had a significant effect on scores on both tests.

4 DISCUSSION

Literacy and numeracy remain at the top of the agenda for Australian education, so it is imperative that research continues to examine the literacy and numeracy skills of Australian school students. Understanding the influences on student achievement in literacy and numeracy, therefore, remains a major research topic for educational research in Australia. In turn, ensuring that all students, regardless of background factors, are literate and numerate is a primary goal for Australian educational policymakers.

The present report has used data from two recent cohorts of the LSAY program to answer three questions about influences on student achievement in literacy and numeracy. By using the full set of background variables available in the LSAY 1995 and 1998 data sets, this report expands on earlier LSAY research reports (Marks & Ainley, 1997; Rothman, 2002), which examined longer-term trends in achievement. Those earlier reports were limited to using only those students and variables that could provide consistency with data collected in 1975, 1980 and 1989. The questions and related findings are presented in this chapter, with implications for education policy.

What factors contribute to differences in literacy and numeracy achievement among Year 9 students in Australian schools? Are these factors the same as factors that have been found to contribute to literacy and numeracy achievement in other studies, from Australia and overseas?

Three recent international studies in which Australian school students have participated—TIMSS 1995, TIMSS 1999 and PISA 2000—used similar-aged students as those participating in the LSAY program. These studies have shown consistent findings, that socioeconomic status, language background, Indigenous status, gender and attitudes toward school have significant effects on reading achievement, and that socioeconomic status, Indigenous status and attitudes toward school have significant effects on mathematics achievement. Language background shows inconsistent effects on numeracy internationally, and no statistically significant effect in Australia. Geographic location has also shown mixed results in the international studies.

The present analysis of Australian Year 9 students' results on reading comprehension and mathematics tests, taken as part of the LSAY program, confirms the findings noted in the international studies. Gender, SES, language background and attitudes toward school have significant effects on achievement in literacy, and SES and attitudes toward school have significant effects on achievement in numeracy. In addition, Indigenous students score significantly lower on tests of literacy and numeracy, even after SES and other factors are considered. Parents' education has a significant effect on literacy achievement; educational aspirations are also significantly associated with differences in achievement.

The major difference in the present report is the role of gender in achievement in numeracy. Gender has been a perplexing issue for analysts of student performance. While there have been inconclusive findings on whether males perform better than females on mathematics tests—and recent research has shown that what differences may have existed in the past are no longer evident—the results in the present report indicate that males performed statistically significantly better than females on the mathematics tests included in LSAY. There was a difference of close to two scaled score points on the mathematics tests between males and females, net of other statistically significant factors. This finding may be related to differences in test instruments—the LSAY tests require less reading than the TIMSS and PISA tests require—and this issue should be investigated further.

Research into school-level effects has noted that school and class composition, including the socioeconomic status of the community and the language background of the school, are also

related to achievement in literacy and numeracy. The research reported here confirms this literature as well, with SES at the individual level having a small but statistically significant influence on academic achievement, and a much greater effect at the school level. Rothman (2002) noted that this relationship had changed since 1975, with student-level SES decreasing in its influence and school-level SES increasing in its influence on the reading comprehension and mathematics scores of Australian 14-year-olds. There is little indication in these studies, however, of the processes by which SES influences student achievement in literacy and numeracy.

Student attitudes and aspirations have been shown to play a major role in academic achievement, with those who plan to complete their secondary education and participate in tertiary study scoring higher than those who have no such plans. The present study confirms this, with those students planning to complete Year 12 achieving higher scores on tests of reading comprehension and mathematics, and those students planning to attend university achieving even higher scores. While it is likely that achievement also influences aspirations, by encouraging higher achievers to increase their aspirations, the role of this form of feedback was not modelled for the present analysis, because achievement and aspirations were measured concurrently.

The analyses in this report used hierarchical linear modelling to allow for the examination of school effects in the achievement literacy and numeracy. The value of this approach is most evident in the information gained from the *Quality of School Life* subscales. At the student level, the Achievement subscale, which contains items regarding the student's achievement orientation independent of the school, was statistically significant. At the school level, the Positive Affect subscale, which contains items relating to school climate, was statistically significant, reinforcing the notion that school quality has many factors that are manifested in different ways, and that some aspects of school life are indeed student-oriented and some are school-oriented.

How much of the variation in student achievement in literacy and numeracy can be attributed to differences between students and how much can be attributed to differences between schools?

As noted in Chapter 1, data from PISA 2000 show that there are differences between countries in the distribution of the variance in student achievement scores. Across participating countries, an average of 34–36 per cent of the variation in student achievement could be attributed to differences between schools, with the remainder attributed to differences between students. In Australia, the proportion of variance at the school level was about half this range. The present study has found that at Year 9, 14–17 per cent of the variation in literacy and numeracy achievement is between schools, similar to the range found for Australian students who participated in PISA 2000. Why is the between-schools variance lower in Australia, compared to the international average?

LSAY uses data on students in Year 9 in Australian schools. The majority of secondary schools in Australia tend to be comprehensive, enrolling students from areas with generally heterogeneous populations. If all schools were similar in their achievement, there would be very little school-level variation, and nearly all of the variation would be at the student level. Not all Australian schools are comprehensive, however, with a small number of schools catering to the needs of specific populations, such as specialist schools for academically-talented students in State capitals. The 14-to-17 per cent school-level effect reflects this combination of comprehensive and specialist schools, as well as a general consistency in curricula, pedagogies and policies within and between States and Territories. Higher levels of between-school differences would indicate that a greater proportion of the differences in literacy and numeracy achievement could be attributed to schools, and lower levels of between-school differences could be attributed to student differences. Understanding the

relationship between student-level and school-level variation offers policymakers scope for further research and policy development. These issues are discussed later in this chapter.

How much of the variation in student achievement in literacy and numeracy can be explained at each of the student and school levels?

Researchers analysing Australia's PISA 2000 results reported that between 80 and 90 per cent of between-school variance could be explained by school characteristics, and between 23 and 26 per cent of the within-school variance could be explained by student characteristics. The present study found that between 58 and 66 per cent of the between-schools variance in literacy and numeracy achievement could be explained, and between 10 and 11 per cent of the within-schools variance could be explained.

The findings reported here for within-school and between-school variance are lower than those reported in PISA 2000. Because LSAY concentrates on the school-to-work transition, the data collected on school and student characteristics is not as extensive as the data collected for PISA 2000. Nevertheless, the LSAY data reflect the PISA 2000 finding that school SES and school climate explain some of the differences in achievement between schools.

Implications for Policy and Further Research

By understanding what proportion of the variation can be explained in these models, it may be possible to design school programs that address the different influences on achievement and ensure that all students become competent in both literacy and numeracy. For example, because gender is seen as a factor influencing both literacy achievement and numeracy achievement—in different directions—early literacy programs may need to be designed to accommodate needs of male students and early numeracy programs designed to accommodate needs of female students.

The major area of student-level differences was found between Indigenous and non-Indigenous students. A small number of students in the sample—3 per cent—identified as Indigenous, yet the magnitude of the differences in scores indicates that there are serious issues for literacy and numeracy achievement among Indigenous students. Literacy and numeracy programs for Indigenous Australian students are required to increase achievement in these areas. One such program is the National Indigenous English Literacy and Numeracy Strategy (Commonwealth of Australia, 2000), which targets attendance, health, pre-school participation, teaching and accountability to increase Indigenous students' levels of literacy and numeracy. As noted in previous LSAY reports, lower achievement in literacy and numeracy is associated with lower engagement with school (Fullarton, 2002), lower participation in Year 12 and lower tertiary entrance scores (Marks, et al., 2000; Marks, et al., 2001), and less successful transitions from school (Lamb & McKenzie, 2001). Without success in literacy and numeracy, young Indigenous Australians will continue to face difficulty in remaining at school to complete Year 12, entering university and other post-school education and training, and making transitions to stable, full-time employment.

In the study reported here, the *Quality of School Life* subscales operate differently, depending on the level being measured. At the student level, a student's achievement orientation was statistically significant; at the school level, a school's positive affect score was statistically significant. Based on these findings, there needs to be differentiation in attitudinal programs for schools and students. Programs that influence an individual student's sense of accomplishment may influence his or her actual achievement, and schools that work to develop a positive school climate may also develop greater academic achievement in their students.

Socioeconomic status also works at two levels. At the student level, SES has a small, statistically significant effect on student achievement scores, but at the school level, SES has a much larger effect. School SES differences are the result of aggregations of students according to SES: some schools are located in areas of lower income or higher occupational status. The data reported here suggest that the schools with larger proportions of low-SES students experience lower achievement scores, and that schools with larger proportions of high-SES students experience higher scores. As such, programs that provide greater school enrolment choices for children from low-SES families may assist in an increase in achievement scores. Alternatively, schools that serve students from low-SES families may benefit from school-wide programs that ameliorate the effects of poverty, especially programs that emphasise literacy and numeracy achievement.

In addition to educational policies and programs, further research into learning and teaching needs to concentrate more on those areas that explain variation to help determine how these relationships operate. For example, why is there a persistent link between socioeconomic status and school achievement? Is achievement related to the number of educational resources in the home or the opportunities that can be provided at home? How is it that a school with a positive climate influences a student's achievement? Can changes in the school environment alone influence student achievement, or are successful schools also developing stronger interpersonal relationships as they continue to develop approaches to instruction, which students perceive as changes to the school climate?

The data used in the present report were collected from young people in Year 9. This precludes the understanding of how achievement during the early years of school may be influenced by the factors noted here, and how early school achievement influences later school achievement. Are other aspects of literacy, such as word recognition and vocabulary development, influenced by the same background factors during the early years of school? Do other school factors, such as classroom organisation, affect the feedback loop shown in Figure 1, which in turn influences the student's sense of achievement and further achievement in numeracy? Is the influence of SES on student achievement the same at all levels of schooling, or is it greater—and most influential—during the early, formative years?

Previous LSAY research has highlighted the link between literacy and numeracy at Year 9, participation in Year 12 and further study, and gaining and maintaining employment. That research has also shown that SES, Indigenous status and gender, as well as other background factors, are also related to various educational and employment outcomes. Future research should continue to examine the link between school achievement and later outcomes, and incorporate the influence that background factors have on school achievement.

REFERENCES

- Ainley, J., Graetz, B., Long, M. & Batten, M. (1995). *Socioeconomic status and school education*. Canberra: Australian Government Publishing Service.
- Australian Bureau of Statistics (1986). *Australian standard classification of occupations*. (1st ed.). *Statistical classification*. Canberra: Australian Government Publishing Service.
- Australian Bureau of Statistics (1997a). *ASCO. Australian standard classification of occupations* (2nd ed.). Canberra: ABS.
- Australian Bureau of Statistics (1997b). *Aspects of literacy: Assessed literacy skills*. Canberra: Commonwealth of Australia.
- Australian Bureau of Statistics (1999). *Standards for statistics on cultural and language diversity*. Canberra: ABS.
- Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L. & Smith, T.A. (1996). *Mathematics achievement in the middle school years. IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College.
- Bourke, S.F. & Lewis, R. (1976). *Australian studies in school performance, Volume II. Literacy and numeracy in Australian schools: Item Report*. Canberra: Australian Government Publishing Service.
- Bourke, S.F., Mills, J.M., Stanyon, J. & Holzer, F. (1981). *Performance in literacy and numeracy: 1980*. Canberra: Australian Government Publishing Service.
- Burnswoods, J. & Fletcher, J. (1980). *Sydney and the bush: A pictorial history of education in New South Wales*. Sydney: New South Wales Department of Education.
- Bryk, A.S. & Raudenbush, S.W. (1992). *Hierarchical linear models: Applications and data analysis methods*. Newbury Park, CA: Sage.
- Coleman, J.S., Campbell, E.Q., Hobson, C.J., McPartland, J., Mood, A.M., Weinfeld, F.D. & York, R.L. (1966). *Equality of educational opportunity*. Washington: US Government Printing Office.
- Coley, R.J. (2001). *Differences in the gender gap: Comparisons across racial/ethnic groups in education and work*. Princeton: Educational Testing Service.
- Coley, R.J. (2002). *An uneven start: Indicators of inequality in school readiness*. Princeton: Educational Testing Service.
- Commission of Inquiry into Poverty. (1976). *Poverty and education in Australia*. Fifth Main Report. Canberra: Australian Government Publishing Service. (R.T. Fitzgerald, Commissioner).
- Commonwealth of Australia (2000). *National Indigenous English literacy and numeracy strategy*. Canberra: Department of Education, Science and Training.
- Fullarton, S. (2002). *Student engagement with school: Individual and school-level influences*. LSAY Research Report 27. Melbourne: Australian Council for Educational Research.
- Goldstein, H. (1987). *Multilevel models in educational and social research*. London: Charles Griffin & Co. Ltd.
- Green, D.A. & Riddell, W.C. (2001). *Literacy, numeracy and labour market outcomes in Canada*. Ottawa: Statistics Canada.
- Interim Committee of the Australian Schools Commission (1973). *Schools in Australia*. Canberra: Australian Government Publishing Service. (P. Karmel, Chairman).
- Jencks, C., Smith, M., Acland, H., Bane, M.J., Cohen, D., Gintis, H., Heyns, B. & Michelson, S. (1972). *Inequality: A reassessment of the effect of family and schooling in America*. New York: Basic Books.
- Jones, F.L. & McMillan, J. (2001). Scoring occupational categories for social research: a review of current practice, with Australian examples. *Work, Employment and Society*, 15(3), 539-563.
- Jones, R.G. (2002). *Education participation and outcomes by geographic location*. LSAY Research Report 26. Melbourne: Australian Council for Educational Research.
- Keeves, J.P. & Bourke, S.F. (1976). *Australian studies in school performance, Volume I. Literacy and numeracy in Australian schools: A first report*. Canberra: Australian Government Publishing Service.

- Kolen, M.J. & Brennan, R.L. (1995). *Test equating: Methods and practices*. New York: Springer.
- Lamb, S. & McKenzie, P. (2001). *Patterns of success and failure in the transition from school to work in Australia*. LSAY Research Report 18. Melbourne: Australian Council for Educational Research.
- Lee, Y.L. & Miller, P.W. (2000). *Literacy, numeracy and labour market success*. Canberra: Evaluations and Investigations Program, Higher Education Division, Department of Education, Training and Youth Affairs. Retrieved 15 September 2001, from http://www.detya.gov.au/highered/eippubs/eip00_9/eip00_9.pdf
- Lokan, J., Ford, P. & Greenwood, L. (1996). *Maths and science on the line. Australian junior secondary students' performance in the Third International Mathematics and Science Study*. Melbourne: Australian Council for Educational Research.
- Lokan, J., Ford, P. & Greenwood, L. (1997). *Maths and science on the line. Australian middle primary students' performance in the Third International Mathematics and Science Study*. Melbourne: Australian Council for Educational Research.
- Lokan, J. & Greenwood, L. (2001). *Maths and science on the line. Australian Year 12 students' performance in the Third International Mathematics and Science Study*. Melbourne: Australian Council for Educational Research.
- Lokan, J., Greenwood, L. & Cresswell, J. (2001). *15-up and counting, reading, writing, reasoning ... How literate are Australia's students? The PISA 2000 survey of students' reading, mathematical and scientific literacy skills*. Melbourne: Australian Council for Educational Research.
- Long, M. (1996). *Samples and sampling for the Y95 LSAY cohort*. LSAY Technical Report 8. Melbourne: Australian Council for Educational Research.
- Long M. & Fleming, N. (2002). *The designed and achieved sample of the 1998 LSAY sample*. LSAY Technical Report 16. Melbourne: Australian Council for Educational Research.
- Marks, G. & Ainley, J. (1997). *Reading comprehension and numeracy among junior secondary school students in Australia*. LSAY Research Report 3. Melbourne: Australian Council for Educational Research.
- Marks, G.N., Fleming, N., Long, M. & McMillan, J. (2000). *Patterns of participation in Year 12 and higher education in Australia: Trends and issues*. LSAY Research Report Number 17. Melbourne: Australian Council for Educational Research.
- Marks, G.N. & Long, M. (2000). *Weighting the 1995 Year 9 cohort sample for differential response rates and attrition*. LSAY Technical Report 15. Melbourne: Australian Council for Educational Research.
- Marks, G.N., McMillan, J. & Hillman, K. (2001). *Tertiary entrance performance: The role of student background and school factors*. LSAY Research Report 22. Melbourne: Australian Council for Educational Research.
- Marsh, C.J. (1984). *Producing a national curriculum: plans and paranoia*. Sydney: Allen & Unwin.
- Massachusetts Department of Education (2001). *Report of 2000 Massachusetts and local school district MCAS results by race/ethnicity*. Malden, MA: The Author. Retrieved 3 October 2001, from <http://www.doe.mass.edu/mcas/2000/results/rande.pdf>.
- Masters, G.N. & Forster, M. (1997) *Mapping literacy achievement. Results of the 1996 National School Literacy Survey*. Canberra: Department of Education, Training and Youth Affairs.
- McMillan, J. & Marks, G.N. (2003). *School leavers in Australia: Profiles and pathways*. LSAY Research Report 31. Melbourne: Australian Council for Educational Research.
- Ministerial Council on Education, Employment, Training and Youth Affairs (1999). *National report on schooling in Australia 1999*. Melbourne: Curriculum Corporation.
- Ministerial Council on Education, Employment, Training and Youth Affairs (n.d.). *National report on schooling in Australia. Preliminary paper. National benchmark results reading and numeracy years 3 and 5*. Melbourne: MCEETYA.

- Mullis, I.V.S., Martin, M.O., Beaton, A.E., Gonzalez, E.J., Kelly, D.L. & Smith, T.A. (1997). *Mathematics achievement in the primary school years. IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College.
- Mullis, I.V.S., Martin, M.O., Beaton, A.E., Gonzalez, E.J., Kelly, D.L. & Smith, T.A. (1998). *Mathematics achievement in the final year of secondary school. IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College.
- Mullis, I.V.S., Martin, M.O., Fierros, E.G., Goldberg, A.L. & Stemler, S.E. (2000a). *Gender differences in achievement. IEA's Third International Mathematics and Science Study*. Chestnut Hill, MA: Boston College.
- Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Gregory, K.D., Garden, R.A., O'Connor, K.M., Chrostowski, S.J. & Smith, T.A. (2000b). *TIMSS 1999 international mathematics report. Findings from the IEA's Repeat of the Third International Mathematics and Science Study at the eighth grade*. Chestnut Hill, MA: Boston College.
- National Center for Education Statistics (2000). *NAEP trends in academic progress: Three decades of student performance*, NCES 2000-469, by J.R. Campbell, C.M. Hombro, & J. Mazzeo. Washington: US Government Printing Office.
- National Center for Education Statistics (2001). *Pursuing excellence: Comparisons of international eighth-grade mathematics and science achievement from a U.S. perspective, 1995 and 1999*, NCES 2001-028, by P. Gonzales, C. Calsyn, L. Jocelyn, K. Mak, D. Kastberg, S. Arafeh, T. Williams & W. Tsen. Washington: US Government Printing Office.
- New South Wales Department of School Education (1997). *Teaching reading: A K-6 framework*. Sydney: The Author.
- Organisation for Economic Co-operation and Development (2001). *Knowledge and skills for life. First results from PISA 2000*. Paris: OECD.
- Organisation for Economic Co-operation and Development, and Human Resources Development Canada (1997). *Literacy skills for the knowledge society: Further results from the International Adult Literacy Study*. Paris: OECD; and Ottawa: HRDC.
- Organisation for Economic Co-operation and Development, and Statistics Canada (2000). *Literacy in the information age: Final report of the International Adult Literacy Study*. Paris: OECD; and Ottawa: Statistics Canada. Retrieved 29 March 2002, from <http://www1.oecd.org/publications/e-book/8100051e.pdf>
- Raudenbush, S. (1984). *Applications of a hierarchical linear model in educational research*. Unpublished thesis, Harvard University Graduate School of Education.
- Raudenbush, S., Bryk, A., Cheong, Y.F. & Congdon, R. (2000). *HLM 5: Hierarchical linear and nonlinear modeling*. Chicago: Scientific Software International.
- Roberts, P. & Fawcett, G. (1998). *At-risk: A socioeconomic analysis of health and literacy among seniors*. Ottawa: Statistics Canada. Retrieved 15 September 2001, from <http://www.nald.ca/nls/ials/atrisk/atrisk.pdf>
- Rothman, S. (2002). *Achievement in literacy and numeracy by Australian 14-year-olds, 1975-1998*. LSAY Research Report 29. Melbourne: Australian Council for Educational Research.
- Rutter, M., Maugham, B., Mortimore, P., Ousten, J. & Smith, A. (1979). *Fifteen thousand hours: Secondary schools and their effects on children*. Shepton Mallet: Open Books.
- Turney, C., ed. (1975). *Sources in the history of Australian Education: A book of readings*. Sydney: Angus & Robertson.
- Tyler, J.H., Murnane, R.J. & Willett, J.B. (2000). Do the cognitive skills of school dropouts matter in the labor market? *Journal of Human Resources*, 35(4), 748-754.
- U.S. Department of Education (n.d.). *The No Child Left Behind Act of 2001: Summary and overview*. Retrieved 13 June 2002, from <http://www.ed.gov/office/OESE/esea/exec-summ.html>
- Williams, T. & Batten, M. (1981). *The quality of school life*. ACER Research Monograph 12. Melbourne: Australian Council for Educational Research.
- Zammit, S.A., Routitsky, A. & Greenwood, L. (2002). *Mathematics and science achievement of junior secondary school students in Australia*. Melbourne: Australian Council for Educational Research.

APPENDIX 1: VARIABLES USED IN THE ANALYSES**Student-level variables***Social and demographic background*

Gender	Sex? Male/Female
Indigenous Australian	Are you an Aboriginal person or a Torres Strait Islander person? Yes/No
Disability	Do you have a disability which entitles you to receive special funding or access to special education support services? Yes/No
Place of birth Other countries classified as:	Where were you born? Australia/Other Other English-speaking country Non-English speaking country
Main language	What language does your family mostly speak at home? English/Other
Home location	Jones classification, based on home postcode Mainland state capital Major urban region Large provincial city Small provincial city Other provincial (inner/outer) Remote (remote/very remote)

Parent information

Mother's place of birth Other countries classified as:	Where were your parents born? Australia/Other Other English-speaking country Non-English speaking country
Father's place of birth Other countries classified as:	Where were your parents born? Australia/Other Other English-speaking country Non-English speaking country
Father's occupation	Occupation coded to ASCO, then ANU4 scale
Mother's occupation	Occupation coded to ASCO, then ANU4 scale
Father's education level/ mother's education level	What is the highest level of education your father and mother have completed? No secondary school Some secondary school All years of secondary school Trade or technical qualification Degree or diploma Don't know

Attitudes

<i>Quality of School Life</i> subscales	Based on Williams & Batten (1981) Interest/Motivation Teachers Opportunity Achievement Positive affect
---	---

Self-concept	Compared with most of the students in your year level at school, how well are you doing in English/Mathematics/your school subjects overall? Very poorly Not very well About average Better than average Very well
<i>Aspirations</i>	
Plans to complete Year 12	When do you plan to leave school? At the end of Year 10 At the end of Year 11 At the end of Year 12 I haven't made up my mind
Plans to do further study	Do you plan to do any further study at any time after you leave school? Yes/No
Plans to attend university	What type of course do you plan to do? University course/ Apprenticeship/Other TAFE course/Other
<i>Employment</i>	
Current employment	Do you currently (in August, September or October) have a part-time or casual job? Yes/No
School-level variables	
<i>Quality of School Life</i> (school means)	Interest/Motivation Teachers Opportunity Achievement Positive affect
Mean school SES	Mean of parents' ANU4 scores
Percent NESB	Percentage of students in the school who indicated they mostly spoke a language other than English at home

APPENDIX 2: SUMMARY STATISTICS

Table A 1 Weighted and unweighted counts, mean scores and standard errors for selected subgroups on reading comprehension and mathematics tests, LSAY 1995 (Y95) cohort

	Count		Reading		Mathematics	
	unweighted	weighted	mean	s.e.	mean	s.e.
Total cohort	13 613	13 613	49.6	0.26	49.8	0.27
Gender						
Male	6 717	6 653	48.6	0.35	50.7	0.36
Female	6 896	6 960	50.6	0.27	49.0	0.29
Indigenous Australians						
Indigenous	389	377	43.6	0.55	43.9	0.52
Parent occupation group (a)						
Managers/Administrators	2 635	2 620	51.3	0.26	51.6	0.28
Professionals	1 987	1 935	54.0	0.29	54.3	0.36
Para-Professionals	541	530	51.0	0.44	50.5	0.45
Tradespersons	2 135	2 171	48.5	0.29	48.8	0.28
Clerks	647	574	51.3	0.52	51.0	0.49
Salespersons/Personal Service	1 078	1 078	49.7	0.40	49.7	0.37
Plant & Machine Opers/Drivers	412	414	49.3	0.68	48.9	0.54
Labourers/Related Workers	1 330	1 331	48.0	0.37	48.1	0.37
Home location (b)						
Mainland state capital	7 348	7 677	49.6	0.40	50.1	0.42
Major urban region	1 565	1 273	49.4	0.72	49.9	0.75
Large provincial city	1 041	933	49.3	0.75	48.6	0.79
Small provincial city	527	582	50.4	0.79	50.4	0.50
Other provincial (inner/outer)	2 498	2 646	49.9	0.39	49.8	0.34
Remote (remote/very remote)	621	485	48.2	0.58	47.3	0.68
Father completed post-secondary education						
Yes	4 555	4 506	52.7	0.24	52.9	0.31
No	4 607	4 684	49.2	0.24	49.1	0.24
Mother completed secondary education						
Yes	5 678	5 609	51.8	0.24	51.9	0.29
No	3 683	3 778	49.4	0.27	49.0	0.24
Country of birth						
Australian born	11 666	11 630	50.1	0.24	50.0	0.24
Other English-speaking	498	467	50.6	0.63	50.3	0.66
Non-English-speaking	901	957	46.0	0.71	49.7	0.77
Mother's Country of birth						
Australian born	9 183	9 156	50.3	0.23	50.2	0.24
Other English-speaking	1 431	1 307	51.3	0.37	50.3	0.36
Non-English-speaking	2 254	2 426	47.4	0.56	49.2	0.56
Plans to Complete Year 12						
Yes	9 603	9 577	51.3	0.25	51.4	0.27
No	3 713	3 750	47.0	0.62	47.5	0.67
Plans to Attend University						
Yes	6 388	6 299	52.9	0.24	53.2	0.29
No	6 574	6 684	46.7	0.26	46.9	0.23
Quality of School Life: Achievement						
0-14	1 870	1 912	46.8	0.35	46.4	0.34
15-16	1 999	2 040	48.4	0.32	48.5	0.33
17-18	4 788	4 734	49.9	0.29	50.1	0.28
19-20	2 478	2 483	50.7	0.32	51.1	0.34
21-24	2 129	2 095	52.3	0.32	52.8	0.38

(a) Occupational groupings based on the Australian Standard Classification of Occupations (ABS, 1986)

(b) Home location based on categories in Jones (2002).

Table A 2 Weighted and unweighted counts, mean scores and standard errors for selected subgroups on reading comprehension and mathematics tests, LSAY 1998 (Y98) cohort

	Count		Reading		Mathematics	
	unweighted	weighted	mean	s.e.	mean	s.e.
Total cohort	14 117	14 117	49.9	0.27	49.6	0.28
Gender						
Male	7 227	7 208	48.7	0.31	50.2	0.33
Female	6 804	6 829	51.1	0.31	49.0	0.36
Indigenous Australians						
Indigenous	453	457	42.3	0.54	43.6	0.62
Parent occupation group (a)						
Managers/Administrators	1 852	1 880	51.8	0.33	51.3	0.34
Professionals	2 499	2 386	54.4	0.35	54.2	0.42
Associate Professionals	1 435	1 399	51.6	0.34	50.7	0.39
Tradespersons/Related Workers	2 575	2 580	49.0	0.26	48.7	0.26
Advanced Clerical & Service	109	100	51.1	0.92	51.2	1.06
Intermed Clerical Sales & Service	734	734	50.3	0.38	49.7	0.41
Intermed Production & Transport	1 380	1 472	47.7	0.37	47.3	0.32
Elem Clerical Sales & Service	419	214	48.9	0.55	48.8	0.52
Labourers/Related Workers	806	836	47.1	0.42	46.7	0.39
Home location (b)						
Mainland state capital	7 758	7 750	49.7	0.38	49.3	0.40
Major urban region	1 920	1 826	51.2	0.93	51.7	0.98
Large provincial city	1 327	991	50.7	0.52	50.2	0.50
Small provincial city	521	598	49.0	0.95	49.7	1.02
Other provincial (inner/outer)	2 219	2 643	49.6	0.41	49.1	0.39
Remote (remote/very remote)	356	293	48.5	0.97	47.7	1.12
Father completed post-secondary education						
Yes	4 272	4 207	53.3	0.35	52.9	0.41
No	9 845	9 910	48.4	0.22	48.2	0.22
Mother completed secondary education						
Yes	7 139	6 883	51.7	0.30	51.5	0.34
No	5 642	5 887	48.6	0.25	48.3	0.25
Country of birth						
Australian born	12 936	12 950	50.0	0.26	49.6	0.26
Other English-speaking	221	205	51.0	0.72	50.3	0.79
Non-English-speaking	960	962	48.0	0.75	50.0	0.76
Mother's Country of birth						
Australian born	10 260	10 306	50.0	0.26	49.6	0.27
Other English-speaking	1 474	1 391	50.5	0.39	49.7	0.37
Non-English-speaking	2 383	2 420	48.8	0.54	49.7	0.56
Plans to Complete Year 12						
Yes	10 529	10 404	51.5	0.27	51.1	0.30
No	3 588	3 713	45.2	0.27	45.4	0.26
Plans to Attend University						
Yes	7 209	6 968	53.3	0.29	52.9	0.34
No	6 908	7 149	46.5	0.22	46.4	0.20
Quality of School Life: Achievement						
0-14	1 667	1 643	46.6	0.43	46.1	0.40
15-16	2 046	2 030	48.2	0.36	47.7	0.34
17-18	5 130	5 187	49.6	0.29	49.5	0.30
19-20	2 605	2 616	50.8	0.34	50.7	0.36
21-24	2 321	2 291	53.6	0.34	53.2	0.40

(a) Occupational groupings based on the Australian Standard Classification of Occupations, 2nd ed. (ABS, 1997a).

(b) Home location based on categories in Jones (2002).

APPENDIX 3: RAW SCORE TO SCALED SCORE CONVERSION TABLES**Table A 3 Raw score to scaled score conversion tables for reading comprehension and mathematics tests, LSAY 1995 (Y95) and LSAY 1998 (Y98) cohorts**

Raw Score (Number Correct)	Reading Comprehension		Mathematics	
	1995	1998	1995	1998
20	71.2	74.1	74.2	74.5
19	67.1	70.0	70.4	70.7
18	63.2	65.9	66.6	66.9
17	59.6	62.1	62.9	63.4
16	56.5	58.8	59.6	60.1
15	53.7	55.9	56.6	57.1
14	51.1	53.1	53.9	54.4
13	48.5	50.5	51.2	51.8
12	46.0	47.9	48.5	49.2
11	43.7	45.4	45.9	46.6
10	41.5	43.1	43.5	44.1
9	39.4	40.9	41.2	41.8
8	37.2	38.7	38.9	39.5
7	34.9	36.5	36.4	37.1
6	32.4	34.0	33.8	34.5
5	29.7	31.4	31.0	31.7
4	26.8	28.5	28.0	28.5
3	23.6	25.3	24.6	25.0
2	20.2	21.6	21.0	21.0
1	16.5	17.5	17.0	16.7
0	12.9	13.1	13.0	12.2

APPENDIX 4: DISTRIBUTION OF SES WITHIN SCHOOLS

Y95 Cohort

Overall mean SES (ANU4)	48.3	Lowest school mean	27.2
Standard deviation	22.9	Highest school mean	77.4

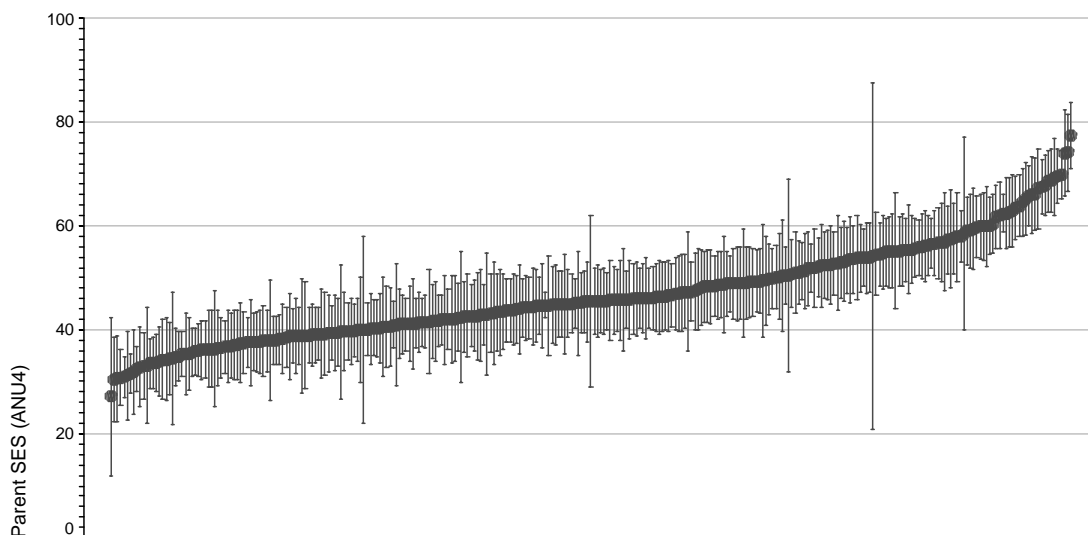


Figure A 1 Distribution of school mean SES, showing 95% confidence intervals, Y95 cohort

Y98 Cohort

Overall mean SES (ANU4)	47.4	Lowest school mean	23.2
Standard deviation	23.3	Highest school mean	74.2

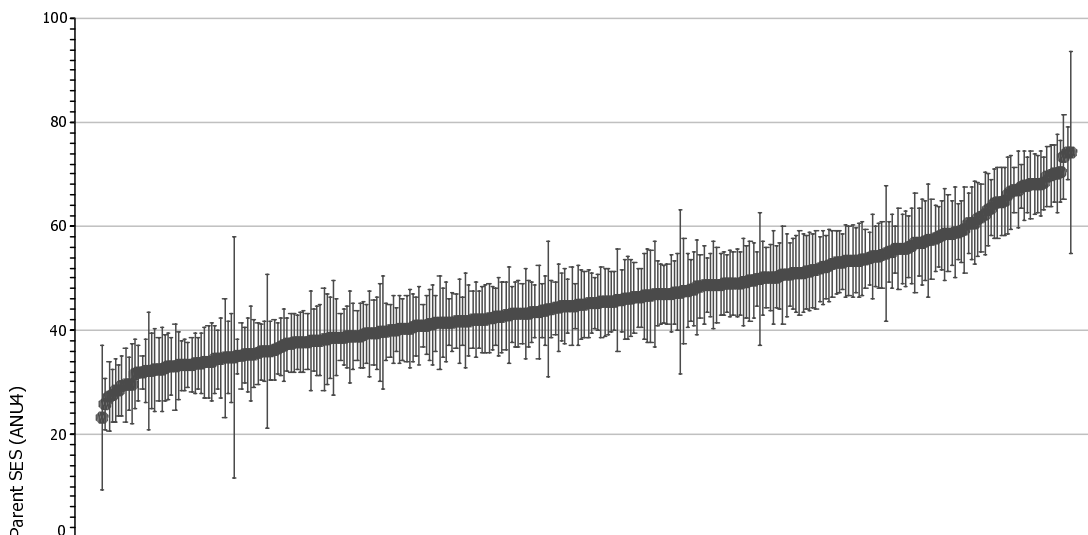


Figure A 2 Distribution of school mean SES, showing 95% confidence intervals, Y98 cohort