

ACER Research Monograph No. 61

**Growth in Literacy and Numeracy in the
First Three Years of School**

Marion Meiers
Siek Toon Khoo
Ken Rowe
Andrew Stephanou
Prue Anderson
Kathy Nolan

June 2006

This publication is the result of research that formed part of a program supported by a grant to the Australian Council for Educational Research by State, Territory and Commonwealth governments. The support provided by these governments is gratefully acknowledged.

The views expressed in this report are those of the authors and not necessarily those of the Commonwealth, State and Territory governments.

Published 2006 by
Australian Council *for* Educational Research Ltd
19 Prospect Hill Road, CAMBERWELL VICTORIA 3124 AUSTRALIA
Copyright © 2006 Australian Council *for* Educational Research
National Library of Australia Cataloguing-on-Publication
Growth in Literacy and Numeracy in the First Three Years of School
Bibliography.

ISBN 978 086431 589 2.

ISBN 0 86431 589 9.

1. Literacy - Australia. 2. Numeracy - Australia.
 3. Educational tests and measurements - Australia.
 4. Education, Primary - Australia. I. Meiers, Marion.
- II. Australian Council for Educational Research.
(Series: ACER research monograph; 61).

Acknowledgments

The authors would like to thank the following for granting permission to reproduce the copyright material in this report.

Page 19, excerpt reproduced from *Handa's Surprise*, written and illustrated by Eileen Browne. Text and illustrations © 1994 Eileen Browne. Reproduced by permission of Walker Books Ltd., London, SE11 5HJ.

Page 19, excerpt reproduced from *Monkey on the Roof*, written by Margaret Clough and illustrated by Naomi C Lewis. Text © 2000 Margaret Clough. Illustrations © 2000 Nelson ITP. Reproduced by permission of Thomson Learning.

Page 31, excerpt reproduced from *The Magical Bicycle*, written by Berlie Doherty and illustrated by Christian Birmingham. Text © 1995 Berlie Doherty. Illustrations © 1995 Christian Birmingham. Reproduced by permission of HarperCollins Publishers Ltd.

Page 31, excerpt reproduced from *Kitty Cat Plays Inside*, written by Annette Smith and illustrated by Ben Spiby. Text © 2000 Annette Smith. Illustrations © 2000 Nelson ITP. Reproduced by permission of Thomson Learning.

Page 40, excerpt reproduced from *Sea Turtles*, written by Stanley Swartz and photography by Robert Yin. Text © 1999 Dominic Press, Inc. Photographs © 1999 Robert Yin. Reproduced by permission of Dominic Press, Inc.

Page 40, excerpt reproduced from *Meet My Mouse*, written by Fay Robinson and photography by Dwight R. Huhn. Copyright © 1993 Scott, Foresman and Company. Reproduced by permission of Pearson Education, Inc.

Contents

TABLES.....	IV
FIGURES	IV
PREFACE	VI
EXECUTIVE SUMMARY	VII
1. INTRODUCTION	1
The Context for a Longitudinal Literacy and Numeracy Study	1
2. THE LLANS PROJECT.....	3
Purposes	3
Theoretical Framework	3
Methodology	3
Assessing Development in Literacy and Numeracy.....	9
3. ASSESSING LITERACY DEVELOPMENT.....	10
The First Year at School: Literacy	10
The Second Year at School: Literacy.....	30
The Third Year at School: Literacy	51
4. ASSESSING NUMERACY DEVELOPMENT.....	63
The First Year at School: Numeracy.....	63
The Second Year at School: Numeracy	78
The Third Year at School: Numeracy	94
5. THE FIRST THREE YEARS OF SCHOOL: LITERACY AND NUMERACY	103
Students' Performance on the LLANS Literacy Scale.....	103
Students' Performance on the LLANS Numeracy Scale	105
6. LITERACY AND NUMERACY ACHIEVEMENT GROWTH.....	107
Individual Differences in Literacy and Numeracy Achievement Growth.....	107
Modelling Literacy Growth	112
Modelling Numeracy Growth	113
Association of Literacy and Numeracy Growth.....	114
Summary	114
7. LITERACY AND NUMERACY IN THE FIRST THREE YEARS OF SCHOOL: CONCLUSIONS	115
Literacy and Numeracy Assessment in the Early Years	115
The LLANS Scales of Developing Literacy and Numeracy Achievement.....	115
Student Achievement in Literacy and Numeracy.....	115
Individual Differences in Literacy and Numeracy Achievement Growth.....	117
Links Between LLANS and Other Studies	117
LLANS in the Middle and Later Years of Primary School.....	118
REFERENCES.....	119
LLANS PAPERS, 1998-2006	122

TABLES

Table 2.1: Random and target samples.....	4
Table 2.2: Schools in states and territories	4
Table 2.3: LLANS data gathering schedule	5
Table 3.1: Literacy assessment tasks, Survey 1.....	10
Table 3.2: Marking Guide for retelling, Survey 1	12
Table 3.3: Marking Guide: Illustrations	12
Table 3.4: Concepts about print.....	15
Table 3.5: Literacy assessment tasks, Survey 2.....	18
Table 3.6: Marking Guide for retelling, Survey 2	21
Table 3.7: Marking Guide: Explaining the title.....	21
Table 3.8: Performance against the writing criteria.....	24
Table 3.9: Percentage of students identifying sounds correctly	24
Table 3.10: Marking Guide: Reading Fluency	25
Table 3.11: Literacy assessment tasks, Survey 3.....	30
Table 3.12: Marking Guide: Writing content	35
Table 3.13: Marking Guide: Writing language.....	35
Table 3.14: ‘ike’ words	36
Table 3.15: Marking Guide: Reading fluency	36
Table 3.16: Literacy assessment tasks, Survey 4.....	39
Table 3.17: Locating information.....	42
Table 3.18: Marking Guide: Writing content	44
Table 3.19: Marking Guide: Writing language.....	44
Table 3.20: Range in difficulty of the eight words the teacher asked the student to spell.....	45
Table 3.21: Marking Guide: Reading fluency	45
Table 3.22: Phonemic awareness tasks.....	46
Table 3.23: Literacy assessment tasks, Survey 5.....	51
Table 3.24: Marking Guide: Writing content	57
Table 3.25: Marking Guide: Writing language.....	57
Table 3.26: Range in difficulty of the six words the teacher asked the student to spell	58
Table 3.27: Marking Guide: Reading fluency	58
Table 4.1: Numeracy assessment tasks, Survey 1	63
Table 4.2: Number assessment tasks	65
Table 4.3: Number tasks involving mental calculation	65
Table 4.4: Space assessment tasks.....	66
Table 4.5: Numeracy assessment tasks, Survey 2	69
Table 4.6: Reciting Numbers.....	72
Table 4.7: Chance and data task	73
Table 4.8: Numeracy assessment tasks, Survey 3	78
Table 4.9: Marking Guide: Number	81
Table 4.10: Marking Guide: Counting	82
Table 4.11: Marking Guide: Space.....	82
Table 4.12: Numeracy assessment tasks, Survey 4	85
Table 4.13: Grouping	88
Table 4.14: Marking Guide: Counting task 1	88
Table 4.15: Counting	89
Table 4.16: Numeracy assessment tasks, Survey 5	95
Table 4.17: Number.....	97
Table 4.18: Number: Written/Mental problems	97

FIGURES

Figure 3.1: LLANS Literacy Item Map for Survey 1	17
Figure 3.2: LLANS Literacy Item Map for Survey 2	27
Figure 3.3: LLANS Literacy Scale description and achievement distributions for the first year of school	29
Figure 3.4: LLANS Literacy Item Map for Survey 3	38
Figure 3.5: LLANS Literacy Item Map for Survey 4	48
Figure 3.6: LLANS Literacy Scale description and achievement distributions for the second year of school	50
Figure 3.7: LLANS Literacy Item Map for Survey 5	60
Figure 3.8: LLANS Literacy Scale description and achievement distributions for the third year of school	62
Figure 4.1: LLANS Numeracy Item Map for Survey 1	68
Figure 4.2: LLANS Numeracy Item Map for Survey 2	75
Figure 4.3: LLANS Numeracy Scale description and achievement distributions for the first year of school	77
Figure 4.4: LLANS Numeracy Item Map for Survey 3	84
Figure 4.5: LLANS Numeracy Item Map for Survey 4	91
Figure 4.6: LLANS Numeracy Scale description and achievement distributions for the second year of school	93
Figure 4.7: LLANS Numeracy Item Map for Survey 5	100
Figure 4.8: LLANS Numeracy Scale description and achievement distributions for the third year of school	102
Figure 5.1: LLANS Literacy Scale description and achievement distributions for the first three years of school	104
Figure 5.2: LLANS Numeracy Scale description and achievement distributions for the first three years of school	106
Figure 6.1: An Individual Literacy Progress Map	108
Figure 6.2: An Individual Numeracy Progress Map	109
Figure 6.3: An individual growth trajectory	110
Figure 6.4: Individual variation in growth trajectories	110
Figure 6.5: Individual growth trajectories in literacy and numeracy	111
Figure 6.6: Average growth trajectories in literacy development (Survey 1 to Survey 5)	112
Figure 6.7: Average growth trajectories in numeracy development (Survey 1 to Survey 5)	113

PREFACE

The development of strong foundational literacy and numeracy skills for all students is a very high priority for schools, education systems and governments. The ways in which children develop these skills during the crucial years of primary education are of major interest to all concerned with students' learning and development. The ACER Longitudinal Literacy and Numeracy Study (LLANS), which commenced in 1999, undertook an investigation of the nature of literacy and numeracy development amongst Australian school children in their first seven years of schooling.

This report describes the findings from the first three years of the ACER Longitudinal Literacy and Numeracy Study, spanning the period in which the students in the study entered school and continued into their second and third years at school.

The Longitudinal Literacy and Numeracy Study drew from a wide range of expertise within ACER. In conducting a longitudinal study involving nearly 1000 children in all Australian states and territories, the project drew on the skills and knowledge of curriculum experts, item writers, psychometricians and researchers, and project support staff. Particular thanks are due to Geoff Masters and Margaret Forster for the initial conceptualisation of this longitudinal research project; to Wendy Bodey, Lynne Darkin, Eve Recht and Prue Anderson, who played a key role in the development of the early years LLANS assessment activities; to Siek Toon Khoo, Ken Rowe, Andrew Stephanou, and Daniel Urbach who undertook the detailed work involved in constructing the LLANS scales for literacy and numeracy achievement; and to Siek Toon Khoo for analysing the longitudinal data set and modelling the literacy and numeracy growth. Over several years Silvia McCormack and Kathy Nolan provided considerable support to the project director in the overall management of the study. Their work is very much appreciated. Thanks are also due to Clare Ozolins and Christine Rosicka for their administrative assistance.

The research for this project formed part of a program supported by a grant to the Australian Council for Educational Research by state, territory and Commonwealth governments. The support provided by these governments is gratefully acknowledged. ACER also acknowledges the support of state and territory education authorities who gave permission for ACER to approach schools to invite them to participate in the project.

Finally, we wish especially to note our appreciation of the principals of all schools involved, and the many teachers in those schools who generously, and with great professionalism, undertook the considerable amount of work involved in conducting interview assessments in both literacy and numeracy with their students. Initially 100 schools were involved in the sample, but as students changed schools for a variety of reasons, a much larger number of schools and teachers became involved in the project. Many teachers were partners in this project, and it is important to acknowledge that the LLANS could not have been established and sustained without their support. ACER thanks them for their interest and commitment.

Marion Meiers
LLANS Project Director
Australian Council *for* Educational Research

EXECUTIVE SUMMARY

This report describes findings from the first three years of the ACER Longitudinal Literacy and Numeracy Study (LLANS). The longitudinal study was established in 1999 in a context in which there was significant national interest in improving achievement in literacy and numeracy for all Australian children, and a particular interest in the development of foundational skills in the early years of school. In 2006, improving literacy and numeracy achievement continues to be a high priority in Australia.

It was decided in 1998 that a national longitudinal study conducted by the Australian Council for Educational Research would create an opportunity to undertake an extensive study of growth in literacy and numeracy across the years of primary school. Scales of developing literacy and numeracy achievement could be developed within this study, and make it possible to show growth from the first year at school until the end of primary school.

The key research question in this longitudinal study was: “What is the nature of literacy and numeracy development amongst Australian school children?”

A nation-wide sample of 100 schools was selected in proportion to the population of each state and territory, and ten students were randomly selected from each of these schools. This provided a cohort for LLANS of 1000 children who commenced school in 1999.

THE LLANS ASSESSMENTS

The literacy and numeracy tasks in the series of five surveys which comprised the assessments in the first three years of the study were developed with a view to gathering a broad range of responses to critical aspects of literacy and numeracy. The assessments were administered by the students’ own teachers in a one-to-one interview situation. Assessments were conducted at the beginning and end of the first and second years of school, and in the second term of the third year at school. These five surveys formed a set of five linked assessments that were used to collect the student achievement data used in the development of literacy and numeracy measurement scales.

THE LLANS SCALES OF DEVELOPING LITERACY AND NUMERACY ACHIEVEMENT

Measurement scales for literacy and for numeracy across the first three years of school were constructed using the LLANS assessment tasks. These scales made it possible to track growth in literacy and numeracy achievement over time, for groups of students and for individuals.

STUDENT ACHIEVEMENT IN LITERACY AND NUMERACY

There was a wide distribution of literacy achievement at school entry and this wide distribution was observed through the first three years of school. All students in the cohort made progress in literacy achievement over the first three years of school.

There was also a wide distribution of numeracy achievement across the whole cohort on each assessment occasion in the first three years of school. All students in the cohort made progress in numeracy achievement over the first three years of school.

Overall, girls achieved slightly better than boys in literacy in the first three years of school, while boys progressed slightly faster than girls in numeracy. The level of development in literacy and numeracy at school entry varied between schools. The wide distribution of literacy and numeracy achievement noted at school entry continued through the first three years at school.

INDIVIDUAL DIFFERENCES IN LITERACY AND NUMERACY ACHIEVEMENT GROWTH

Individual student performances in literacy and numeracy were estimated for each assessment on the LLANS Literacy Scale and on the LLANS Numeracy Scale. Individual differences in student growth across the first three years of school were investigated.

It was found that there was significant variation in students' literacy achievement at school entry, and in the growth rate of literacy development. There was significant variation in the level of development in numeracy at the time of school entry, and there was also significant variation in the growth rate of numeracy development. There were no significant gender differences in literacy growth rates in the first three years of school. However, boys sustained a faster growth rate in numeracy than girls in the first three years of school.

RELATED RESEARCH STUDIES

The usefulness of the set of linked literacy and numeracy assessment tasks for the first three years of school and the LLANS literacy and numeracy scales has been recognised, and they have been used as key research tools in a number of other research projects for studying children's growth in literacy and numeracy, and in teacher effectiveness studies. These studies include the ACER Indigenous LLANS project, and a national study of effective literacy teaching practices.

LLANS IN YEAR 3 TO YEAR 6

The Longitudinal Literacy and Numeracy Study continued beyond the first three years of school until 2005, when the students in the sample were in Year 6. A companion volume to this report will present the findings relating to Year 3 to Year 6.

1. INTRODUCTION

THE CONTEXT FOR A LONGITUDINAL LITERACY AND NUMERACY STUDY

In 1998, when work commenced on the Longitudinal Literacy and Numeracy Study (LLANS), there was strong interest in the development of foundational skills in literacy and numeracy for all Australian children. A number of major initiatives at the time created an educational context in which a longitudinal study was of particular relevance.

In 1998, the commitment of the Ministers for Education in the States, the Territories and the Australian Government to literacy and numeracy education in Australian schools was clearly articulated in the National Literacy and Numeracy Plan agreed to by the Ministers in March 1997 (Department of Employment, Education, Training and Youth Affairs, 1998). The plan emphasised the importance of literacy and numeracy, and called for a coordinated approach by the Commonwealth and the States and Territories to improving literacy and numeracy standards.

The plan comprised five interrelated elements:

- assessment of all students as early as possible in the first years of schooling,
- early intervention,
- the development of agreed benchmarks for specific year levels against which students' achievement could be measured,
- national reporting against the benchmarks within the annual National Report on Schooling in Australia, and
- professional development for teachers to support the key elements of the plan.

The goal contained within the plan, “*that every child leaving primary school should be numerate, and be able to read, write and spell at an appropriate level*”, focused attention on the primary school years as a whole. The related sub-goal, that every child commencing school from 1998 will achieve a minimum acceptable literacy and numeracy standard within four years, focused more closely on the crucial early years of schooling.

The national goal for literacy was reaffirmed in 1999 when State, Territory and Australian Government Ministers of Education endorsed new *National Goals for Schooling* (Ministerial Council on Education, Employment, Training and Youth Affairs, 1999) and agreed that, in relation to literacy and numeracy, upon leaving school:

students should have attained the skills of numeracy and English literacy; such that every student should be numerate, able to read, write, spell and communicate at an appropriate level.

One of the key elements of the national plan was realised by the publication of national literacy and numeracy benchmarks for Years 3, 5 and 7 which were agreed by Australian, state and territory ministers of education in 1998. The benchmarks articulate nationally agreed minimum acceptable standards in literacy for the year levels of achievement necessary for students to be able to make further progress at school (Curriculum Corporation, 1998, 2000a, 2000b). The benchmarks have enabled reporting to the Australian community of aggregated student achievement data against common minimum standards through the annual MCEETYA National Report on Schooling in Australia.

In such a context, where literacy and numeracy achievement is a matter of public interest, it is important to understand the nature of development in literacy and numeracy across the years of schooling. Elements of the *National Literacy and Numeracy Plan*, such as the assessment of all

students by their teachers as early as possible in the first years of schooling, and the development of agreed benchmarks in literacy and numeracy for Year 3, Year 5 and Year 7 (Curriculum Corporation, 1998, 2000a, 2000b) created a context in which increased understanding of the patterns and sequences of growth in literacy and numeracy would be highly relevant. The plan had a strong focus on the crucial early years of schooling (Department of Employment, Education, Training and Youth Affairs, 1998) The LLANS project was designed to report on comprehensive explorations of growth in those early years, and to continue the investigation throughout primary schooling until students in the study made the transition to secondary school.

The 1996 *National School English Literacy Survey* (NSELS) (Masters & Forster, 1997) provided a comprehensive mapping of literacy achievement in reading, viewing, writing, speaking, and listening for students in Year 3 and Year 5. The NSELS provided snapshots of achievement at these two year levels. Although NSELS was not a longitudinal study, the report noted that it had been ‘possible to quantify student achievements at Year 3 and Year 5 on the same scale and so these achievements can be directly compared in each aspect of literacy and an estimate can be made of typical ‘growth’ over these two years of schooling’. (Masters & Forster, 1997) The most significant finding from the NSELS was the wide range of achievement among the sample of Australian school children at both Year 3 and Year 5: ‘Data from the Main Sample in the Survey indicated that the top 10 per cent of students at both year 3 and year 5 are working about five year levels ahead of the bottom 10 per cent of students’. (Masters & Forster, 1997).

It was decided that a national longitudinal study would create an opportunity to undertake a more extensive study of growth across the years of primary school. Scales of developing literacy and numeracy achievement could be developed within this study, and make it possible to describe growth from the first year at school until the end of primary school.

The LLANS was therefore established in a context where there was significant national interest in improving achievement in literacy and numeracy for all Australian children, and a particular interest in the development of foundational skills in the early years of school. Planning for the LLANS project commenced at ACER in March 1998, with the intention of gathering the first set of student achievement data in March 1999.

This report covers the first three years of the LLANS project, that is, the first three years of school, often referred to as the ‘early years’. A further report will present the findings from Years 3 – 6 in primary schools.

2. THE LLANS PROJECT

PURPOSES

The ACER Longitudinal Literacy and Numeracy Study (LLANS) was designed to follow the growth in literacy and numeracy of a single cohort of students across the years of primary school. The key research question in this seven-year longitudinal study was: “What is the nature of literacy and numeracy development amongst Australian school children?” As a national longitudinal study, the LLANS created an opportunity to develop achievement scales describing growth in literacy and numeracy from the very first year of schooling.

THEORETICAL FRAMEWORK

The LLANS is underpinned by the concept of developmental assessment. If we can measure students’ performance in an area of learning using the same ruler over time, then we can construct a progress map (Masters and Forster, 1997) to describe typical progression of development in that area of learning. This progress map can provide a framework for reporting development of individual students based on repeated measures of achievement by these students. Locating students’ achievements on the same scale over time can be useful in a variety of ways. An individual student’s growth over time can be described. The progress of groups of students can be compared over time. The relative achievement levels of particular cohorts of students can be identified at different stages or year levels of schooling. It is also possible to compare achievements in the same learning area among individual students. The LLANS scales were constructed based on the Rasch model (Masters, 1982; Rasch, 1960) to provide progress maps for literacy and numeracy.

METHODOLOGY

A longitudinal design was chosen as the most appropriate means of identifying patterns of growth in literacy and numeracy achievement. In cross-sectional studies different students are assessed at a particular point in schooling, and this data is sometimes used to infer developmental patterns. A longitudinal design made it possible to investigate development and growth by following the same cohort of students across seven years of schooling, in order to identify the changes in what students know and can do.

THE SAMPLE

This longitudinal study involved children who commenced school in 1999. One thousand children from a random Australia-wide sample of 100 schools, selected in proportion to the population size of each state and territory, formed the original cohort for the LLANS. Eighty schools were selected from the ACER Australian sampling frame as a random sample, and a further 20 schools were selected as a target sample in consultation with state and territory education authorities. With the approval of the education authorities the principals of these schools were invited to participate in the study. If a principal was unable to commit the school to participation in a seven year study, a replacement school from the sample drawn from the ACER national sampling frame was approached. Table 2.1 shows the numbers of schools from each sector and Table 2.2 shows the number of schools from each state and territory.

Table 2.1: Random and target samples

School Type	Random Sample	Target Sample
Government schools	59	9
Catholic schools	15	8
Independent schools	6	3
Total	80	20

Table 2.2: Schools in states and territories

State	Number
Australian Capital Territory	3
New South Wales	31
Northern Territory	2
Queensland	17
South Australia	10
Tasmania	3
Victoria	23
Western Australia	11
Total	100

Ten students were randomly selected from class lists provided to ACER at the beginning of the 1999 school year by the 100 schools in the project, and the approval was obtained from the parents of these children for their participation in the study. This created a total sample of 1000 students for the study. The starting age for schooling varies across the Australian states and territories, from 4.5 years to 5.11 years. As the cohort included students from all states and territories, the students would have been aged between 4.6 and 6 years old at the time of the first survey.

Almost all students in the sample, 980, completed the first literacy and numeracy assessments. A questionnaire seeking key information about the students was sent to all schools in 1999. Seven hundred and sixty responses were received. The missing data limited the scope of the analyses that could be carried out. Further student background information was collected in the final year of the study, 2005, from a large proportion of the students who remained in the study. The student background information collected in 1999 indicated that in the sample of 760 returns 53% were female and 47% were male. Four per cent were of Aboriginal and Torres Strait Islander background. Nine per cent spoke a language other than English at home. Four per cent suffered from a disability. Less than 1% of the students were born in 1983, 4% were born in 1992, 74% in 1993, and 22% in 1994.

The students were the focus of this study, not the schools. When students transferred to another school, they were retained in the study if their destination was known, and if the new school agreed to carry out the assessments.

THE DATA GATHERING SCHEDULE

Table 2.3 shows the data gathering schedule for each year of the study. In each survey, students completed assessments in literacy and numeracy. Two surveys were conducted in the first two years of school, in order to take account of the amount of learning that occurs in those years. Each round of assessments was identified as a survey, with the school entry assessment in 1999 being Survey 1. Over the course of the whole seven-year study, nine surveys were developed and administered.

Table 2.3: LLANS data gathering schedule

1 st year* of school 1999	2 nd year of school 2000	3 rd year of school 2001	4 th year of school 2002	5 th year of school 2003	6 th year of school 2004	7 th year of school 2005
Survey 1 Term 1	Survey 3 Term 1					
		Survey 5 Term 2	Survey 6 Term 2	Survey 7 Term 2	Survey 8 Term 2	Survey 9 Term 2
Survey 2 Term 4	Survey 4 Term 4					

DEVELOPING THE CONCEPTUAL FRAMEWORK

A review of assessment approaches, longitudinal studies, and studies of literacy and numeracy development in the early years of school was undertaken at the commencement of the study. This review informed the design of the study, and the development of appropriate assessment instruments.

Several studies of baseline assessment in the first year of school were reviewed. These included a recent national survey of literacy and numeracy assessment in the early years of school (Curriculum Corporation, 1999), a major study of current practice in baseline assessments (Wolfendale, 1993), and other studies of baseline assessment (Blatchford & Cline, 1992; Lindsey & Desforges, 1998).

Information about school entry assessment in Australia and internationally was collected from a number of sources, including a South Australian resource on school entry assessment (Department of Education, Training and Employment South Australia, 1999) and work from New Zealand (New Zealand Ministry of Education, 1997).

Recent national and international studies of literacy in the early years of schooling were reviewed, with a specific focus on the acquisition and development of literacy, and assessment approaches and instruments (Adams, 1994; Brooks *et al.*, 1999; Crévola & Hill, 1998a, 1998b, 1998c; David *et al.*, 2000; Department of Education, Community and Cultural Development Tasmania, 1997; Education Department of Western Australia, 1994; Hill *et al.*, 1998; Holdaway, 1979; Mosenthal *et al.*, 2000; Munro, 1998; Neuman & Roskos, 1998; Raban, 1998; Raban & Ure, 1996; K. J. Rowe, 1991; K. J. Rowe, 1997). The work of Marie Clay in early literacy assessment, including the observation survey of early literacy achievement (Clay, 1993) was also reviewed. The reading developmental continuum in the *First Steps* materials developed by the Education Department of Western Australia was included in the review.

The 1998 report from the National Research Council, *Preventing Reading Difficulties in Young Children* (Snow *et al.*, 1998) provided useful insights into key aspects of literacy necessary for students to make adequate progress in reading. The report included a list of particular accomplishments that successful learners are likely to exhibit during the early school years. The authors note 'that this list is neither exhaustive nor incontestable, but it does capture many highlights in the course of reading instruction that have been revealed through several decades of

* We have used the terms '1st Year', '2nd Year' rather than Year 1 or Year 2, as the Australian states and territories currently use a range of nomenclature for the years of schooling. In July 2003 the Ministers for Education asked that a position paper be prepared to address the issue of the states and territories moving towards a more uniform starting age for schooling and common nomenclature by 2010.

research' (Snow et al., 1998). This list helped to identify key aspects of literacy to be assessed in the first three years of school.

A review was also undertaken of recent national and international studies of numeracy in the early years of schooling, focusing on the acquisition and development of key skills and knowledge in numeracy, assessment approaches and instruments. Some of these studies were work-in-progress, reported in subsequent years (Basic Skills Agency & National Foundation for Educational Research, 1998; Brown, 2000; Clarke & Cheeseman, 2000; Gould, 2000; Victoria Department of Education, Employment and Training, 2000; Willis, 2000).

Key sources of information were *English – a curriculum profile for Australian schools* and *Mathematics – a curriculum profile for Australian schools* (Curriculum Corporation, 1994a, 1994b). These documents, and the various curriculum and standards frameworks developed by the states and territories following the national collaborative curriculum work, provided the curriculum context for this national study.

A number of longitudinal studies were reviewed, particularly in relation to the methodology used. These included the New Zealand longitudinal study, *Competent children and their teachers*, which was then in its initial years (Meade et al., 1995; Wylie, 1996; Wylie & Else, 1998; Wylie & Thompson, 1998). Other longitudinal studies were reviewed, including the large scale US *Early Childhood Longitudinal study* (ECLS) (Green et al., 1997).

DEFINING THE SCOPE OF LITERACY AND NUMERACY

The literacy and numeracy assessments tasks were of critical importance to this study. Decisions about the key aspects of literacy and numeracy to be assessed established the scope of the study. At an early stage of planning, the nature of literacy and of numeracy was clarified.

LITERACY

The definition of literacy included in the policy paper, *Literacy for All: the Challenge for Australian Schools* (Department of Employment, Education, Training and Youth Affairs, 1998) is comprehensive, and drew attention to the significance of effective literacy which:

requires the ability to read and use written information, to write appropriately, in a range of contexts, for many different purposes and to communicate with a variety of audiences. Literacy is integrally related to learning in all areas of the curriculum, and enables all individuals to develop knowledge and understanding. Reading and writing, when integrated with speaking, listening and viewing and critical thinking constitute valued aspects of literacy in modern life (Department of Employment, Education, Training and Youth Affairs, 1998).

Given the currency of this definition, it was adopted for LLANS.

Consideration was given to the assessment of the strands of reading, writing, speaking, listening and viewing, as had been done in the 1996 National School English Literacy Survey (Masters & Forster, 1997). However, it was decided that the resources available for the LLANS over seven years would not make it feasible to collect achievement data relating to speaking, listening and viewing. The focus was therefore on reading and writing, as learning to read and learning to write are integrally linked.

NUMERACY

The Commonwealth policy paper, *Numeracy, A Priority for All* (Department of Education, Training and Youth Affairs, 2000) notes that 'the concept of numeracy is much debated, having different meanings across times and contexts'. The paper indicates that:

The nature of numeracy education in schools may be interpreted widely. Current Australian approaches in the early and middle years of schooling broadly include the development of students' mathematical knowledge, skills and understanding, and the fostering of students' capacities and disposition to make effective use of this learning. Approaches tend to emphasise providing support for learning and enabling students to effectively deal with the general demands of their lives (Department of Education, Training and Youth Affairs, 2000).

The numeracy assessment tasks were built around the mathematical strands of number, space, measurement and chance and data.

DEVELOPING THE ASSESSMENT TASKS

Work on the LLANS tasks commenced in 1998, and a number of criteria shaped their development. The assessment tasks were designed to model good assessment practice for schools, and to reflect the range of current classroom practices.

The tasks were developed through a rigorous process of collaborative work by ACER item writers, and trialled in schools. A series of 'panels' of item writers scrutinised draft tasks until it was agreed that the tasks were likely to gather a broad range of responses from students in relation to particular skills and knowledge targeted by the tasks. The tasks were then trialled in schools, and the trial data indicated where the tasks needed improvements and adjustments. The tasks were revised on the basis of this information.

Key criteria for developing the assessment tasks included:

- The tasks should be research based, that is, they should assess aspects of literacy and numeracy that contemporary research indicated to be central to the development of strong literacy and numeracy skills.
- The tasks should engage students and be built around contexts likely to be familiar to students in the early years of school.
- The tasks would be administered one-to-one in an interview situation, if possible by the student's own teacher.
- Where possible, the tasks should involve authentic texts and hands-on equipment.
- The tasks should be easy for teachers to administer, and supported with clear and explicit marking and recording guides.
- The tasks should be designed to be administered in a reasonable time, taking account of the attention span of early years students, and teachers' workloads.
- The tasks should link with the *ACER Developmental Assessment Resource for Teachers* (DART) tasks available for middle and upper primary school.

Assessments of young children in the early years of school have a number of specific requirements because they need to be administered one-to-one. The LLANS assessments were intended to be child-centred and unobtrusive. They were designed to take place in a meaningful context and emphasise process as well as product. Particular attention was given to providing administration and scoring instructions which were sufficiently clear to ensure consistency and the reliability of the data.

The tasks for Surveys 1-5 were administered one-to-one in an interview situation by teachers, designed to interest and engage students and built around contexts familiar to students in the early years of school. The practicality of administration by teachers working with one student at a time was an important consideration. The marking guides were a critical component of the assessment package, providing clear and explicit ways for teachers to judge and record students' responses during the course of the assessment interview. A common set of instructions was provided to all

teachers of the students involved in LLANS, in order to ensure standard conditions for the assessments. The clarity of the administration and scoring instructions was particularly significant in ensuring consistency.

Instructions addressed to the students had the following characteristics:

- present tense
- simple sentences
- direction given last in a sequence of instructions
- brief
- precise, simple vocabulary

Choice of language was a critical factor in developing items for young students. It was imperative that students understood what was being asked of them. Much of the development time for the LLANS tasks was devoted to refining directions that the teacher gave to the student to make these directions as simple and clear as possible.

The series of literacy and numeracy tasks focused on critical aspects of literacy and numeracy, and included many hands-on activities and authentic texts, for example, high quality children's picture storybooks. This process of assessing students provided teachers conducting the assessments with important and useful insights into the progress and achievement of their students and a familiar environment for the child participating. Continuity across all surveys was ensured by focusing on key aspects of literacy and numeracy. All materials required for the assessments were provided to schools, to ensure that the tasks would be uniform. These materials included simple reading books and picture storybooks, calculators, rulers, charts, blocks and dice amongst a range of other items.

For each of literacy and numeracy, all students completed the same assessment form in Survey 1. Two assessment forms were developed for each of Surveys 2-5. The majority of items were common in the two forms, but a small set of items, designated as link items, was specific to each form. These link items were to be used for linking the surveys. Each set of link items was repeated in the next survey, in the alternative form. That is, the link items from the first form in Survey 2 were repeated in the second form in Survey 3. This pattern of alternating the sets of link items between alternative forms was continued for each of the first three years of the study.

The cohort of participating students was divided into two groups, and these groups were kept constant for the whole of the study. Group 1 completed form 1 each year, and group 2 always completed form 2. This arrangement meant that all students attempted all items only once. For example, all students completed some items from Survey 2 in Survey 3, but as these items came from the form that had not been administered to their group in Survey 2, they did not repeat any assessment tasks.

DATABASE

Once the students in the sample had been identified, a database was established for all aspects of the management of the study. All students were assigned unique identifiers which remained in use throughout the study. The database of students and schools was continually updated so that the distribution of assessments was accurate and targeted.

MAINTAINING THE COHORT

Keeping schools informed about the study and the annual assessment schedules was an important management issue throughout the study. Different teachers were involved each year as students progressed through the school. Information about the study was therefore sent to all schools each year. Where new principals had taken over, further information was often requested.

During the course of the study many students transferred to other schools. A small number of students repeated a year of schooling, and some of the sampled schools found that they were unable to continue. Over 200 schools were ultimately involved in the study, many with a single student who had transferred from another school. However, the total cohort did become slightly smaller each year.

Several difficulties were encountered in maintaining the size of the cohort. For example it was not always possible to track students as they moved from one school to another. When students transferred to a different school and the original school knew of their destination, it was possible to approach the new school seeking their support for the student involved to continue in the study. Almost all principals of these schools agreed to this request. When the original school did not know the student's destination, it was not possible to track that student.

SCALE CONSTRUCTION

Assessment data collected in the five LLANS surveys provided information needed for the calibration of the LLANS items and the LLANS instruments.

In order to measure progress over time in a developmental area, it was necessary for the students' performance in each survey to be measured on the same scale. When students' performances in literacy across surveys were measured on a common literacy scale, the performance over time could be compared so that it was possible to measure growth and change on the scale, and to track students' achievement progress over time. The same applied to the numeracy performances and numeracy growth over time. It was therefore necessary to construct a LLANS Literacy Scale and a LLANS Numeracy Scale with each scale covering the full range of proficiency. Easier tasks in the first year of school and more difficult tasks in the subsequent years were used to construct and establish the scales.

The assessment tasks in the surveys were equated vertically to develop a long measurement scale for each of literacy and numeracy. The equating of these tasks was made possible by embedding common items in the assessment instruments. The common items serve as 'links' for the equating. The common items were checked to make sure that they functioned as good linking items. The calibration, equating of assessment tasks and construction of the scales were carried out based on the Rasch partial credit model (Rasch, 1960; Masters, 1982). A LLANS Literacy Scale and a LLANS Numeracy Scale were constructed and used to provide measures across the surveys.

Additionally, since the Rasch item difficulties and student performance estimates were defined on the same scale for Literacy and for Numeracy, it was possible to relate the performance levels along the Literacy Scale and the Numeracy Scale to the skill demands at those levels based on the assessment tasks. A set of descriptions of the skill demands along the literacy scale continuum was developed for literacy and another set of descriptions was developed along the numeracy scale continuum. The skill descriptions along the scales made it possible to put the students' progress and development in context.

ASSESSING DEVELOPMENT IN LITERACY AND NUMERACY

In the next two chapters, the assessment tasks and the students' responses are described in detail. Chapter 3 is focused on the literacy assessments in the first three years of the study, describing the tasks administered in each year. Chapter 4 is focused on the numeracy assessments for these years, and provides a description of the assessments for each year.

3. ASSESSING LITERACY DEVELOPMENT

THE FIRST YEAR AT SCHOOL: LITERACY

Two literacy surveys were completed by students in 1999. Survey 1 was administered in a one-to-one interview situation by the students' own teachers early in the first year at school, and provided the baseline data for the longitudinal study. Survey 2 was administered, again by the students' own teachers, towards the end of the school year.

LITERACY: THE FIRST SURVEY

The first literacy survey included five sets of assessment tasks focused on broad aspects of literacy. As far as possible, the tasks were based on everyday materials students were likely to have encountered in their daily lives. A picture story book, photographs of environmental print and picture charts were used in the tasks. Table 3.1 shows the aspects of literacy that were assessed in the first survey, and the tasks related to each aspect.

Table 3.1: Literacy assessment tasks, Survey 1

Making Meaning from Text	<ul style="list-style-type: none"> listen to <i>Precious Eggs</i> and retell the story explain the intentions of a character in the picture story book <i>Precious Eggs</i>
Reading Fluency	<ul style="list-style-type: none"> read Lego, COCO-POPS, BP and Shell from photographs read any text the student recognises in <i>Precious Eggs</i> read any text the student recognises on a cereal box read a single word (shade)
Concepts about Print	<ul style="list-style-type: none"> recognise writing identify front and title of <i>Precious Eggs</i> show where to begin reading and reading direction identify a full stop, question mark and quotation marks explain the purpose of quotation marks identify a word, a letter & the first & last letter of a word match letters with the same and different fonts on cereal labels identify a capital letter match a lower case and capital letter
Phonemic Awareness	<ul style="list-style-type: none"> identify two rhyming words from a list of three words (7 examples) identify two words with the same first sound from a list of three words (7 examples) name the letters s, h, a, d and e
Writing	<ul style="list-style-type: none"> write own name draw and write about a picture about <i>Precious Eggs</i>

A PICTURE STORYBOOK

A picture storybook, *Precious Eggs*, written especially for this survey, provided the text on which the assessment tasks were based. The animal characters and rural Australian setting were designed to appeal to a wide range of children at this age level. The story line was simple and brief in order to be accessible to students. The simple plot was complicated by the illustrations that conveyed a sub-plot not included in the written text. The first page of the story is shown below, and the Bush Rat, who is not referred to in the written text, can be seen in the lower left hand corner.

Knowledge of book orientation and reading directionality were assessed by asking students to indicate the front of the book and where to start reading. Emerging independent reading was assessed by inviting students to read some of the story, and noting their responses. Understanding of the text was assessed by asking students to retell the story after listening to it read aloud twice. The writing task used the story as a stimulus. Students drew a picture about the story and then wrote about their drawing. Knowledge of concepts about print such as letters and words, or the name and purpose for some common punctuation were assessed by asking specific questions about an extract from *Precious Eggs*.

One day Beaky and Long Neck found a big pile of eggs.
 'We must look after these eggs until they hatch,' said Beaky.
 'I know,' said Long Neck, 'Let's cover them with dirt.
 That will keep them safe.'



ENVIRONMENTAL PRINT

The students' reading of print in the everyday environment was assessed by asking them about words and letters they recognised or were able to match in a set of coloured photographs of popular signs and logos.

The photographs included service stations, breakfast cereal boxes and toy packages.*



PICTURE CHARTS

Phonemic awareness skills, such as identification of rhyming words and words with the same first sound were assessed by asking students to match two of a set of three words. The teacher read the words aloud from a picture chart of familiar objects.

WHAT STUDENTS COULD DO WHEN THEY STARTED SCHOOL

The responses to the assessment tasks showed a wide range of achievement amongst the students at the beginning of school, across each of the aspects of literacy assessed in this survey.

MAKING MEANING FROM TEXTS

Understanding of texts read aloud was assessed by asking questions about specific aspects of a text, including the main idea and the links between illustrations and text.

At the beginning of the first year of school, almost half the students were able to retell key aspects of a story that had been read aloud to them. The teacher read *Precious Eggs* to the student twice. The story tells of two birds moving a cluster of eggs several times, trying to find a comfortable

* These photographs were originally used in the study *100 Children go to School* (Hill, S., Comber, B., Loudon, W., Rivalland, J., & Reid, J., 1998) and were used in the LLANS study with permission.

place to keep them safe. The teachers' instructions and marking guide for the retelling task are shown in Table 3.2. In response to this task, 44 per cent of students demonstrated their understanding of the details of a story by giving a summary of the main events or focussing on a key aspect. A less accomplished response to the task was shown by 41 per cent of students who showed an incomplete understanding when they included some elements of the story in their retelling without linking these elements to the main idea.

Table 3.2: Marking Guide for retelling, Survey 1

Instructions and questions	Marking guide
<p>Let's read the book again. When we finish you can tell me the story. Do not discuss the pictures. Acknowledge the child's comments (if any) but do not engage in conversation. Read <i>Precious Eggs</i> to the child again. Close the book when you have finished reading it. Put the book aside. Now tell me the story that I read you.</p> <p>If the child tells the story of the bush rat prompt them to tell you about the two birds.</p>	<ul style="list-style-type: none"> gives a short summary of the story, includes a beginning, middle and end may be quite brief (e.g., 'They found some eggs, they moved them, the eggs hatched.') focuses on central point of story (e.g., 'Long Neck and Beaky covered up the eggs so that no one could steal them.') incomplete story but includes some elements (e.g., characters, an action, the ending - 'They had a nest, blossoms made them sneeze, then they went home. The eggs hatched into little baby birds.')
	<ul style="list-style-type: none"> tells a different story
	<ul style="list-style-type: none"> no attempt

It is interesting to note that for this task, giving a short summary was at the same level of difficulty for students as focussing on a central point of the story.

The illustrations in *Precious Eggs* convey information to readers additional to that presented in the written text. Students' ability to infer the connections between the illustrations and the story that they had heard was assessed by asking about the role of the character, Bush Rat, who is not referred to in the written text but features in all of the illustrations. Thirty-five per cent of students who made the link recognised Bush Rat's sinister intentions by saying, for example, *It's trying to steal the eggs*. At a more superficial level, 34 per cent of students were able to describe what Bush Rat was doing in an illustration without realising the significance of his role in the story. These students identified Bush Rat's interest in the eggs or the birds by saying, for example, *It's watching them*. The teachers' instructions and marking guide are shown in Table 3.3.

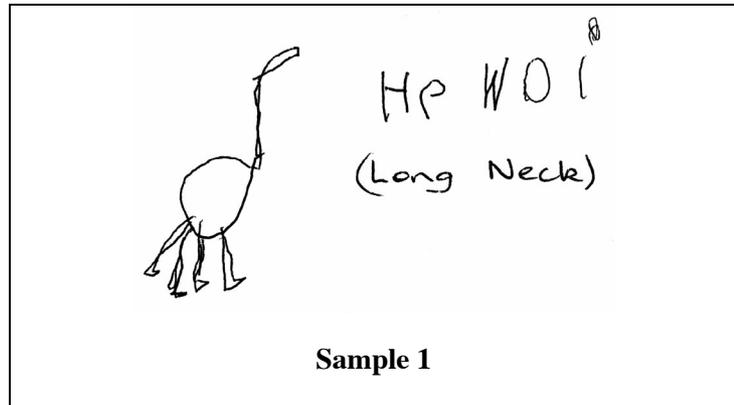
Table 3.3: Marking Guide: Illustrations

Instructions and questions	Marking guide
<p>Put <i>Precious Eggs</i> in front of the child. Point to the Bush Rat at the bottom of the front cover. Look at the Bush Rat and see what he's doing in the story. Allow child time to look through the book. When the child has finished close the book. Point to the Bush Rat on the front cover. What is this character doing in the story?</p>	<ul style="list-style-type: none"> recognises sinister intentions (e.g., 'It's trying to steal the eggs.')
	<ul style="list-style-type: none"> recognises he's interested in the birds (e.g., 'It's watching them.')
	<ul style="list-style-type: none"> unlikely interpretation of bush rat's actions (e.g., 'Crying because he's lost his little brother.' 'Swimming at the end.' 'Cutting the leaves off.')
	<ul style="list-style-type: none"> I don't know
	<ul style="list-style-type: none"> other (please elaborate in space below.)

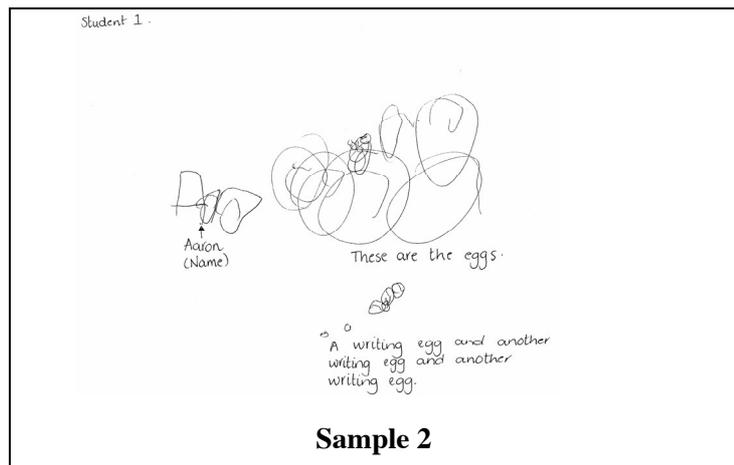
WRITING

Students' writing also reflected their understanding of the main events in *Precious Eggs*. Students wrote about the picture they drew after listening to *Precious Eggs*. The following samples are a small selection of the broad range of emerging writing skills demonstrated by students early in their first year at school. Sixteen per cent of students included at least one recognisable word in their writing. Thirty-nine per cent of students included some recognisable letters in their writing; six per cent wrote scribble and 30 per cent of students made no attempt to write.

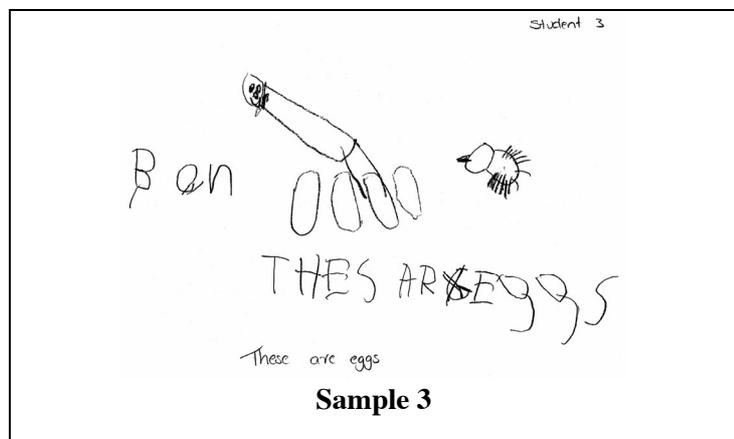
Sample 1 shows accurate observation of the visual detail of one of the characters in *Precious Eggs*. The student has used clearly recognisable letters arranged in word-like clusters. The teacher has transcribed the student's reading of these letters.



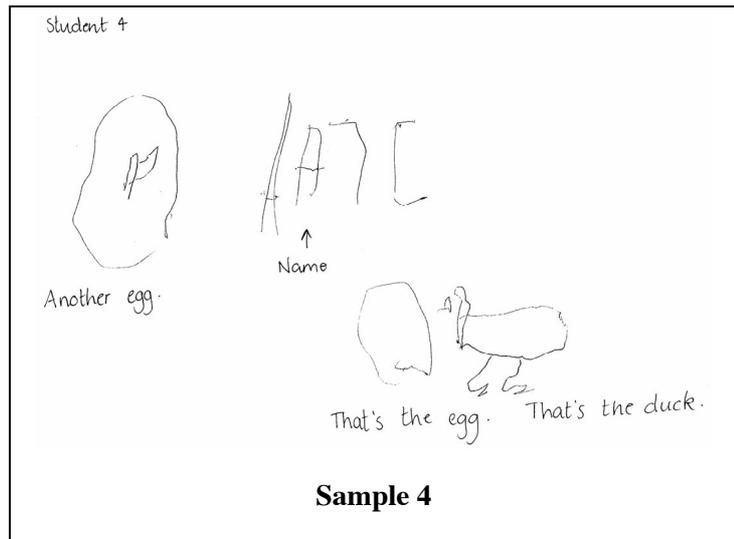
In Sample 2 the student has illustrated his response to the text, focusing on the central role of the eggs in the story. He has written his name with a recognisable letter A. The teacher has transcribed the student's spoken descriptions of his drawing.



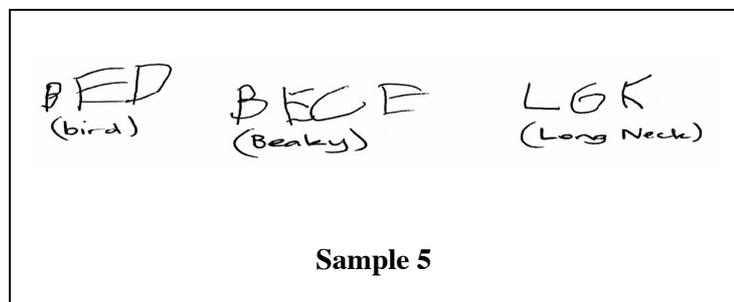
The writer of Sample 3 has written a recognisable sentence focusing on the eggs in the story, accurately spelling *eggs*, and writing *thes* for 'these' and *ar* for 'are'.



In Sample 4 the writing illustrates one of the main characters with an egg. The writer pictured one of birds in the story as a duck. The writer's name is recognisable though two letters are incompletely formed.



Sample 5 shows a student's attempt to write the names of the characters in the story. There are three recognisable words with plausible spelling. The use of vowels in the first two words demonstrates this student's emerging understanding of the conventions of spelling.



These five samples indicate the diversity of students' progress in learning to write.

PHONEMIC AWARENESS

More than 75 per cent of the students showed some understanding of rhyming words and initial word sounds but the least proficient were only able to demonstrate this understanding to a limited extent. An interesting pattern emerged in the development of these skills. The level of difficulty of the task was also dependent on the order in which students heard the words. Students found it easiest to recognise that words rhymed when the first two of three words, given as a list, rhymed, such as, *egg, leg, bag*. More than three quarters of the students could do this. It was more difficult for students to identify rhyming words that were first and third in a list, such as *tail, gate, whale*. It was more difficult still for students to identify rhyming words that were second and third in a list, such as, *rain, stamp, lamp*. Approximately 40 per cent of students could do this. A similar pattern emerged in the recognition of words beginning with the same first sound.

READING FLUENCY

Sixteen per cent of students were able to read correctly some words from *Precious Eggs* before the story had been read to them but most students could not read any of the words when asked, *Can you read some of the story?* Thirty-two per cent did not attempt to read, 17 per cent were confident of their ability to make meaning from the illustrations and told a story based on the pictures and 10 per cent of students said they could not read. Ten per cent of students recognised the word *shade* and 17 per cent recognised COCO POPS or other words on a photo of a cereal box.

CONCEPTS ABOUT PRINT

Most, but not all, students demonstrated understanding of book orientation and print directionality. They were also able to recognise writing. The following table shows the tasks assessing concepts about print and the percentage of students who completed each task correctly. The % correct was over 75% for each of these tasks.

Table 3.4: Concepts about print

% correct	Task
88.9%	can you point to the writing on this box? (cereal box)
80.3%	can you tell me the name of any letters? (names at least one letter on a cereal box)
87.2%	show me any letters that are the same. (identifies C, O and P as the same in COCO POPS)
87.5%	point to the letters that are the same in these two pictures. (identifies O as the same in COCO POPS and LEGO)
89.9%	show me the front of the book
87.3%	the name of this book is <i>Precious Eggs</i> . Show me where it says <i>Precious Eggs</i>
77.3%	I'm going to start reading the story on this page. Show me where to begin (indicates top left hand of text on page)
87.4%	show me which way to go. (indicates left to right)
77.6%	where do I go after that? (indicates return sweep to left)
80.4%	show me a word
88.4%	point to a letter
80.5%	show me the first letter in this word

The more difficult tasks asked students to identify capital and lower case letters. Approximately 40 per cent of students were able to do this. Twenty-three per cent of students could give the name and purpose for a question mark and six per cent the name or purpose for quotation marks.

STUDENTS' PERFORMANCE ON SURVEY 1 ITEMS

Figure 3.1 shows an item variable map.

ITEM VARIABLE MAPS

Item variable maps are constructed from Rasch estimates. On the right hand side of the map, item steps are shown ranked on a logit scale according to the estimates of their step thresholds, from the easiest (at the bottom of the map) to the most difficult (at the top of the map).

In each of LLANS surveys, there are dichotomous items with two categories and partial credit items with more than two categories. A dichotomous item has only one item step threshold separating the two categories while an item with three categories has two item step thresholds separating the three categories. Each item step is represented by a label, such as 1PA4.2. The '1' in this item step label indicates the item was in Survey 1. 'PA' describes the particular aspect of literacy or numeracy assessed by the item, in this case phonemic awareness. The '4' is item number in the PA cluster. The '.2' indicates that this is the second step threshold of a partial credit item. So if this is a three category item, the two item thresholds would be represented by 1PA4.1 and 1PA4.2. A dichotomous item will simply be represented by 1PA4 with the step indicator left out.

The left hand side of Figure 3.1 shows the distribution of the student scores on the survey. Each X on Figure 3.1 represents four students. A student at a certain logit level has a 50% chance of

achieving the item step at the same level or a higher step of the same item, and a greater than 50% chance of succeeding on less difficult item steps.

SURVEY 1 ITEM VARIABLE MAP

Figure 3.1 shows the literacy item variable map for Survey 1, the following specific item labels are used:

- 1EP - the environmental print tasks
- 1PA - phonemic awareness tasks
- 1BO - book orientation tasks
- 1RE - retelling tasks
- 1CP - concepts of print tasks.

The item steps at the top of the map were the most difficult for this group of students. The items 1EP9¹ and 1EP were items that tested students' ability to read numbers in a photograph of BP and Shell service stations. 1EP9.3 indicates that the number 73.9 was correctly read as a decimal number, and 1EPo.3 indicates that students correctly identified one of 2, 3, 5, 6, 7 or 9 from the photograph. 1CP3 indicated that students were able to identify quotation marks and knew their purpose when the assessor pointed to a set of quotation marks in the text of *Precious Eggs*.

In the middle of the map, 1PA3 indicates the item that asked students to listen to the words *tree*, *rock*, *sock* and to tell the assessor the words that rhymed. 1CPa asked students to point to a lower case 'n' ('a little n') after the capital N in the character's name, *Long Neck*, was pointed out. The easiest item steps located at the bottom of the map included 1BO2 (*show me the front of the book*); 1EP5.1 (identifying one letter the same as another in the photo of a Coco Pops cereal box), and 1PA1 (identifying the words that rhymed in the list *egg*, *leg*, *bag*).

Comparing the distribution of students' performances and the distribution of item difficulties on Figure 3.1 indicates that this assessment survey was at an appropriate level of difficulty for this group of students. The map shows a good spread of the items and students' performances.

¹ The items discussed below have been highlighted in Figure 3.1.

LITERACY: THE SECOND SURVEY

The assessment tasks used in Survey 2, conducted at the end of the students' first year at school, were designed to link to subsequent surveys. The assessment tasks in the second survey comprised five sets of activities based around familiar classroom materials. Three sets of activities were centred on a picture storybook and a simple reading book. Other activities included tasks with picture charts, flash cards, a labelled diagram and an extract from the reader. Two published texts were used as resources in this survey: the picture storybook *Handa's Surprise* by Eileen Browne (1994), and the simple reading book, *Monkey on the Roof* (Clough, 2000). Table 3.5 summarises the literacy assessment tasks.

Table 3.5: Literacy assessment tasks, Survey 2

Making Meaning from Text	<ul style="list-style-type: none"> • listen to the picture storybook, <i>Handa's Surprise</i>, and retell the story • explain a character's reaction in <i>Handa's Surprise</i> • explain a pivotal event portrayed through the illustrations only of <i>Handa's Surprise</i> • identify how friendship is communicated in an illustration (<i>Handa's Surprise</i>) • explain the purpose of a close up image (<i>Handa's Surprise</i>) • make a prediction about the story from the front cover of <i>Monkey on the Roof</i> • explain the two key events in <i>Monkey on the Roof</i>
Reading Fluency	<ul style="list-style-type: none"> • read the simple reading book, <i>Monkey on the Roof</i> • read the title of a diagram of the body • read words shown as labels on a diagram of the body • read a list of words that match body parts shown on a diagram • read flashcards for 16 common words
Concepts About Print	<ul style="list-style-type: none"> • identify a word and a letter • identify the title of an early reader (<i>Monkey on the Roof</i>) • locate and explain the purpose of a full stop, question mark and quotation marks
Phonemic Awareness	<ul style="list-style-type: none"> • identify two words with the same first sound from a list of three words (4 examples) • say the end sound for a word (5 examples) • say all the sounds in a word (4 examples) • identify pairs of rhyming words (3 examples) • generate rhyming words (3 examples) • say the name and sounds for the letters a, l, s, m, p, e, k, b, g, r, f, t
Writing	<ul style="list-style-type: none"> • write own name • write about what is happening in an illustration in <i>Handa's Surprise</i>

A PICTURE STORYBOOK

The picture storybook *Handa's Surprise*, by Eileen Browne (1994), an engaging story about two friends, makes effective use of visual and verbal language to contribute to the meaning of the text, and deals with the theme of friendship in ways relevant to students at this age. The first page of the book is shown here.



Handa put seven delicious fruits in a basket for her friend, Akeyo.

The teacher read the story aloud twice and then asked the students to retell the story, explain the main idea, interpret key illustrations and explain how some images were linked with the text. Students were also asked to reflect on the illustrator's purpose in constructing visual images in particular ways.

Students were also asked to reflect on the illustrator's purpose in constructing visual images in particular ways.

The story provided the context for a writing task. Students were asked to write about what was happening in an illustration near the end of *Handa's Surprise*. The writing was assessed for relevance of content, quality of sentence construction and the extent to which the writing could be read by the teacher, and by the student who had written it.

A READING BOOK

The simple reading book *Monkey on the Roof* (PM Reader Level 5) was selected as appropriate for students at the end of their first year of school. The first page of the book is shown here.



"Look," said Matthew.

"Look at Monkey!"

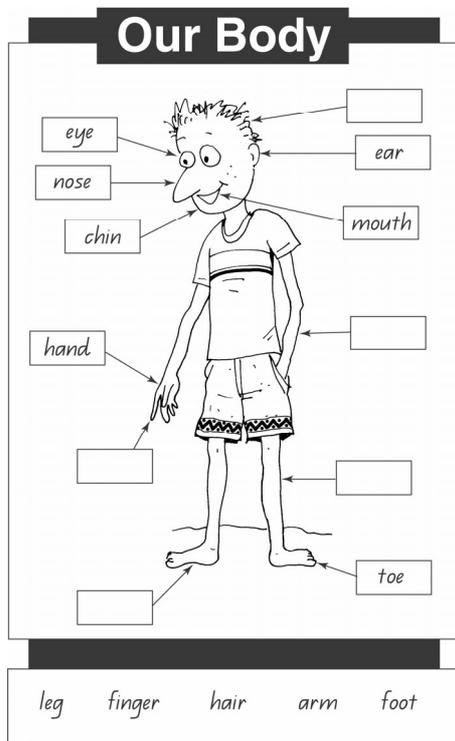
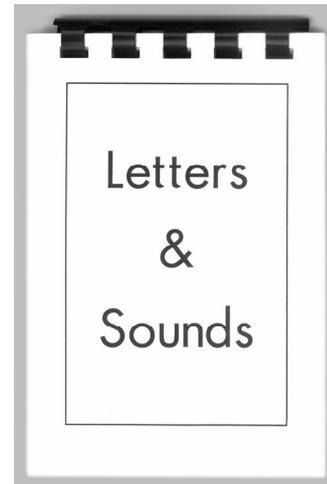
"Up he goes," said Emma.

The tasks involving the students' independent reading of *Monkey on the Roof* assessed their ability to make meaning from a familiar and predictable text. The large number of detailed illustrations provided strong support for the written text in a simple story of a toy monkey thrown onto the roof and retrieved by the mother with a ladder. Students were asked to predict the story from the front cover, identify the title and read the book. Students were also asked to explain the two main events, which were how the monkey got on and off the roof.

One activity was based on a specific page from *Monkey on the Roof*. The teacher asked the student to identify letters and words, name letters and identify the name and purpose of some common punctuation marks.

PICTURE CHARTS AND BOOKLETS

Phonemic awareness and alphabet knowledge were assessed from tasks using picture charts and letter booklets. Students were asked to identify words with the same first sound from picture charts. They were also asked to identify the sound at the end of a word, all the sounds in a word, pairs of rhyming words and to generate rhyming words. Tasks asking students to name and sound out twelve letters of the alphabet and to read sixteen high frequency words were presented in a specially made *Letters & Sounds* booklet with a single letter or single word on each page.



LABELLED DIAGRAM

Students' ability to use visual and phonemic clues to read words was assessed in tasks based on a partly labelled diagram. The teacher showed students a simple diagram of familiar body parts and asked them to locate words shown as labels, to read labels, to identify words required for missing labels and to read a list of words about parts of the body.

WHAT STUDENTS COULD DO AT THE END OF THEIR FIRST YEAR AT SCHOOL

The students' performance in each of the aspects of literacy assessed in the second survey showed considerable variation.

MAKING MEANING FROM TEXTS

Most students were able to recall and explain aspects of the story they heard, however it was more difficult for them to remember all the key details or to demonstrate full understanding of the main idea. The teacher read *Handa's Surprise* aloud to each student twice. In the story, Handa takes a basket of fruit to her friend, Akeyo. Handa does not realise that different animals steal fruit from her basket as she walks along, nor is she aware that a goat butting a tree fills her empty basket with tangerines. Handa and Akeyo are equally surprised to see the tangerines.

The most comprehensive retelling was indicated by a student response that included the following aspects: the orientation, the complication, the goat's involvement, the end of the story and the surprise. Seventy-one per cent of students retold the story including between one and three of these aspects. An additional 12 per cent of the students included four aspects and a further nine per cent included all five aspects. Responses giving a full and detailed retelling were the most difficult items in this survey.

The teacher's instructions and marking guide for the retelling task are shown in Table 3.6. The teacher selected as many categories as were evident in the student's response.

Table 3.6: Marking Guide for retelling, Survey 2

Instructions and questions	Marking guide
I want you to tell me what happened in the story.	<ul style="list-style-type: none"> • tick as many boxes as evident in the retell (order irrelevant)
There are a lot of animals and fruit in this story. You don't need to tell me about all of them.	<ul style="list-style-type: none"> • orientates the story (e.g., 'The girl is taking fruit to her friend.') • includes complication — taking of the fruit by the animal(s)
Tell me what happened in the story.	
You may help with the name Handa and/or Akeyo if the child asks.	<ul style="list-style-type: none"> • understands impact of goat's involvement (e.g., 'Fruit fell into her basket.')
Consider the content of the child's retell. It may be simply or elaborately conveyed but does it include each of the listed components?	<ul style="list-style-type: none"> • includes the end of story (e.g., 'They eat the fruit together.') • identifies the surprise at the end

Much of the meaning of *Handa's Surprise* is conveyed through the illustrations rather than the written text. The animals that steal Handa's fruit are not referred to in the written text, neither is the goat that butts the tree and knocks tangerines into Handa's empty basket. Students' ability to infer the connections between the illustrations and the written text was assessed by asking them to explain why the book is called *Handa's Surprise*. Forty-eight per cent of students explained that Handa was surprised to see the tangerines in her basket. A further 22 per cent either focussed on the illustrations by describing the surprise, that the animals had taken the fruit, or they focussed on the text explaining that Handa had set out to surprise Akeyo with the fruit. It was more difficult for the students to make comprehensive links between the text and the illustrations. Table 3.7 shows the teacher's instructions and marking guide for this task.

Table 3.7: Marking Guide: Explaining the title

Instructions and questions	Marking guide
The book is called Handa's Surprise.	<ul style="list-style-type: none"> • understands new fruit is a surprise (e.g., 'She put in fruit and found tangerines.')
Why is Handa surprised?	<ul style="list-style-type: none"> • refers to animals taking fruit (e.g., 'Because all the animals took the fruit.') • identifies Akeyo's surprise (e.g., 'Her friend liked mandarins.') • incorrect (e.g., 'Because she's afraid. Because it's called Handa's Surprise.') • no attempt

Students were asked to reflect on the illustrator's purpose. In *Handa's Surprise*, many of the illustrations show Handa walking along the road and an animal peering over some foliage followed by a close up view of Handa's basket and a piece of fruit in the animal's grasp, as seen in the example shown on page 22. The teacher identified the close up view and then asked, *Why has*

the illustrator drawn it this way? Forty-four per cent of students gave a plausible reason such as: to know the ostrich was very close, so you can see it better or because all the ostrich would not fit in. A further 27 per cent of students described the picture without giving a specific purpose for the close up, such as because he's eating fruit.

Over 90 percent of students were able to describe what was happening in two of the illustrations in *Handa's Surprise*. These were among the easiest tasks in this survey.



WRITING

A selected illustration from *Handa's Surprise* was used as the prompt for a writing task. Students were asked to write about what is happening in this part of the story.

By the end of their first year of school much of the students' writing was recognisable. Students were able to focus on the content of their writing and to give details and show levels of understanding that were not present in their writing in the first survey.



The following writing samples indicate the range of performance.

The writing in Sample 1 is constructed from specific, accurate observations of the visual detail in the text. It is presented as a correctly punctuated sentence, with three ideas linked with *and*. The spelling of basket - *barscit* - is phonetically plausible.

Handa's Surprise
There was Handa and she had
a barscit and she had tandreitis
and Akeo ran to Handa.

Sample 1

Sample 2 suggests that this student has not understood that the fruit was not mangoes, but tangerines. However, the sentence is complete, and punctuated with a capital letter and a full stop. Words are clearly distinguished, letters are well-formed, and the meaning is clear. There is evidence of some self-correction, in the *o* that has been crossed through.

Handa is bring
Akeyo & sum
magos.

Sample 2

Sample 3 also contains two ideas. The main action in these two pages is neatly summarised – *Handa is giving Akeyo a surprise*. This is supported by a comment on Akeyo's action of waving to her friend, referring to specific visual detail in the text.

Handa is u giving Akeyo a
surprise her arm. Akeyo is waving
to Handa.

Sample 3

The response in Sample 4 is set up in narrative style. It begins: *When Handa cam back ...*, which is an appropriate choice of form in response to the task. The piece focuses on the surprise, recognising the centrality of this to the whole text.

Handa surprise
When Handa cam back from
her vilage. Akeyo ran up
to Handa I bot you a
surprise yering Akeyo
was surprise.

Sample 4

Teachers judged students' writing against several criteria: the relevance of the content to the illustration, the quality of the sentence construction and readability. Table 3.8 shows the range of students' performance against these criteria.

Table 3.8: Performance against the writing criteria

%	Readability
87%	'reads' sentence
62%	readable match
23%	'reading' matches some of writing (e.g., some recognisable words)
%	Relevance of content
70%	relates an event from this part of the story
11%	relates an event from elsewhere in the story
11%	describes the picture only (no connection to story) (e.g., 'There are lots of people.')
%	Sentence construction
55%	writes one or more generally recognisable sentences
22%	some recognisable words with spaces
9%	contains groups of letters and word like spaces
12%	a continuous string of letters
1%	scribble

PHONEMIC AWARENESS

Over 90 per cent of the students knew the names and sounds of at least 12 letters of the alphabet: *a, l, s, m, p, e, k, b, g, r, f, t*. Over 90 per cent matched two words beginning with the same sounds from each of the following lists:

rat, sun, sink,
fish, web, feet,
man, mud, goat.

It was more difficult for students to match beginning sounds for words beginning with consonant blends, such as *brush, tray, tree*. Only 66 per cent of students could do this.

Over 85 per cent of students could identify the end sound for the words, *bike, bag, cup, coat* and *bird*. Most students could successfully separate simple words into their component sounds. Table 3.9 shows the percentage of students who separated each word into the sounds of each letter or a correct combination of sounds.

Table 3.9: Percentage of students identifying sounds correctly

	pig	bus	ten	kick
says the sound for each letter	73% P-I-G	70% B-U-S	68% T-E-N	69% K-I-K
correct combination of sounds	7%	11%	14%	9%

Slightly fewer than three quarters of the students could identify pairs of rhyming words even when they were mixed with pairs of words with the same first sound (65%, 68%, 76%). Many students could also generate rhyming words (55%, 74%, 73%).

READING FLUENCY

Approximately 50 per cent of the students were able to read all of the simple text *Monkey on the Roof* either ‘mostly accurately’ or with ‘word for word accuracy’. The teachers’ judgments of the reading fluency of the students are shown in Table 3.10.

Table 3.10: Marking Guide: Reading fluency

Students’ response	Marking guide
26%	<ul style="list-style-type: none"> reads all book, word for word accuracy, may self correct, no substitutions
33%	<ul style="list-style-type: none"> reads all book, mostly accurate occasional substitutions maintain meaning of text (e.g., ‘said’ for ‘shouted’, ‘Mary’ for ‘Mum’) some omissions which do not affect meaning
17%	<ul style="list-style-type: none"> reads all or most of the book moderate accuracy, may be some key omissions some substitutions may not maintain exact meaning of text (e.g., ‘Yes, you can go up on the roof.’) but substitution is not nonsensical
8%	<ul style="list-style-type: none"> limited reads 2-3 pages, may add or omit words limited maintenance of meaning of text some substitutions nonsensical (e.g., ‘He’s up on the road.’)

Over 90 per cent of the students recognised the high frequency sight words; *and*, *is* and *the* and they were able to name the written labels *toe*, *hand* and *ear* shown on a diagram of the body. Over 75 per cent of students recognised the words: *my*, *you*, *one*, *are*, *from* and *so*. Approximately 50 per cent of the students recognised the words: *because*, *morning* and *thing*.

CONCEPTS ABOUT PRINT

Many students could show the teacher a full stop (73%) and name a question mark (78%). Some could explain what a question mark was for (57%) but few (27%) could explain the purpose of quotation marks.

STUDENTS’ PERFORMANCE ON SURVEY 2 ITEMS

Figure 3.2 shows the literacy item variable map for Survey 2². On the right hand side of the map the item steps for the items in the survey are shown ranked on a logit scale according to the estimates of their step thresholds, from the easiest (at the bottom of the map) to the most difficult (at the top of the map). The left hand side of the map shows the distribution of the student’s performances relative to the items. Each X represents three students.

In Survey 2 the following specific item labels were used:

- 2MR - items based on the simple reading book *Monkey on the Roof*
- 2HS - items based on the picture storybook *Handa’s Surprise*
- 2HW - the writing task based on *Handa’s Surprise*
- 2WS - words and sounds items
- 2LS - items asking about the sounds and names of letters
- 2SW - sight word items
- 2OB - items based on the *Our Body* chart
- 2PC - print conventions items.

² For further detail about item variable maps see the section ‘Item variable maps’ on page 15.

The item steps at the top of the map were the most difficult for this group of students. The items 2HS2 and 2HS7 tested students' understanding of the picture storybook *Handa's Surprise*. 2HS2 was an item that asked students to retell the story. The item step 2HS2.3 refers to retellings that captured all key elements of the story. 2HS7.2 refers to responses that showed students' understanding of the visual details used in a particular illustration to indicate the friendship between the two girls. Item 2SWg was a sight word item, *would*.

In the middle of the map, 2SWc was a sight word item, *little*. 2WS5 was an item asking students to indicate which words started with the same letter from *brush, tray, tree*. 2MR3.3 gave credit for the correct reading of the title of *Monkey on the Roof*. The easiest items located at the bottom of the map included 2PC1 – point to a word (*show me the front of the book*); 2LSg – saying the sound of the letter 's', 2LSH – saying the sound of the letter 'p'. 2HS4.1 was a partially correct answer to the question about what was happening in a double page spread from *Handa's Surprise*.

It is interesting to look at the location of the letter names and sounds items (2LS) on the map. More than half of the students provided correct responses to the majority of these items, suggesting that these items assessing the knowledge of letter names and sounds were generally easy for this group of students at the end of their first year at school.

Comparing the distribution of students' performances and the distribution of item difficulties on the map indicates that this assessment survey was somewhat easy for this group of students with many items located at the lower end of the scale. The assessment could have been improved by reducing the number of easy letter name and sound items, and including some more difficult items. The map shows a good spread of the items and students' performances.

LITERACY PERFORMANCE IN THE FIRST YEAR OF SCHOOL

The scale of developing literacy achievement shown in Figure 3.3 is based on data collected in 1999 during the students' first year of school. The assessment tasks from Survey 1 and Survey 2 were calibrated on to a common literacy scale. This LLANS Literacy Scale is a linear transformation from the logit scale.

Descriptions of skills assessed in Surveys 1 and 2 are shown on the left of Figure 3.3. A selected sample of skill descriptions has been used to describe performance at different points on the scale. Each description refers to one item. The descriptions have been selected from the whole range of items in both surveys. The placement of the skill descriptions shows the estimated level of difficulty of a particular skill relative to other skills.

The four shaded bands on the right hand side of Figure 3.3 show the distributions of performance of boys and girls in their first year at school in Surveys 1 and 2. The shaded bands represent the middle 80 per cent of students. The darker shading represents the middle 50 per cent. The black line towards the middle of the darker band represents the median score.

Average growth in literacy achievement in the first year of school can be assessed by comparing the position of the median scores across the two surveys. A comparison of the bands showing the middle 80 per cent indicates that girls and boys in the cohort made progress in literacy achievement between March and November in their first year at school, in the aspects of literacy assessed in the surveys.

Figure 3.3 also shows the wide distributions of achievement in Survey 1 and Survey 2. Although, on average, the students in the study made progress in literacy in their first year at school, there was a wide distribution of achievement at the beginning of the school year, and this wide distribution was again found at the end of the school year. This highlights the complexity of teachers' work in providing teaching programs to meet the diverse needs of all students in their class.

Survey 1 provided baseline data for the study. This survey was conducted early in the students' first year at school, and provides a picture of the diversity of literacy skills and knowledge that children already have at school entry. The skill descriptions corresponding to the median score indicate that students in this cohort around the 50th percentile were likely to be able to *identify a capital letter correctly*. Students who achieved above the 90th percentile were likely to be able to *retell a narrative in a picture story book including some key events*. Students whose achievement fell in the 10th percentile were likely to be able to *locate the front of a picture story book*, and *understand the directional sequence of text*, and, after listening to a picture storybook, be able to *describe some events shown in an illustration*.

By the end of the first year of school, in November 1999, students around the 50th percentile were likely to be able to *read simple common words from labels on a chart*, and *write one or more generally readable sentences*. Students who achieved around the 75th percentile were likely to be able to *read all of a simple reading book with word for word accuracy*, *read 'would' as a sight word*, and *write a recognisable sentence*. Students whose achievement was around the 10th percentile were likely to be able to *identify letters correctly in a given word from a simple reading book*, *identify the 'k' sound at the end of 'bike'*, and *identify words with the same first sound from a list of three words*.

From Figure 3.3 it can be seen that the girls were performing better than the boys. Overall, however the difference is small.

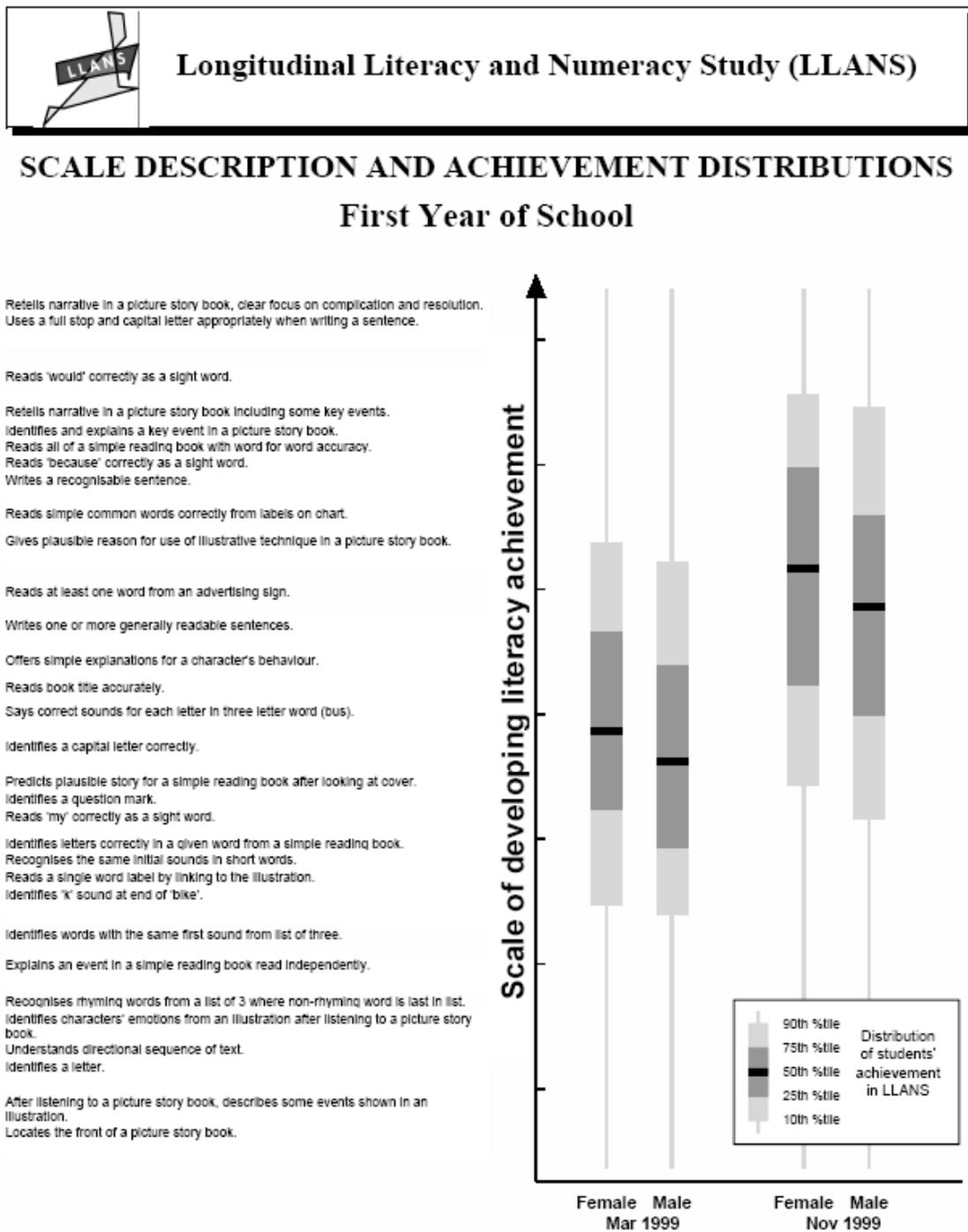


Figure 3.3: LLANS Literacy Scale description and achievement distributions for the first year of school

THE SECOND YEAR AT SCHOOL: LITERACY

Two literacy assessments were completed by the children in the study in their second year at school. Survey 3, the third LLANS literacy assessment, was administered by the students' teachers early in the 2000 school year. Survey 4, the fourth literacy assessment, was administered towards the end of the school year in November 2000. Both assessments were conducted in one-to-one interviews by the students' own teachers.

LITERACY: THE THIRD SURVEY

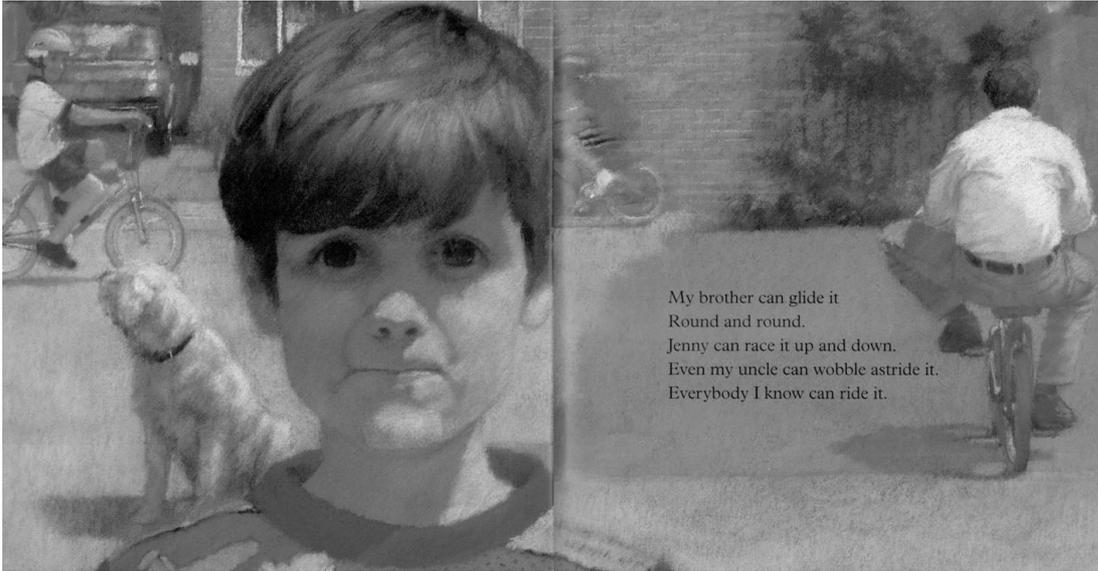
The third literacy survey included six sets of activities, focused on the same broad aspects of literacy as in the two surveys conducted in the students' first year at school. Three sets of activities were based on a picture storybook and a simple reading book, *Kitty Cat Plays Inside*. Other activities included spelling, manipulation of sounds in words, and segmenting and blending words and letters. Table 3.11 shows the aspects of literacy that were assessed in this survey, and the tasks related to each aspect.

Table 3.11: Literacy assessment tasks, Survey 3

Making Meaning from Text	<ul style="list-style-type: none"> • after reading <i>Kitty Cat Plays Inside</i> <ul style="list-style-type: none"> ❖ predict the story from the cover ❖ explain the reason for a character's behaviour ❖ give a personal opinion about the story • after listening to the teacher read <i>The Magical Bicycle</i> <ul style="list-style-type: none"> ❖ summarise the main idea ❖ explain the reasons for events ❖ make links between written text and illustration ❖ make links between an image and a character's hopes ❖ identify and describe images used to suggest dreaming ❖ interpret a visual metaphor used to suggest success (riding high in the sky over mountains)
Reading Fluency	<ul style="list-style-type: none"> • read aloud the PM Plus level 8 reader (<i>Kitty Cat Plays Inside</i>)
Concepts about Print	<ul style="list-style-type: none"> • identify direct speech in the simple reading book • name and explain the purpose of quotation marks
Phonemic Awareness	<ul style="list-style-type: none"> • read words built around 'ike': like, bike, hike, spike, strike, likes, liked, likely and likeness • read unfamiliar words composed of phonetically regular segments: satin, sandal, seminar, satellite and sentimental • remove end sounds to give new words (e.g., remove 'm' from meat)
Writing	<ul style="list-style-type: none"> • write about a favourite part of a picture storybook • spell big, come, played and basket

A PICTURE STORYBOOK

The picture storybook, *The Magical Bicycle* by Berlie Doherty and Christian Birmingham (1996), presents a powerful account of the success of a young child learning to ride a bicycle. The story line unfolds in simple sentences and poetic language with bold, colourful illustrations. The book was accessible to students at this age because it focused on a common childhood experience of learning to master a challenging physical skill. The style of the writing and emphasis on feelings, and the use of metaphor also allowed for several levels of interpretation.



My brother can glide it
Round and round.
Jenny can race it up and down.
Even my uncle can wobble astride it.
Everybody I know can ride it.

The teacher read *The Magical Bicycle* to each student and then asked the student a series of questions that assessed different aspects of the student's understanding of the text. The student was asked to summarise the main idea, explain an event, infer connections between the written text and the illustrations and interpret a visual metaphor. The story then provided a context for the writing task. The teacher asked the student to write about their favourite part of the story. The writing was assessed by the teacher in terms of the quality of the content, language, spelling and punctuation.

A READER

Kitty Cat Plays Inside (PM plus Level 8) was selected as a text that would allow a wide range of students to demonstrate their reading fluency. It was not too complex for weaker readers, but offered some challenges to more proficient readers.



Kitty Cat played in the basket.
She played in the wool.

"Meow! Meow! Meow!
I can not get out,"
said Kitty Cat.

Students were asked to predict the story from the cover, read the story, explain the reason for the Kitty Cat's behaviour and give an opinion about the conclusion. Students were asked to identify direct speech, and to name and explain the purpose of quotation marks. They were also asked to spell four words that had been used in the reader.

WORD LISTS

Two activities were based on lists of words. One activity assessed segmenting and blending. The teacher asked students to read a list of unfamiliar words composed of phonetically regular segments. In the other activity students were asked to read a list of words sharing a common base of 'ike'. The teacher told the student the first word *like*.

ORAL ACTIVITY

Students were also asked to manipulate the sounds in words by removing letters, such as taking the 'm' out of meat and saying the word that is left.

WHAT STUDENTS COULD DO AT THE START OF THE SECOND YEAR OF SCHOOL

The students' performance in each of the aspects of literacy assessed in this survey encompassed a range of achievement.

MAKING MEANING FROM TEXTS

The students' understanding of the picture storybook, *The Magical Bicycle*, was assessed through their answers to a series of focussed questions, after the story had been read aloud to them. This approach was chosen rather than asking them to retell the story because the main idea of the story is very straightforward. A boy is given a bike for his birthday, makes persistent efforts to learn to ride it and finally succeeds. The complexity of this text lies in the interpretation of the illustrations and their connections with the written text.

Forty-five per cent of students were able to give a concise summary when asked, *What is this story about?* They suggested answers such as: *learning to ride his bike*. A further 46 per cent of students showed more superficial understanding. They either gave an unfocussed explanation, listing a series of episodes that occurred as the boy struggled to ride, or they misinterpreted the text by focussing on the final illustration and saying things such as *learning to fly* or *going on an adventure*.

The illustration reproduced on page 31 shows the boy looking very sad, and scenes of different people riding bikes in the background. Fifty-two per cent of students were able to make links between the text and the illustrations and recognised that it was the boy's bike being ridden in each scene, showing that they were able to distinguish what was happening from the detailed information presented in the double-page spread.

A more subtle connection between the illustration and the text was identified by 46 per cent of students. These students understood that a cloud-like image of a horse emerging from the frame of the bike, where the seat had been removed, was linked with the boy's belief that learning to ride required magical intervention. When asked: *what is happening on these pages?*, these students gave responses such as *he's fixing it to make the magic*.

It was more difficult for students to interpret the visual metaphor of the final image. The image shows the boy riding his bike, high in the sky, over the mountains, pulled by a magical horse. The accompanying text says:

Like a bird over mountains
Like a ship over oceans
To the end of the world
I had magic in me.

Thirty-four per cent responded to the question, *what is happening on these pages?* by saying *he has learned how to ride his bike*, or *it shows that he can ride*. Fifty-four per cent of students gave a literal interpretation, describing the illustration by giving responses such as *he's flying off*, *he's riding over the clouds*.

READING FLUENCY

Students read *Kitty Cat Plays Inside* by themselves. Kitty Cat is being naughty playing inside the house, and is about to be put outside. Kitty Cat decides to be good and go to sleep rather than face Fat Cat in the back yard.



Kitty Cat looked outside.
Fat Cat looked back at her.

"Meow," said Kitty Cat.
"I can see Fat Cat.
I am not going outside."

Approximately 60 per cent of students were able to infer a reason for Kitty Cat's decision not to go outside, either by noting Kitty Cat's decision, *I can see Fat Cat. I am not going outside*, or by carefully interpreting the illustration of Fat Cat looking slightly antagonistic. These students gave reasons such as, *Kitty Cat is afraid of Fat Cat* or *She will fight with Fat Cat*. Even more students were able to express a personal opinion about whether Kitty Cat, who had been very naughty inside the house, should be put out. Seventy-seven per cent of students could support their opinion with a plausible reason linked to the story.

WRITING

Students were invited to write about their favourite part of *The Magical Bicycle*. Their writing reflected their individual responses to the story, and provided evidence of the range of emerging proficiency in writing.

The brief piece of writing in Sample 1 focuses on a key aspect of the book, the white horse shown in the illustrations to suggest the magic the boy thinks he needs to ride his bike.

The Magical Bicycle Writing Sheet 2

~~I like the ^{part} part~~
~~were the ^{horse} horse~~
~~come out~~



Sample 1

The writing in Sample 2 lists the events in the story, with the writer's own interpretation of the urgency of learning to ride the bike before it is outgrown.

2000

I liked the part when he tried to ride the bicycle that he got when it was the boy's birthday. Because he always tried to ride his bicycle everyday because he wanted to ride his bicycle because he wants to ride his bicycle before he grows too big for it and it has lost of detail and his pictures and you enjoy it.



10

Sample 2

In Sample 3 the writer explores the boy's feelings about finally learning to ride his bike. The writer has interpreted the illustrations and the text to infer that the boy was proud of himself.

3

The Magical Bicycle Writing Sheet

my book boy bike could he him
 faint was good and what was self
 Part of the when he had of the he bike of



f

Sample 3

In Sample 4, the writer shows depth of understanding in the interpretation of the illustrations on the final pages. The writer notes that the detail in the illustration of the red tee-shirt in the air shows the boy is riding very fast. The writer also clearly understands and explains the metaphorical image of the last page, *the last page doesn't really happen. The boy is riding his bike over the mountains and see in the end he is happy and can ride his bike. I bet he's not going to be falling out of his bike any more.*

9

The Magical Bicycle Writing Sheet

I like the last row pages... because the xx second last page show a bit of his red t-shirt in the air. SO you can tell he can ride the bike very fast. The last page doesn't really happen. The boy was riding the bike over the mountains and see in the ending he is happy and can ride the bike I bet he's not going to be falling out of his bike any more.

f

Sample 4

The following tables show the percentage of students whose writing matched the criteria in the content and language marking guides for writing. These judgements were made by the students' teachers, who used the provided marking guides, which are shown in Tables 3.12 and 3.13.

Table 3.12: Marking Guide: Writing content

% students	Marking guide
4%	writes a well connected extended piece that shows the beginnings of a recognisable structure (e.g., recount or narrative)
15%	a sequence of thoughts or a number of ideas (e.g., 'The boy couldn't ride his bike and he kept falling off. He tried hard and he got magic and then he could ride.')
22%	expresses two ideas (e.g., 'I liked it when his Dad helped. My Dad helps me.')
44%	expresses one idea (e.g., 'I liked it when he fell off.')
5%	unrelated or irrelevant ideas
10%	other

Table 3.13: Marking Guide: Writing language

% students	Marking guide
17%	includes one or more complex sentences (e.g., 'When I rode my bike the chain came off.')
34%	includes one or more sentences joined with simple conjunctions 'and', 'but', 'then' (e.g., 'I play on my bike then I go on the swings.')
32%	includes one or more simple sentences (e.g., 'I like my bike.')
12%	makes some errors in the construction of simple sentences (e.g., 'The ride the bike to the sky.')
5%	writes a series of unrelated words

PHONEMIC AWARENESS

Approximately three quarters of the students (74% - 83%) were able to manipulate the sounds in words they heard by removing the first or last letter of a short word. The teacher asked the student, for example, to *take the 'b' out of bend* and say the word that is left (*end*). It was slightly more difficult for students to remove the 'l' from the blend in *black* to make *back*. Sixty-five per cent of students could do this.

Fifty per cent of students could blend two phonetically regular segments to pronounce the words *satın* and *sandal* but only 20 per cent could blend three or four segments to pronounce the words, *seminar*, *satellite* or *sentimental*.

The teacher asked students to read a list of words built around a common base of *ike*. Students found it easiest to say words made by adding a single letter to *ike* and more difficult as added blends or segments became longer. Table 3.14 shows the percentage of correct responses. The teacher told the student the first word in the list, which was *like*.

Table 3.14: 'ike' words

% students	word
83%	bike
79%	hike
64%	spike
53%	strike
81%	likes
74%	liked
42%	likely
39%	likeness

READING FLUENCY

Almost three quarters of the students were able to read *Kitty Cat Plays Inside* with moderate accuracy. Table 3.15 shows the distribution of student performances across the criteria in the reading marking guide.

Table 3.15: Marking Guide: Reading fluency

% students	Marking guide
65%	<ul style="list-style-type: none"> reads all or most of the book moderate accuracy, may be some key omissions (words or sentences) some substitutions may not maintain exact meaning of text (e.g., 'she prayed in the basket') but substitution is not nonsensical
14%	<ul style="list-style-type: none"> limited - reads 2-3 pages, may add or omit words limited maintenance of meaning of text some substitutions nonsensical (e.g., 'She picked by the big chair.')
10%	<ul style="list-style-type: none"> minimal or no attempt to read (1 page or less)
10%	<ul style="list-style-type: none"> 'invents' text (develops text from pictures only)

CONCEPTS ABOUT PRINT

Approximately 50 per cent of the students were able to indicate direct speech by pointing to writing *that tells you what Kitty Cat says when she is climbing the curtains* (53%), to give a name for quotation marks or talking marks (45%) and to explain the purpose of quotation marks (58%).

STUDENTS' PERFORMANCE ON SURVEY 3 ITEMS

Figure 3.4 shows the literacy item variable map for Survey 3³. On the right hand side of the map the item steps are shown ranked on a logit scale according to the estimates of their step thresholds, from the easiest (at the bottom of the map) to the most difficult (at the top of the map). The left hand side of the map shows the distribution of the student's performances relative to the items. Each X represents three students.

³ For further detail about item variable maps see the section 'Item variable maps' on page 15.

In Survey 3 the following specific item labels were used:

- 3KC - items based on the simple reading book *Kitty Cat Plays Inside*
- 3KS - spelling items (words selected from the *Kitty Cat* book)
- 3IW - items requiring to read a series of words containing ‘-ike’
- 3MB - items based on the picture storybook *Magical Bicycle*
- 3MW - the writing task based on *Magical Bicycle*
- 3SS - items asking students to segment words beginning with ‘S’
- 3PA - a group of phonemic awareness items.

The item steps at the top of the map were the most difficult items for this group of students. The most difficult item 3KS4 asked for the correct spelling of ‘basket’. The next most difficult items, 3MW1 and 3MW4, were writing items. 3MW1.4 referred to a well-connected extended piece showing a recognisable structure, and 3W4.3 referred to the correct use of capital letters and full stops in the writing.

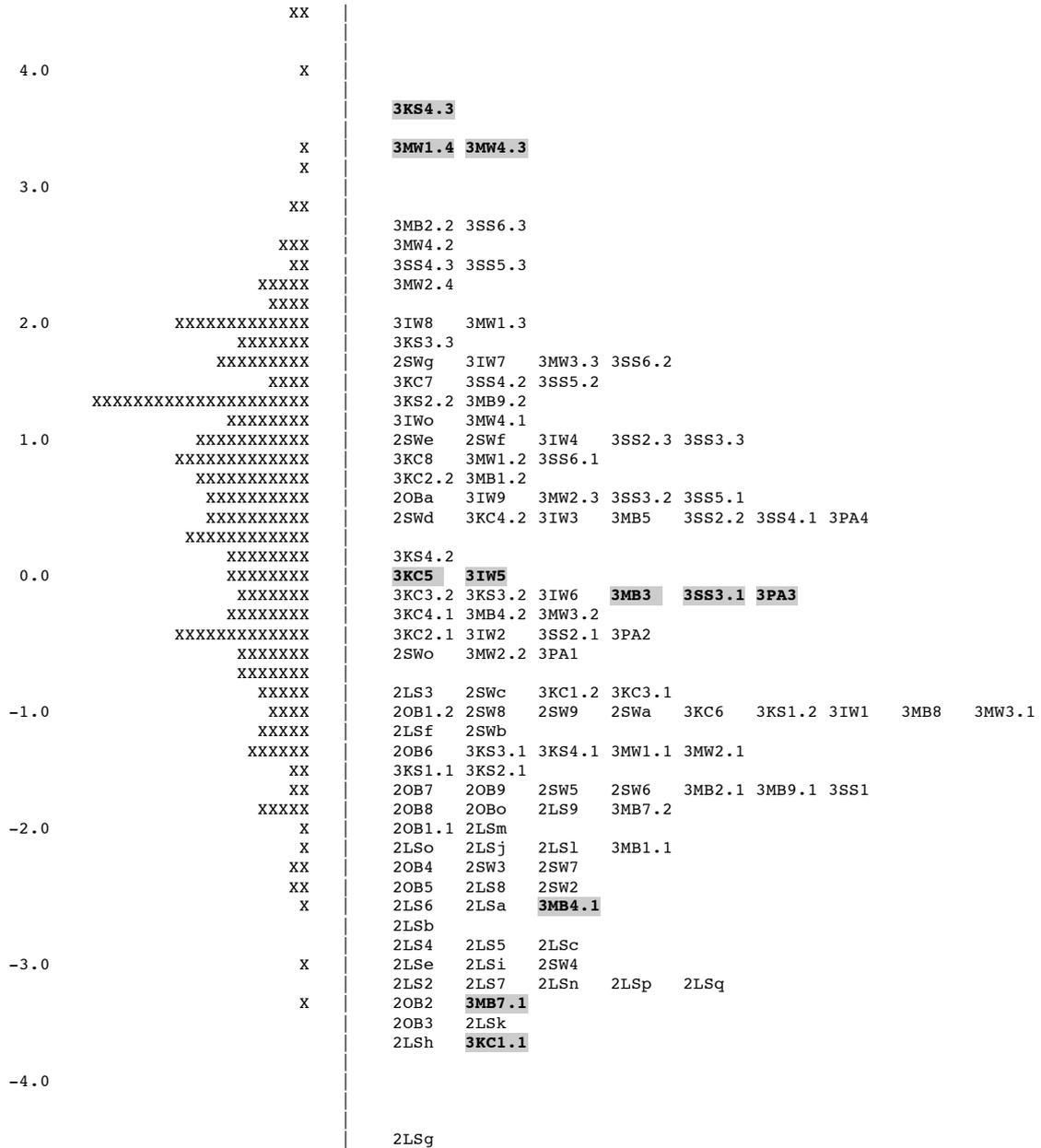
Item steps around the middle of the map included 3KC5 (plausible answer to the question about the reading book, ‘Why doesn’t Kitty Cat want to go outside?’), 3IW5 (correct reading of the word ‘likes’), 3MB3 (appropriate answer to the question *Why does the boy get a bike?*), 3PA3 (provides the word ‘car’ when asked to take the ‘d’ out of ‘card’, and 3SS3.1 (correctly segments ‘sandal’, but does not blend syllables into a single word).

The easiest item steps located at the bottom of the map were mostly from Survey 2. Some items from Survey 2 were included to be used as link items. A small number of Survey 3 item steps were located at the lower end of the scale, including 3MB4.1 (an incomplete answer to the question ‘Why does the boy feel sad here?’), 3MB7.1 (an answer to the question about a key image that does not recognise the metaphorical meaning), 3KC1.1 (a generalised prediction about the content of the reading book from the cover).

Comparing the distributions of student performance and the distribution of item steps indicates that this assessment survey was somewhat easy for this group of students. The easier items were mainly items from Survey 2.

Item Estimates (Thresholds) Probability Level = 0.50

Logits



Each X represents 3 students

Figure 3.4: LLANS Literacy Item Map for Survey 3

LITERACY: THE FOURTH SURVEY

There were six sets of activities in the fourth survey, administered at the end of the children's second year at school. Three sets of activities were based on a factual text written for younger readers and a simple reading book. Other activities included spelling and word recognition tasks, manipulation of sounds in words, and segmenting and blending words. Table 3.16 shows the aspects of literacy that were assessed, and the tasks related to each aspect.

Table 3.16: Literacy assessment tasks, Survey 4

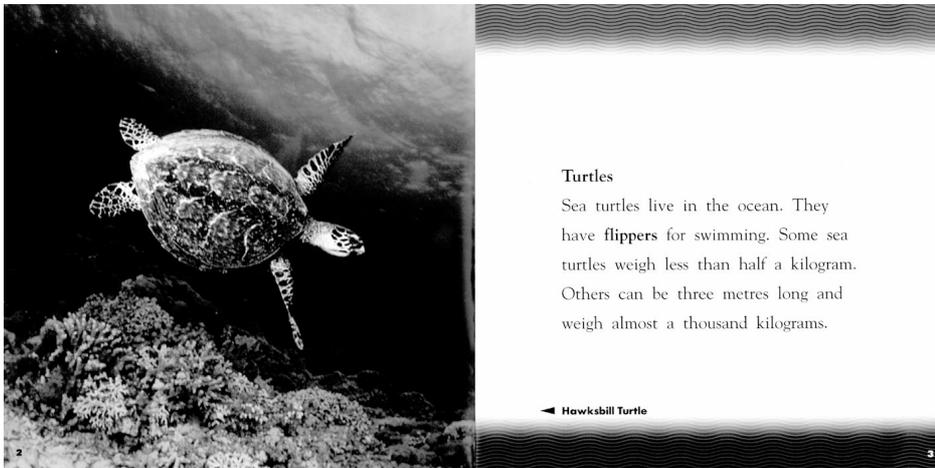
Making Meaning from Texts	<ul style="list-style-type: none"> • after listening to sections of <i>Sea Turtles</i> <ul style="list-style-type: none"> ❖ identify and recall information required to complete a data chart ❖ generate an appropriate heading for information given in a data chart ❖ infer a reason for an event ❖ infer the role of a person in a photograph ❖ infer the meaning of a word from contextual clues ❖ summarise a sequence of events ❖ link the page design to the theme of the book • after reading <i>Meet My Mouse</i> aloud <ul style="list-style-type: none"> ❖ locate directly stated information on a given page ❖ identify the main idea from a given page of text ❖ locate the correct page to find specified information
Reading Fluency	<ul style="list-style-type: none"> • read <i>Meet My Mouse</i>
Concepts about Print	<ul style="list-style-type: none"> • explain text indicates the author and the illustrator • explain the purpose of a caption • explain the purpose of a glossary • recognise an internet address
Phonemic Awareness	<ul style="list-style-type: none"> • read unfamiliar words composed of phonetically regular segments: ten, tablet, ticket, target, tactical, tetrahedron • substitute letters in words to create new words (e.g., hat swap the /h/ with the /m/)
Writing	<ul style="list-style-type: none"> • write about a pet that you would like • spell his, plan, games, time, thin, running, great, basket

FACTUAL TEXT

Sea Turtles, by Stanley L. Swartz (Longman, 1999), was selected as an illustrated text that presents factual information about sea turtles in ways likely to be of interest to students in the age range of the students in the study. Each double-page spread presents an attractive coloured photograph accompanied by several sentences of informative text. The teacher read the text aloud to the student. The picture story-books used in Surveys 1, 2 and 3 were fictional stories. This text provided an opportunity to assess students' understandings of a different kind of picture book text read aloud.

The activities were designed to assess the kinds of skills students need to locate information and interpret factual texts. The teacher read the text aloud in short sections. Before listening to a section of text, the student was told what information to listen for. In one task, the student was asked to listen for specific details and in another to retell a sequence of events and infer the role of a person shown in the photograph. The teacher also read a single page and asked the student to

infer the reason for an event, infer the meaning of an unfamiliar word in context and explain the purpose of a caption. Students were also shown the glossary and asked, *what is this page for?*

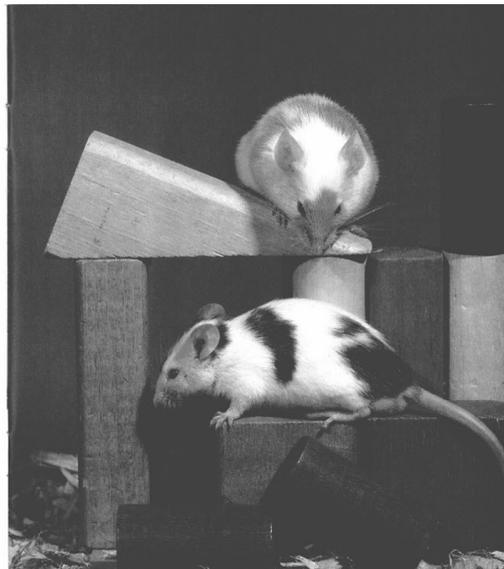


A READER

Meet My Mouse was selected as a simple factual text suitable for students of a range of abilities to read independently. The teacher read the first page aloud to demonstrate a sentence structure that was repeated throughout most of the text.



My mouse has round, black eyes.
Like all mice, she has oval ears
and a pointed nose.



Students were then asked to read the rest of *Meet My Mouse* independently. After the student had finished reading, the teacher turned to a specific page and asked questions about that page before turning to another page. Students were asked to summarise the main idea of a page of text, find and repeat an explanation, locate information in the book and explain the purpose of *these dots* (an ellipsis).

Meet My Mouse provided a context for the writing task. When the student had read and discussed the book about a pet mouse, the teacher engaged the student in a brief discussion about a pet that they would like and then invited the student to write about that pet. Writing was assessed for content, language, spelling, sentence structure and punctuation. Teachers' judgements about these aspects of writing were moderated through a set of annotated samples of students' writing

provided in the marking guide. The annotations showed which categories of the marking guide applied to various aspects of each of the writing samples.

WORD LISTS

In two activities, students were asked to read lists of unfamiliar words composed of phonetically regular segments. The list of words for each activity was different. Students were also asked to spell eight words.

ORAL ACTIVITY

Students were asked to manipulate the sounds in words by replacing letters, for example, *start with hat, swap /h/ with /m/ to make mat*. Teachers used the sounds, not the names of letters, for these tasks.

WHAT STUDENTS COULD DO AT THE END OF THE SECOND YEAR OF SCHOOL

The set of literacy tasks in the survey made it possible to identify the range of achievement within the whole cohort of students.

MAKING MEANING FROM TEXTS

Both books chosen for this survey were illustrated, factual texts. Activities assessed the breadth of skills and understandings that students demonstrated in locating and interpreting information. Before reading the picture-book, *Sea Turtles*, the teacher showed the student the cover of the book and an incomplete data chart.

The teacher read the information on the chart to the student, pointing out all the pieces of missing information the student needed to listen for. The teacher then read aloud the text from three double pages of *Sea Turtles*. Most students could recall one or more pieces of information but many did not recognise when there was a range of possibilities. Eighty-seven per cent of students recalled that a sea turtle either had no teeth or a hard jaw when they provided information about the sea turtle's mouth. When asked about the size of a sea turtle, only 22 per cent of students referred to the information about the turtles ranging in size from small to very big. An additional 47 per cent recalled one detail and said that turtles were either small or big.

To assess students' understanding of the way information is organised in a data chart, the teacher asked the student to generate a heading for information given as *the ocean*. Fifty-eight per cent of students made reference to location giving responses such as, *where it lives* and *its home*.

Students found it difficult to infer a reason for a sea turtle's behaviour. Students needed to make links between all the information in the text to do this. The teacher read the following section of text.

Sea turtles do not eat every day. They can go a whole month without eating. When food is plentiful, they eat more and grow big.

The teacher then asked the student why he or she thought sea turtles sometimes go for a whole month without eating. Twenty-seven per cent of students referred to information provided in the text, such as a shortage of food or the difficulty of finding food but most students (73%) provided generalised explanations such as the sea turtles were not hungry, or they did not eat much.

Almost half the students were able to infer meaning that was not directly stated in the text. The teacher read the following section from the book:

The eggs hatch in several months. Baby turtles dig out of the sand. They hurry towards the water. Once in the water, they swim and are on their own.

When asked, *Who looks after the baby turtles?*, 48 per cent of students used the information provided to work out that the baby turtles had to look after themselves.

Students generally found it easy to locate information in *Meet My Mouse*. Table 3.17 shows the percentage of correct responses. The teacher turned to the relevant page before asking these questions, except for the last question where the student found the relevant page by themselves.

Table 3.17: Locating information

% correct	Question	Correct response
82%	What does this page tell you a mouse uses its whiskers for?	refers to feeling things
86%	What do these pages tell you about mice?	refers to information about teeth (e.g., 'It tells you all about a mouse's teeth.')
67%	What does this page tell you about why mice chew things?	refers to mice chewing to <u>stop</u> their teeth from becoming too long
77%	Turn to the part of this book that tells you what you need for a pet mouse. What does it say you need?	turns to page 14-15 and reads or points to text (e.g., a cage, water bottle, food dish, mouse food, litter)

WRITING

Students wrote about a pet they would like to have. Their writing reflected points discussed after reading *Meet My Mouse*. Students discussed what sort of pet they would like and how they would look after it.

The writing in Sample 1 focuses on the key aspects of the discussion held after reading *Meet My Mouse*. The student names her preferred pet and the food the pet would require. The illustration supports the meaning of the written text.

A pet I would like

I Poetia Kalie
I Like kale
cat goatle and
Ximoo



I want a kitten
I like kittens
cat food and milk.

Sample 1

The writing in Sample 2 shows an understanding of the task required and some elaboration of ideas. The writer states that she would like a cat and explains some of the tasks usually associated with owning a cat.

A pet I would like

I would like a cat
I would feed it and
I would wake it.
I'd let it sit.

Sample 2

The writer in Sample 3 shows he is capable of understanding and responding to the key task and elaborating upon it. The writer states that he wants a pet snake, outlines how he would care for it and then includes explanations and reasons as to why he needs a snake.

A pet I would like

I would want
a snake. I would want
it for scaring my mom
and putting ^{it} in her bed. I need
it to scare off bullies at
school. I would take it for
^{walks} walks and feed it on eggs and
meat. I would keep it ^{warm} warm.
I would play with it I would
coddle it.

Sample 3

The following tables show the distribution of the teachers' judgements of the quality of students' writing for content and for language.

Table 3.18: Marking Guide: Writing content

% students	Marking guide
17%	shows control of selected content (e.g., selects specific details for their appropriateness to the piece, includes some explanations, opinions or reasons, attempts to meet readers' needs for specific information)
29%	writes a connected piece that shows some overall coherence (e.g., logical sequence of events or a detailed list) but shows little evidence of selection and control of the content to achieve specific purposes (e.g., an engaging description)
42%	lists ideas with little elaboration, shows a general understanding of the task, writing may be brief or long and disjointed
9%	expresses one idea (e.g., 'My best pet is a cat.')
2%	unrelated or irrelevant ideas
2%	other (e.g., unrecognisable script)

NOTE: The following instructions were given to the teacher: If the writing has no recognisable words or word-like clusters of letters with some sound correspondence, please select 'other'. Do not continue to assess this piece of writing.

The language students used in their writing was assessed in terms of the complexity of the sentence construction. This marking guide differentiates longer pieces of writing, of at least six sentences, from shorter pieces.

Table 3.19: Marking Guide: Writing language

% students	Marking guide
writes a longer piece (at least 6 'sentences'), AND	
6%	controls a variety of simple and complex sentences
9%	controls a variety of mainly simple sentences
10%	mainly uses 'run-on' writing (e.g., 'My favourite pet is my dog and she is fun and she likes it when we throw the ball for her and she chases it but sometimes she is naughty and she chews our shoes then ...')
writes a shorter piece, AND	
42%	includes simple sentences joined with simple conjunctions like and, but, and then
24%	includes simple sentences but does not join them (e.g., 'I like dogs. Dogs are fun.')
9%	makes some errors in the construction of simple sentences (e.g., 'My pet I like cat.')
1%	writes a series of unrelated words

NOTE: The following instructions were given to the teacher: For the purposes of language assessment sentences are not defined as text that falls between two full stops. In this instance a sentence is defined as a piece of text which would normally be understood as a sentence, regardless of punctuation. Punctuation is assessed elsewhere.

The teachers judged half the students' writing to be very readable, with many words spelled correctly and plausible errors (49%) and an additional third of the students' writing as mostly readable with plausible spelling though many errors (36%). Fourteen per cent of writing samples made some sense and included some recognisable words.

Table 3.20 indicates the range in difficulty of the eight words the teacher asked the student to spell. Each word was given in a sentence to provide a context.

Table 3.20: Range in difficulty of the eight words the teacher asked the student to spell

% correct	spelling words
90%	his
77%	plan
68%	games
85%	time
41%	thin
39%	running
32%	great
26%	basket

READING FLUENCY

Most students were able read *Meet My Mouse*, some with word for word accuracy and others maintaining meaning even if they did not read all the text as it was written. Table 3.21 shows the results for reading fluency.

Table 3.21: Marking Guide: Reading fluency

% students	Marking guide
43%	<ul style="list-style-type: none"> reads the whole book, word for word accuracy, may self correct, no substitutions
28%	<ul style="list-style-type: none"> reads the whole book, mostly accurate occasional substitutions maintain meaning of text (e.g., 'races' for 'runs', 'mouse' for 'mice') some omissions which do not affect meaning
15%	<ul style="list-style-type: none"> reads all or most of the book with moderate accuracy, may be some key omissions, and some substitutions may not maintain exact meaning of text (e.g., 'My mouse has long toes (teeth).') but substitution is meaningful
13%	<ul style="list-style-type: none"> reads 2-3 pages (may attempt to read more) limited maintenance of meaning of text adds, substitutes or omits words so sentences are often nonsensical (e.g., 'My mouse has big and with spots.')
2%	<ul style="list-style-type: none"> 'invents' text (develops text from pictures only)

PHONEMIC AWARENESS

Approximately half the students demonstrated some strategies for reading unfamiliar words. Thirty per cent of the students could blend three phonetically regular segments to pronounce *tactical* and an additional 23 per cent were able to sound out segments such as, *t-ac-tic-al* without blending them together. Twenty per cent could pronounce *tetrahedron* and 32 per cent sounded out *segments*.

Almost all students were able to swap the first sound in a word to make a new word such as camp, *swap the /c/ with the /l/* to make lamp (95%, 94%). More than half could manipulate middle sounds and end sounds including blends. The results shown in Table 3.22 do not show any obvious pattern in the relative difficulty of these tasks.

Table 3.22: Phonemic awareness tasks

% correct	Task
68%	BIN Swap the /n/ with /g/
71%	ART Swap the /t/ with /m/
56%	STEM Swap the /m/ with /p/
77%	CUP Swap the /u/ with /a/
85%	SHOP Swap the /o/ with /i/
67%	SMELL Swap the /m/ with /p/
77%	BLUSH Swap the /l/ with /r/

CONCEPTS ABOUT PRINT

Students' understanding of the purpose of some common features of factual texts was assessed by asking them to identify the purpose of a caption and a glossary. Most students recognised that these features provided additional information but fewer were able to be more specific. Forty-seven per cent linked the purpose of the caption to the picture saying, for example, *to tell you about the picture*. An additional 32 per cent gave a generalised response saying things such as, *to tell you more*. Twenty-nine per cent gave the purpose of the glossary page saying, for example, *it tells you about these words*. An additional 43 per cent generalised, saying things such as *you learn more*.

STUDENTS' PERFORMANCE ON SURVEY 4 ITEMS

Figure 3.5 shows the literacy item variable map for Survey 4⁴. On the right hand side of the map the item steps are shown ranked on a logit scale according to the estimates of their step thresholds, from the easiest (at the bottom of the map) to the most difficult (at the top of the map). The left hand side of the map shows the distribution of the student's performances relative to the items. Each X represents three students.

In Figure 3.5 the following specific item labels are used:

- 4ST - tasks involving the information text *Sea Turtles*
- 4MM - tasks based on the simple reading book *Meet My Mouse*
- 4WR - the writing task based on *Meet My Mouse*
- 4TW - the items asking students to segment a series words beginning with 'T'
- 4PA - phonemic awareness items
- 4SP - eight spelling words.

⁴ For further detail about item variable maps see the section 'Item variable maps' on page 15.

The item steps at the top of the map were the most difficult for this group of students. These included a number of writing items. The most difficult item step 4WR2.4 referred to the language aspect of the writing, and the control of a variety of mainly simple sentences. 4WR5.3 referred to the use and control of a variety of common punctuation, 4WR2.3 to writing that consisted of simple sentences joined by conjunctions, and 4TW6.3 to the segmenting, blending and correct pronunciation of 'tactical'. 4SP8.2 asked for the correct spelling of 'basket'.

Item steps around the middle of the map included some Survey 3 items. The Survey 4 item steps included 4SP3.2 (spelling 'time'), 4MM2.3 (mostly accurate reading of the simple reading book), 4MM5 (appropriate answer to the question 'What does this page tell you about why mice chew things?'), 4PA3 (provides the word 'big' by swapping end sound of 'bin' with 'g'), and 4TW3.2 (correctly segments 'ticket', but does not blend syllables into a single word).

The easiest item steps located at the bottom of the map included those of the link items from Survey 3, and some of the items from Survey 4. The Survey 4 item steps located at the lower end of the scale included 4MM 2.1 (reading 2-3 pages of *Meet My Mouse* with limited maintenance of meaning'), 4MM4.1 (limited information in responses to question about what specific pages tell about mice), 4TW1 (correctly pronounces 'ten'), 4PA1 (swaps 'h' in 'hat' with 'm' to make 'mat').

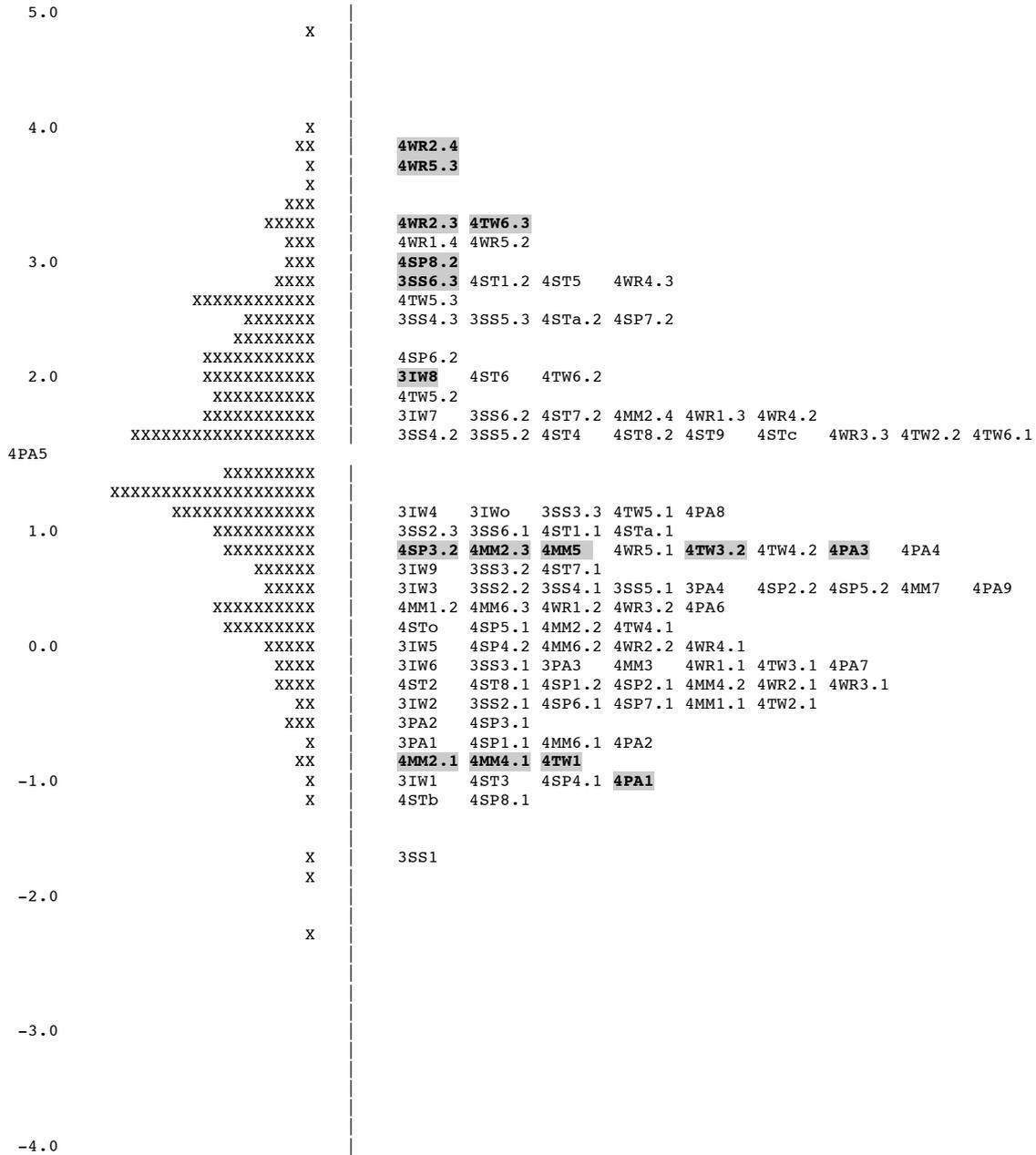
It is interesting to note that the Survey 3 items used as link items appear at different points along the scale, and are not clustered at the bottom of the map, as was the case with the Survey 2 items used in Survey 3. Some students would be likely to have difficulty with some of these items, for example segmenting, blending and pronouncing 'sentimental' (3SS6.3) and correctly reading 'likeness' in the '-ike' words group (3IW8).

Comparing the distribution of performance and the distribution of item difficulties indicates that this assessment survey was at an appropriate level for this group of students.

Item Estimates (Thresholds)

Probability Level = 0.50

Logits



Each X represents 3 students

Figure 3.5: LLANS Literacy Item Map for Survey 4

LITERACY PERFORMANCE IN THE SECOND YEAR OF SCHOOL

The scale of developing literacy achievement shown is based on data collected in 2000 during the students' second year of school. The assessment tasks from Survey 3 and Survey 4 were calibrated onto the LLANS Literacy Scale through the use of link items.

Descriptions of skills assessed in Surveys 3 and 4 are shown on the left of Figure 3.6. A selected sample of skill descriptions has been used to describe performance at different points on the scale. Each description refers to one item. The descriptions have been selected from the whole range of items in both surveys. The placement of the skill descriptions shows the estimated level of difficulty of a particular skill relative to other skills.

The four shaded bands on the right hand side of Figure 3.6 show the distributions of performance of boys and girls in their second year at school in Surveys 3 and 4. The shaded bands represent the middle 80 per cent of students. The darker shading represents the middle 50 per cent. The black line towards the middle of the darker band represents the median score.

Average growth in literacy achievement in the second year of school can be assessed by comparing the position of the median scores across the two surveys. A comparison of the bands showing the middle 80 per cent indicates that girls and boys made progress in literacy achievement between March and November in their second year at school, in the aspects of literacy assessed in the surveys. The distributions show that although, on average, the students in the study continued to make progress in literacy in their second year at school, the wide range of achievement identified in the first year at school year remained.

From Figure 3.6 it can be seen that the girls, on average, continued to perform better than boys in the second year of school.

The students completed the assessment tasks in Survey 3 early in Term 1 of the 2000 school year, soon after the long summer holiday break. It can be seen that at this time, the students around the 50th percentile were likely to be able *to write a single sentence using a capital letter and a full stop*. Students who achieved above the 90th percentile were likely to be able *to identify key events after listening to a picture story book*. Students whose achievement fell in the 10th percentile were likely to be able *to give a literal interpretation of an illustration in a picture story book, and spell initial sounds in common words*.

By the end of the year, in November 2000, students around the 50th percentile were likely to be able *to read a simple reading book (with predictable structure, varied content) with word for accuracy, and write readable text with many words spelt correctly*. Students who achieved around the 75th percentile were likely to be able *to use context to provide meaning for unfamiliar words in an informational text, and to include one or more complex sentences in their own writing*. Students whose achievement was around the 10th percentile were likely to be able *to express more than one idea in their own writing, and to be able to locate specific information in a simple informative reading book read independently*.

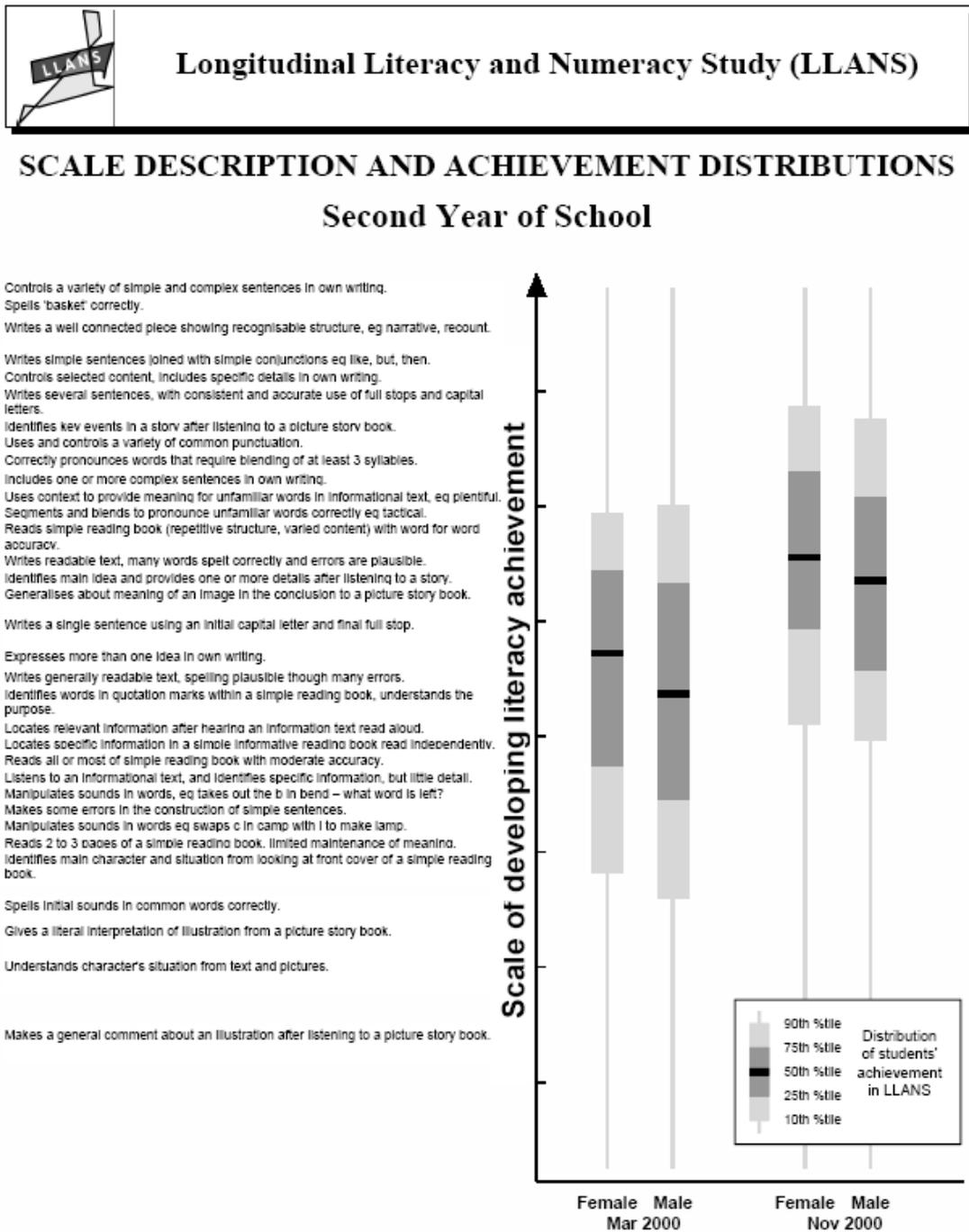


Figure 3.6: LLANS Literacy Scale description and achievement distributions for the second year of school

THE THIRD YEAR AT SCHOOL: LITERACY

The fifth literacy assessment was administered in April 2001, in the second term of the students' third year at school. Consistent with the practice established in Survey 1-4, Survey 5 was administered in a one-to-one interview situation by the students' teachers. In the first two years of schooling, students had completed two assessments, one in Term 1 and the other in Term 4. From Survey 5 onwards in this longitudinal study, students completed only one assessment each year, in Term 2.

LITERACY: THE FIFTH SURVEY

A number of the literacy assessment activities for Survey 5 were centred on a picture storybook and a simple reading book. To make links with pen and paper assessments to be used in all surveys subsequent to Survey 5, this survey also included some pen and paper reading comprehension tasks that students completed independently. Students read two brief texts, one descriptive and one procedural, and answered some questions. There was also a spelling task. Phonemic awareness items from Survey 4 were included as link items in this survey. The relatively constrained skills such as letter knowledge, concepts of print and phonics assessed in the earlier surveys were not assessed in Survey 5, but skills that continue to develop throughout schooling, including reading fluency, comprehension and writing were assessed.

Table 3.23: Literacy assessment tasks, Survey 5

Making Meaning from Text	<ul style="list-style-type: none"> • after reading <i>Clever Bird</i> <ul style="list-style-type: none"> ❖ explain an agreement made by the main characters ❖ explain the trick played on the main character ❖ discuss the moral of the story • after listening to the teacher read <i>The Deep</i> <ul style="list-style-type: none"> ❖ summarise the events in the story ❖ discuss a character's feelings ❖ make links between visual images and a character's feelings ❖ interpret the main character's actions and words • written comprehension tasks based on short texts <ul style="list-style-type: none"> ❖ select appropriate answer in multiple choice items ❖ identify information directly stated in the text ❖ infer information from the text ❖ identify and describe images in the illustrations
Reading Fluency	<ul style="list-style-type: none"> • read <i>Clever Bird</i> aloud
Spelling	<ul style="list-style-type: none"> • spell words said aloud, and included in a sentence (<i>sing, brick, said, friend, station, whiskers</i>)
Writing	<ul style="list-style-type: none"> • write about what happened in <i>The Deep</i>

A PICTURE STORYBOOK

The Deep, by Tim Winton (1960, reprinted 1998), depicts a family who lived by the sea and swam and played in the water every day. Although Alice 'wasn't scared of many things', she 'was afraid of the deep'. Alice wanted to join the rest of her family in the water, but was held back by her fear of 'the deep'. Eventually, after an episode with dolphins and with some encouragement from her brother, Alice found that 'you could swim in the deep just as easily as in the shallows.' The teacher read *The Deep* to the student.

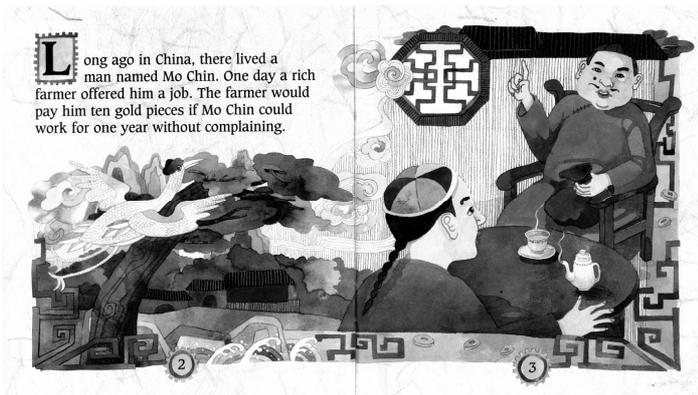
The bold and colourful illustrations add to the written text to provide insights into the Alice's emotions, giving scope for assessing the students' ability to explain more subtle aspects of the text.

Students' ability to make connections between the illustrations and the written text in order to fully understand the meaning of the narrative was a key assessment task. Students were also asked to interpret the intended effect of the repetition of the words 'the deep' at the conclusion of the story.

After students had listened to a reading of the picture story book, and answered a series of questions about it, *The Deep* provided scaffolding for the students' writing and an opportunity to assess their depth of understanding of key issues. Students were asked to *write about what happened in The Deep*.

A READER

Clever Bird, by Charlie Chin (1996) is a folk tale. The story is a simple telling of a complex story involving several tricks. The full colour illustrations reflect the setting in China, and support the written text with visual detail. This text was made available for the survey even though it was not commercially distributed in Australia, thus ensuring that it was unlikely to have been read previously by any of the students. The teacher read the opening pages of *Clever Bird*.



The students then continued to read the rest of the story to the teacher. Questions the teacher asked assessed the student's understanding of the tricks played by the rich farmer and Mo Chin and the role of some of the other characters, and a parrot. The student was also asked about the moral, or the lesson they thought the story taught them.

DESCRIPTIVE AND PROCEDURAL TEXTS

Comprehension tasks were used for the pen and paper assessments. These consisted of brief texts, with five mainly multiple-choice format questions. Each student completed two units, one based on a passage of procedural text, and the other based on a short descriptive text. The teacher explained the activity and waited while the student completed the tasks independently. The teacher was asked to offer encouragement, if necessary, without providing assistance. The following is an example of one of the descriptive texts.

I'm Joanne. This is a photo of me at the beach sucking a rock. Yum, Yum! I didn't like the water much but the rocks were great. Mum says I was always putting things in my mouth when I was little.

I was one year old when this photo was taken. Mum is surprised I have my hat on. She says that when I was a baby I was very stubborn. I hated wearing hats. I would always pull them off. Dad says I haven't changed!



Questions about the descriptive text assessed students' ability to locate directly stated information and make connections within the text to interpret meaning, to identify a person's attitude or the

implications of a phrase. Questions about the procedural text also assessed students' ability to match an illustration to a step in a sequence, and identify a text type (recipe).

Students were asked to spell a list of words, and to write an extended piece about what happened in *The Deep*.

WHAT STUDENTS COULD DO IN THEIR THIRD YEAR AT SCHOOL

The following section highlights some of the achievements of students in their third year of school. Survey 5 focussed on four aspects of literacy: Making Meaning from Texts, Reading Fluency, Spelling and Writing. Activities that assessed phonemic awareness, included in previous surveys, were not included as most students had mastered the relevant skills. Spelling continued to be assessed as part of writing and through spelling lists. Tasks that assessed students' understanding of linguistic structures and features of texts were included in the aspect, Making Meaning from Texts rather than being a separate set of activities addressing Concepts about Print.

MAKING MEANING FROM TEXTS

The Deep was read to students by the teacher. Alice can swim but she is afraid of deep water. Finally it is a group of dolphins playing near the shore which entices Alice into forgetting her fear as she delights in swimming with them into deeper water. The role the dolphins play in helping Alice is implied in the text and by the illustrations, rather than being clearly stated. The turning point in the story, where Alice overcomes her fear, is expressed through changes in Alice's feelings ranging from elation to fear and back to delight. Slightly more than half the students (58%) were able to interpret the links between the key events and Alice's emotions. They could explain the role the dolphins had played in distracting Alice so that she found herself swimming in the deep before she realised where she was. These students said, for example, *she wanted to go with the dolphins and she forgot it was deep*. A further 26 per cent of students recognised that dolphins played a role but did not elaborate why, even when the instructions asked the teacher to prompt these students to explain their answer. Three quarters of the students were able to explain that Alice's elation had turned to fear because she realised that she was in deep water.

One part of the story shows Alice heading away from the jetty with a backward glance of envy and sadness as her family exuberantly fling themselves off the end of the jetty into the sea. Given that they knew Alice was afraid of the deep, 64 per cent of students inferred *what else Alice might be feeling* and gave an explanation for why they thought this. These students said, for example, *jealous, because her family are jumping in and she can't*, and *embarrassed because she can't do it and lonely because she cannot be with them*. Seventeen per cent identified a plausible emotion but could not give an explanation.

In another illustration there is a shadowy suggestion of a large dark octopus shape lurking in the deep water behind Alice's frightened face. The images extend ideas and emotions in the written text.

But, Alice watched from the jetty. The water looked beautiful. It went all greeny-blue out there. It was deep. So deep you couldn't see the bottom.

When asked why they thought the shape was there, 45 per cent of students recognised that the octopus shape symbolised menace and made the link to Alice imagining the deep to be filled with dangerous creatures saying for example, *to show that Alice is afraid because she thinks there is a monster in the deep*. Thirty-nine per cent of students did not make this link and literally described the shape as either an octopus or seaweed that was in the water.

The most difficult question for students was to explain why the story ends with the words, *the deep*, repeated three times. Nineteen per cent of students gave an interpretive response saying, for

example, *she is amazed she was swimming in the deep*, demonstrating a deeper understanding of the text than the 76 per cent of students who gave a literal response saying, for example, *it is very, very deep*.

Students read *Clever Bird* themselves and then answered questions the teacher asked them. The students were invited to use the book to find the answers but asked not to read it all again. In the story, a rich farmer cheats Mo Chin of a year's wages. Mo Chin uses the farmer's greed to play a trick on the farmer and get his wages back. Mo Chin persuades the farmer that a parrot has magical powers and sells the parrot to the farmer. Close to half the students explained both of the scams in this story by linking the events to the characters' misunderstandings (49%, 54%). It was easier for students to simply link events. Seventy-five per cent were able to explain that the rich farmer gave Mo Chin the gold as payment for the parrot, even if they did not all realise that the parrot did not possess the powers the rich farmer thought it had. Sixty-six per cent of students were able to generate a moral for the story saying, for example, *it is bad to be greedy, or you should not trick people*.

Each student was given a pen and paper assessment consisting of a descriptive text and a procedural text with mainly multiple-choice questions.

Students found the questions for the descriptive tests fairly easy. Over 90 per cent of students were able to locate directly stated information, especially when the wording in the text closely matched the wording of the question as shown in the following example.

Question: *What did Joanne like about the beach?*
Relevant sentence: *I didn't like the water much but the rocks were great.*

It was slightly more difficult for students to make a generalisation (84% of students were able to do this). Approximately half the students were able to work out the meaning of an unfamiliar word using contextual clues (57%). To find the meaning of the word *stubborn*, students had to interpret the following sentences:

Mum is surprised I have my hat on. She says that when I was a baby I was very stubborn. I hated wearing hats. I would always pull them off.

and then select from the following multiple-choice options:

This means Joanne did

- what she wanted to do.
- what people told her to do.
- what everyone else was doing.
- what made other people happy.

Questions about the procedural texts were generally more difficult for students to answer than for the descriptive texts. Questions that approximately three quarters of the students could answer correctly asked them to locate information directly stated in one of the sections of the text such as, one of the steps, the list of ingredients or the list of equipment (75%, 70%, 79%, 68%). This kind of question became more difficult when the text included competing information (35%, 53%).

WRITING

After the student had listened to *The Deep* and answered some questions the teacher asked the student to write about *what happened in The Deep*. Their discussion of the text had provided students with content organised in a logical sequence and models for a range of sentence constructions.

The following samples illustrate some of the range of writing skills shown by students.

In Sample 1 the writer adopts the narrative style of the story, beginning with the classic opening line *Once there was a girl, her name was Alice and she wasn't scared of anything*. The writer shows control of a complex sentence and reiterates the story's focus by writing deep in capital letters. *Lizards and spiders didn't frighten her, but the only thing she was scared of was the DEEP*. The writer shows a depth of understanding of the story, recognising the role the dolphins played in helping Alice to overcome her fear of the deep.

A

The Deep Writing Sheet

THE DEEP There ONCE was a
 gile her name was ALICE
 she wasent scorde of e
 thing Lizerds and spiders
~~didn't~~ fritent her but th
 only thing she was scorde
 of was the DEEP.

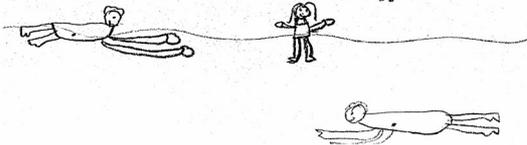
The next day her fam
 went the beach and jump
 of the jety but ALICE didno
 Then one day she folde
 some to the DEEP as soon
 as she nodest * she sunck
 and * the next day she
 jumde soff the Jety.

Sample 1

In Sample 2 the writer explains Alice's fear and the happy conclusion, but omits to explain the key events that enabled Alice to overcome her fear.

B

THE DEEP Well in the deep story the little girl was scared of the deep she was friend. Because if she went in there she would grow down to the bottom. But every time she went near the deep her mum and dad and brother said come in but she didnt. But at the end she new how to jump in the deep. She wasent scared like she all ways was.



Sample 2

In this example the writer has given a brief introduction and conclusion and focused on the key event in the story, how Alice overcame her fear. The writer has given a detailed description of this scene, showing understanding of the role of both the dolphins and Alice's brother.

C

THE DEEP A Girl named Alice was afraid of the deep but she really wanted to go out to the deep. One day she saw some dolphins in the show and started to go out to the deep her brother said dont go you is use to swim in the deep and then she froze and started to cry her brother got her hand and pulled her up then bring her to the show then she wasnt afraid of the deep any more. So the day after she went out in the yeste and jumped off.

Sample 3

Table 3.24 shows the distribution of the teachers' judgements for the writing content categories of students' writing.

Table 3.24: Marking Guide: Writing content

% students	Marking guide
27%	shows control of selected content (e.g., selects specific details for their appropriateness to the piece), includes some explanations, opinions or reasons, attempts to meet readers' needs for specific information
32%	writes a connected piece that shows some overall coherence (e.g., logical sequence of events or a detailed list) but shows little evidence of selection and control of the content to achieve specific purposes (e.g., a well reasoned choice)
34%	lists ideas with little elaboration, shows a general understanding of the task, writing may be brief or long and disjointed
5%	expresses one idea (e.g., 'I can swim in the deep.')
1%	unrelated or irrelevant ideas
1%	other (e.g., unrecognisable script)

NOTE: the following instructions were given to the teacher: If the writing has no recognisable words or word-like clusters of letters with some sound correspondence, please select 'other'. Do not continue to assess this piece of writing.

The language students used in their writing was assessed through the complexity of the sentence construction. The marking guide shown in Table 3.25 differentiates longer pieces of writing of at least six sentences from shorter pieces of writing.

Table 3.25: Marking Guide: Writing language

% students	Marking guide
writes a longer piece (at least 6 'sentences'), AND	
25%	controls a variety of simple and complex sentences
17%	controls a variety of mainly simple sentences
17%	mainly uses 'run-on' writing (e.g., 'My favourite pet is my dog and she is fun and she likes it when we throw the ball for her and she chases it but sometimes she is naughty and she chews our shoes then ...')
writes a shorter piece, AND	
25%	includes simple sentences joined with simple conjunctions like and, but, and then,
12%	includes simple sentences but does not join them (e.g., 'I like dogs. Dogs are fun.')
4%	makes some errors in the construction of simple sentences (e.g., 'My pet I like cat.')
0.5%	writes a series of unrelated words

NOTE: The following instructions were given to the teacher: For the purposes of language assessment sentences are not defined as text that falls between two full stops. In this instance a sentence is defined as a piece of text which would normally be understood as a sentence, regardless of punctuation. Punctuation is assessed elsewhere.

The teachers judged 46 per cent of the students' writing to be very readable, with many words spelled correctly and plausible errors. An additional 41 per cent of the students' writing was judged as mostly readable with plausible spelling though many errors. Twelve per cent of writing samples made some sense and included some recognisable words.

Table 3.26 indicates the range in difficulty of the six words the teacher asked the student to spell. Each word was given in a sentence to provide a context.

Table 3.26: Range in difficulty of the six words the teacher asked the student to spell

% correct	spelling words
87%	sing
72%	brick
60%	said
45%	friend
18%	station
11%	whiskers

It should be noted that almost three quarters of the students gave phonetically plausible spellings for *station* (67%) and *whiskers* (73%), including initial, middle and end sounds and at least one vowel. This was in addition to the students who spelled these words correctly.

READING FLUENCY

Most students were able read *Clever Bird*, and, as can be seen in Table 3.27, one third could do so with word for word accuracy and others maintained the meaning even if they did not read all the text as it was written.

Table 3.27: Marking Guide: Reading fluency

% students	Marking guide
34%	<ul style="list-style-type: none"> reads the whole book, word for word accuracy, may self correct, no substitutions
30%	<ul style="list-style-type: none"> reads the whole book, mostly accurate occasional substitutions maintain meaning of text (e.g., 'races' for 'runs', 'mouse' for 'mice') some omissions which do not affect meaning
25%	<ul style="list-style-type: none"> reads all or most of the book with moderate accuracy, may be some key omissions, and some substitutions may not maintain exact meaning of text (e.g., 'My mouse has long toes (teeth).') but substitution is meaningful
10%	<ul style="list-style-type: none"> reads 2-3 pages (may attempt to read more) limited maintenance of meaning of text adds, substitutes or omits words so sentences are often nonsensical (e.g., 'My mouse has big and with spots.')
1%	<ul style="list-style-type: none"> 'invents' text (develops text from pictures only)

STUDENTS' PERFORMANCE ON SURVEY 5 ITEMS

Figure 3.7 shows the literacy item variable map for Survey 5⁵. On the right hand side of the map the item steps are shown ranked on a logit scale according to the estimates of their step thresholds, from the easiest (at the bottom of the map) to the most difficult (at the top of the map). The left hand side of the map shows the distribution of the student's performances relative to the items. Each X represents three students.

In Figure 3.7 the following specific item labels are used:

- 5TD - tasks involving the picture storybook *The Deep*
- 5CB - tasks based on the simple reading book *Clever Bird*
- 5WR - the writing task based on *The Deep*
- 5SP – six spelling words
- 5AB *At the Beach* comprehension questions
- 5BP *Body Painting* comprehension questions
- 5BG *Ben and Grandpa Joe* comprehension questions
- 5FT *French Toast* comprehension questions.

The item steps at the top of the map were the most difficult for this group of students. These included a number of writing items. The most difficult item step 5SP6.2 indicated the correct spelling of *whiskers*. The correct spelling of *station* (5SP5.2) was also found difficult by most students. Some of the more difficult writing item steps were 5WR5.3 and 5WR5.2, referring to the use and control of a variety of common punctuation, and 5WR4.3, involving the consistent use of full stops and capital letters. Item step 5TD6.2, the interpretive response to the question about the repeated words *The deep, the deep, the deep*, was difficult for this group of students. A link item from Survey 4, 4TW6 (segmenting and blending syllables to say *tetrahedron*) was found to be difficult. Item 5BG5, a pen and paper item in which students were asked to underline the sentence that tells that the photo was taken a long time ago was difficult for these students

Item steps around the middle of the map included 5AB3 (identifying the writer of *At the Beach*), 5CB5.2 (explaining the role of the parrot in the trick in *Clever Bird*), 5TD1.2 (including reference to the dolphins in answer to the question 'How did Alice learn to swim in the deep?'), 4PA3 (provides the word 'big' by swapping end sound of 'bin' with 'g'), 5SP4.2 (*correctly spelling station*) and 4TW5.2 (*correctly segments 'tactical', but does not blend syllables into a single word*).

The easiest item steps located at the bottom of the map were mostly those of link items from Survey 4. The Survey 5 item steps located at the lower end of the scale included 5SP2.1 (plausible but incorrect spelling of *brick*), 5SP3.1 (plausible but incorrect spelling of *said*), 5TD6.1 (literal response to the question about the repetition of 'the deep' in the last sentence of the book), 5BG1 (correct answer to question about age of child in photo).

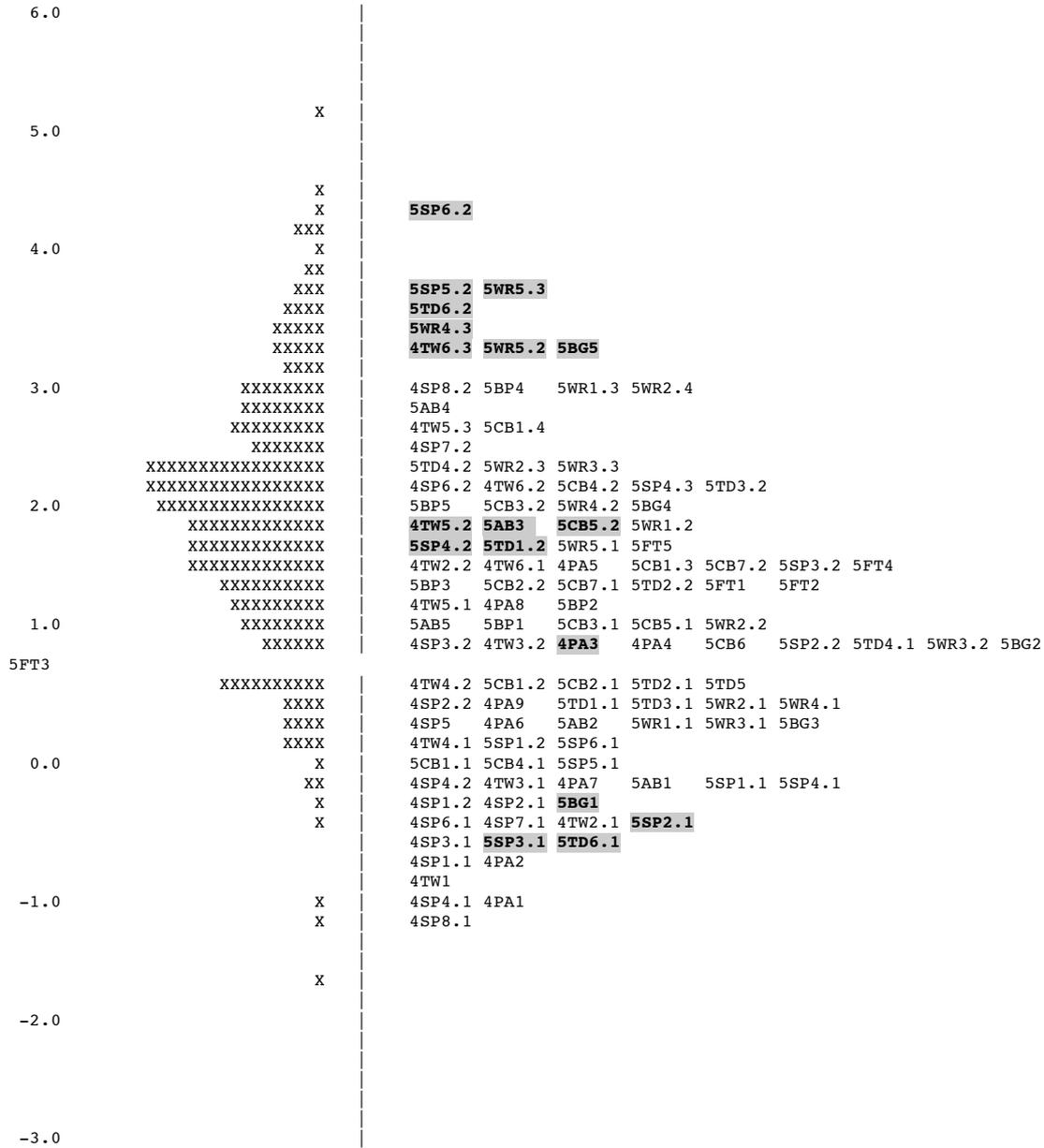
It is interesting to note that the item steps of link items from Survey 4 appear at different points along the scale, but are mostly located at the bottom of the map.

Comparing the distribution of performance and the distribution of item steps indicates that the assessment was at an appropriate level for the students except for some link items from Survey 4 which appeared to be easy.

⁵ For further detail about item variable maps see the section 'Item variable maps' on page 15.

Item Estimates (Thresholds) Probability Level=0.50

Logits



Each X represents 3 students

Figure 3.7: LLANS Literacy Item Map for Survey 5

LITERACY PERFORMANCE IN THE THIRD YEAR OF SCHOOL

Descriptions of skills assessed in Survey 5 are shown on the left of Figure 3.8. A selected sample of skill descriptions has been used to describe performance at different points on the scale. Each description refers to one item. The descriptions have been selected from the whole range of items in both surveys. The placement of the skill descriptions shows the estimated level of difficulty of a particular skill relative to other skills.

The two shaded bands on the right hand side of Figure 8 show the distributions of performance of boys and girls in their third year at school in Survey 5. The shaded bands represent the middle 80 per cent of students. The darker shading represents the middle 50 per cent. The black line towards the middle of the darker band represents the median score.

From Figure 3.8 it can be seen that the girls perform slightly better than the boys. This finding is consistent with the findings from Surveys 1, 2, 3 and 4.

Figure 3.8 displays both student performance and task difficulty. The achievement distributions show the considerable range of achievement. Some students' achievement is at a low level on the LLANS Literacy Scale, and others' achievement is very high on the Scale. Around the median level of achievement, students were able to *explain a character's actions in a simple reading book read independently* and to *write several sentences using some capital letters and full stops*. Students around the 75th percentile were able to *read a simple reading book with word for word accuracy*. Students above the 90th percentile were able to *use and control a variety of common punctuation in their own writing*. Students in the 10th percentile could *read 2-3 pages of a simple reading book with limited maintenance of meaning*.

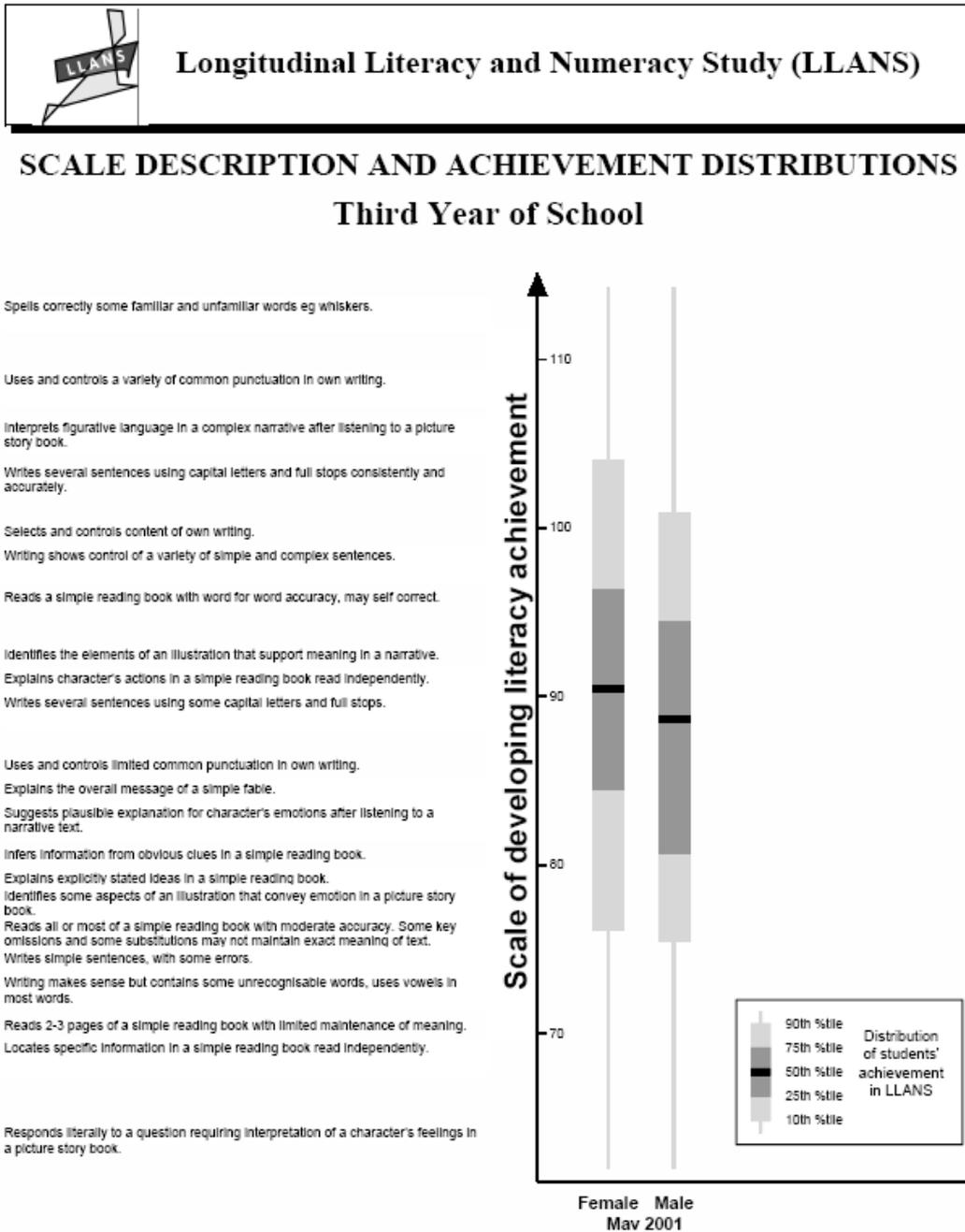


Figure 3.8: LLANS Literacy Scale description and achievement distributions for the third year of school

4. ASSESSING NUMERACY DEVELOPMENT

THE FIRST YEAR AT SCHOOL: NUMERACY

The children in the sample selected for the study completed literacy and numeracy assessments twice in their first year at school. Two sets of assessment tasks were developed for each survey, to assess the students' performance. These tasks were piloted and trialled in the months prior to each survey. Survey 1 was administered in 1999, in a one-to-one interview situation, by the students' own teachers early in their first year at school, and provided the baseline data for the longitudinal study. The second set of assessment tasks (Survey 2) was administered, again by the students' own teachers, towards the end of the 1999 school year.

NUMERACY: THE FIRST SURVEY

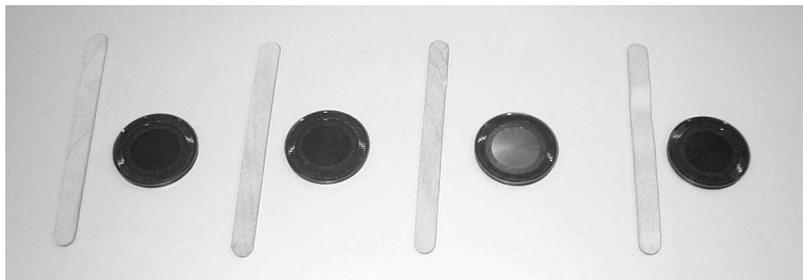
The first survey for numeracy included six sets of activities many of which were 'hands on' and designed around materials students were likely to have encountered in their everyday lives. As far as possible, each set of activities was presented in a meaningful context. Students demonstrated their skills and understandings by carrying out simple tasks with the provided materials, reciting number sequences and performing simple mental calculations. Table 4.1 shows the three strands of mathematics (number, space, chance and data) that were assessed in the first survey and the tasks related to each aspect.

Table 4.1: Numeracy assessment tasks, Survey 1

Number	<ul style="list-style-type: none"> • continue a repeating pattern ab, ab, ab ...and make a repeating pattern • say age and identify numeral for age • use fingers to show age and use counters to represent age • identify 3, 7 • count picture of 8 objects and count out 8 counters • write 8 • count to 20 • give numbers after 6 and 13 and give numbers before 8 and 10 • count backwards from 5 and count backwards from 10 • count objects (7,14) • calculate $3 + 2$ mentally and calculate $7 - 4$ mentally • read \$1.75 and 40c • identify numbers on a menu as representing prices
Space	<ul style="list-style-type: none"> • place objects upside down, on top of, in front of, behind, under, close and a long way in front • identify two shapes that are the same in some way and identify two shapes that are different in some way • identify two shapes with the same colour but the same in some other way • give the name for a square, circle and triangle
Chance & Data	<ul style="list-style-type: none"> • sort attribute blocks into 3 groups • describe criterion used for sorting

PATTERNS

Students' understanding of patterns was assessed with pop-sticks and large plastic counters that were all the same colour. The teacher made a simple pattern, alternating a pop-stick with a counter that the student continued for at least three repetitions. The student was then invited to make a pattern for the teacher to continue.

*COUNTING*

The student's age was the theme of several tasks. The teacher asked students to say their age, show their age with their fingers and use counters to represent their age. The students also selected the numeral for their age from a sheet with the numerals from one to ten shown in random order. Students were asked to count the number of candles on a picture of a birthday cake, put eight counters out and count a pile of counters.

PRICES

A simple illustrated menu for *Carl's Café* provided the basis for some tasks designed to assess students' recognition of prices and their ability to read numbers shown as dollars and cents.

NUMBER SEQUENCE

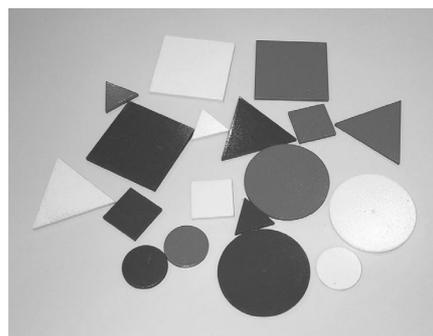
Students were asked to demonstrate their knowledge of number sequences by counting forwards from one and backwards from ten. The teacher also said a number and then asked students to give the number before and the number after.

OVER AND UNDER

Students' understanding of terms used to describe the relative position of objects was assessed by asking students to place the teacher's pen in different positions such as; *on top of*, *behind* and *under* a container.

SHAPES

Students' understanding about shapes was assessed by asking them to find similarities and differences between shapes in a set of 18 attribute blocks consisting of circles, squares and triangles in different sizes and colours. Students were asked to name three shapes and to generate a criterion for sorting the shapes into three groups.



Attribute Blocks

WHAT STUDENTS COULD DO WHEN THEY STARTED SCHOOL

The responses to the numeracy assessment activities showed a wide range of achievement amongst students at the beginning of their first year at school. The following section highlights some of the students' achievements in each of the strands assessed in Survey 1.

NUMBER

Students found it easy to continue a simple repeating pattern modelled by the teacher. Ninety-three per cent of students continued a pattern made by alternating a pop-stick with a counter for at least three repetitions. Seventy-four per cent of students were able to generate their own different repeating pattern using a combination of pop-sticks and counters.

Almost all students were familiar with the number for their own age. They gave their age (97%), used fingers to show their age (95%), used counters to represent their age (92%) and read the numeral for their age from the numbers sheet (92%).

Most students could identify some numerals and count some numbers under ten, as shown in Table 4.2. Sixty-four per cent also counted 14 counters and 72 per cent wrote the number eight.

Table 4.2: Number assessment tasks

Skill	% correct	Task
Numeral recognition	92%	identify the numeral three
	85%	identify the numeral seven
Counting	91%	count 8 candles on a picture of a birthday cake
	85%	count out 8 counters
	88%	count 7 pop sticks
	64%	count 14 counters
Writing	72%	write the number 8

The results in Table 4.3 show that approximately half the students were able to give the number before and the number after for a range of numbers. Approximately a quarter of the students gave the number after when asked for the number before.

Table 4.3: Number tasks involving mental calculation

% correct	Task
80%	number just after 6
51%	number just after 13
50%	number just before 8
49%	number just before 10

Two more difficult number tasks involved mental calculations. Forty-four per cent of students mentally added three and two to give five. Thirty-two per cent mentally subtracted four from seven to give three.

Students were shown a menu, *Carl's Café*. The teacher read the names of the items shown on one side of the menu and then asked students to identify what the other part of the menu (the prices) was for. Seventy-four per cent recognised that these were the prices, the money or what things cost. Very few students were able to read prices. Fourteen per cent read \$1.75 correctly saying either, one seventy-five, one dollar and seventy-five cents or one dollar seventy five. Twelve per cent read 40c correctly as 40 cents.

SPACE

Most students were familiar with a wide range of terms used to indicate relative position. Eighty-three per cent followed all seven of the teacher's directions about placing an object upside down, on top of, in front of, behind, under, close and a long way in front of another object. A further 13 per cent followed at least five of the directions.

Almost all the students were able to identify similar and different attributes of shapes and name everyday two-dimensional shapes. To do this they used circles, squares and triangles in different sizes and colours. Table 4.4 shows the percentage correct for each of these questions.

Table 4.4: Space assessment tasks

% correct	Task
94%	show me two pieces that are the same in some way
90%	show me two pieces that are different in some way
83%	show me two pieces that are different colours but the same in some other way
87%	do you know what this shape is called? (square)
95%	do you know what this shape is called? (circle)
90%	do you know what this shape is called? (triangle)

CHANCE AND DATA

Just under 50 per cent of the students were able to generate a criterion to sort shapes. The teacher modelled sorting the shapes into two groups, one of *big pieces* and one of *small pieces*. The student was then asked to sort the shapes into three groups. Forty-six per cent did this sorting either by colour or by shape. An additional 39 per cent of students followed the instructions to make three groups but they did not sort the groups by any obvious attribute.

STUDENTS' PERFORMANCE ON SURVEY 1 ITEMS

Figure 4.1 shows the numeracy item variable map for Survey 1⁶. On the right hand side of the map, the item steps of the items in the survey are shown ranked on a logit scale according to the estimates of their step thresholds, from the easiest (at the bottom of the map) to the most difficult (at the top of the map). The left hand side of the map shows the distribution of the student's performances relative to the items. Each X represents five students.

In Survey 1 the following specific item labels were used:

- 1OU for over and under items
- 1PT for the pattern items
- 1BI for the number items using birthday information
- 1SH for the shapes items
- 1CO for the counting items
- 1CC for money items using the Carl's Café menu.

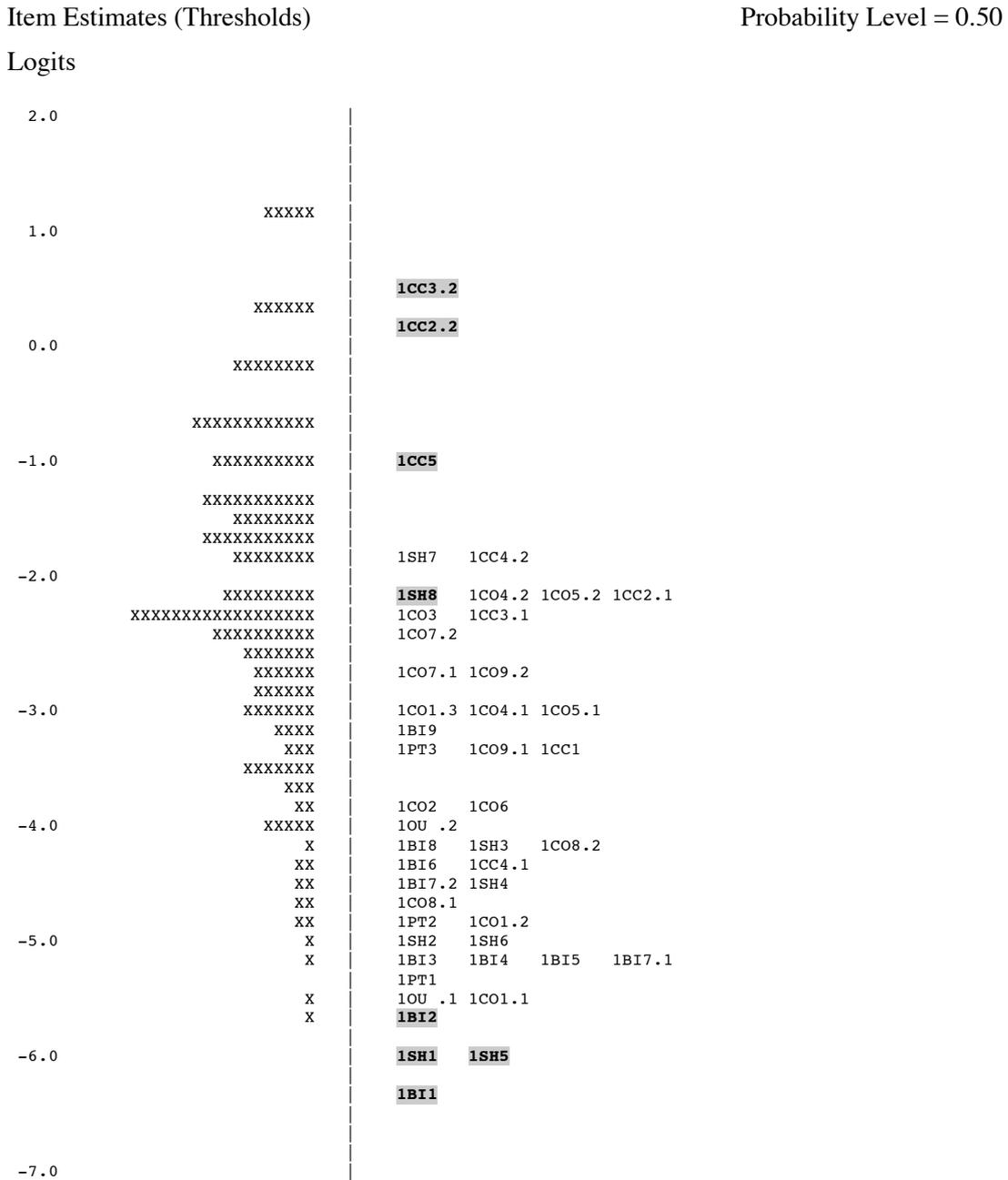
⁶ For further detail about item variable maps see the section 'Item variable maps' on page 15.

The item steps at the top of the map were the most difficult for this group of students. The items 1CC3 and 1CC2 were items that tested students' ability to work out the prices of individual items on a menu. 1CC5 asked students to work out how many muffins were left after four muffins had been eaten from seven that had been bought.

In the middle of the map, 1SH8 represents the item that asked students to tell the assessor how they had sorted the set of coloured shapes; credit was given to students who were able to describe the attribute they had used to sort the pieces. A number of the counting items (1CO) were located around the middle of the map.

The easiest item steps located at the bottom of the map included 1BI1 (*how old are you?*); 1SH1 (*selecting two shapes that were the same in some way and saying how they were the same*); 1SH5 (*naming a circle shape*); and 1BI2, (*showing their age with their fingers*).

On this map, comparing the distribution of students' performances and the distribution of item difficulties indicates that this assessment survey did not include a sufficient number of more difficult items and was, overall, rather easy for this group of students.



Each X represents 5 students

Figure 4.1: LLANS Numeracy Item Map for Survey 1

NUMERACY: THE SECOND SURVEY*END OF FIRST YEAR ASSESSMENT ACTIVITIES*

The Survey 2 numeracy assessment tasks were designed to link to subsequent surveys, and included five sets of activities. The assessment was conducted in Term 4, 1999, towards the end of the students' first year at school.

The activities were based around familiar classroom and everyday materials. Table 4.5 shows the strands of numeracy that were assessed in the second survey and the tasks related to each strand. The strands of number, space, chance and data, assessed in Survey 1, were again assessed, and items in the measurement strand were introduced in this survey.

Table 4.5: Numeracy assessment tasks, Survey 2

Number	<ul style="list-style-type: none"> • count to 20 and count from 36 to 47 • give numbers after 7, 16 and 32 and before 5, 12 and 26 • count backwards from 10 and from 24 • count objects (6, 5, 18, 27) • say how many more to make a group of 4 into 7 • say how many left when 2 removed from hidden collection of 6 • read numerals 8, 15, 29, 74, 50, 100 • add 5 to 8 mentally • make four groups of two and share 10 counters between two 'people' • calculate cost of two items at 20c each • read \$2.85 and 60c • identify first, third and last object in a line • place an object between second and third position and identify fourth position
Space	<ul style="list-style-type: none"> • name a rectangle/oblong
Measurement	<ul style="list-style-type: none"> • identify the longest and shortest of four ribbons and estimate which ribbon matches a given length • combine two ribbons to match a given length and measure a ribbon with paper clips • compare the mass of three objects and select the heaviest
Chance & Data	<ul style="list-style-type: none"> • identify the highest price • sort objects according to a given criterion (shape) and generate a criterion to sort objects • create a bar graph by placing objects on a grid • identify the largest and smallest group on a bar graph • count the quantity in a group on a bar graph • calculate the difference between two groups on a bar graph

COUNTING

Students were asked to demonstrate their knowledge of number sequences by counting forwards from one and from 36 and backwards from ten and from 24. The teacher said a number and then asked students to say the number before and the number after. The students were invited to count the number of counters in a collection. One task used counters to assess the students' ability to count out and count on.

SUBTRACTION

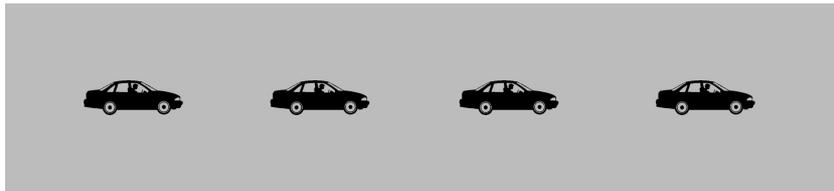
To assess subtraction, the teacher showed the student six counters, covered the collection and removed two counters and asked the student how many were left.

NUMBER RECOGNITION

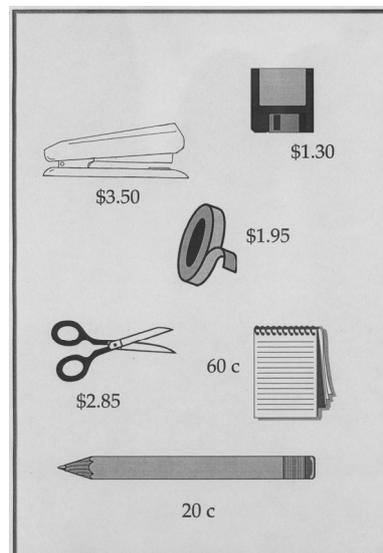
The teacher gave the student a box of paper clips and asked the student to read numbers printed on the box.

ORDINAL POSITION

To assess students' understanding of ordinal position, the teacher gave students a grey strip of paper, which was 'the road', with a printed line of cars. The teacher asked the student to identify positions such as third in line, and also invited the student to add cars printed on small cards to different places in the line such as last in line.

*NUMBERS AND PRICES*

To assess numeral recognition, students were asked to read a range of numbers from a sheet. Understanding of groups was assessed by asking students to make two groups of four, and to share ten counters between two 'people' drawn on a sheet. Students were shown pictures of some common stationery items with prices and asked to identify some prices, compare prices and calculate costs.

*SHAPE RECOGNITION*

Students were asked to name the shape of the top of the paper clip box.

MEASURING LENGTH

Students' understanding about measurement of length was assessed using four ribbons. Each ribbon was a different colour and had been cut to a particular length. The student was handed the ribbons as a bundle and invited to compare lengths and combine ribbons to match a given length. The student was given paper clips and asked to show the teacher how to measure a ribbon with paper clips.

*MASS*

Children compared the paper clip box with a bag of ribbons and a bag of counters to say which one was the heaviest.

INTERPRETING A GRAPH

Students' ability to interpret a simple graph was assessed with tasks based on a graph of star stickers. The graph showed a distribution of 26 stars by favourite colour. There were five colours.

The teacher asked the student to identify the size of groups, compare groups and calculate the difference between two groups. The student was invited to build or to extend the graph by adding their favourite star in the appropriate position. The teacher gave the student a sheet of star stickers that were the same size and in the same range of colours as those printed on the graph. The student was also asked to count all the stars on the graph.

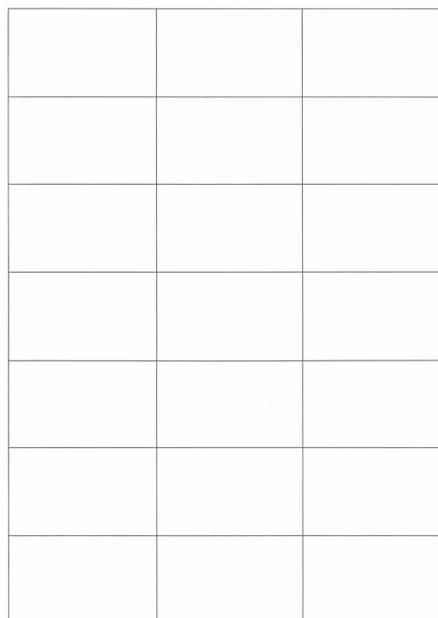
Our favourite coloured stars

				☆
☆				☆
☆				☆
☆		☆		☆
☆	☆	☆		☆
☆	☆	☆		☆
☆	☆	☆	☆	☆
☆	☆	☆	☆	☆
<i>silver</i>	<i>red</i>	<i>blue</i>	<i>green</i>	<i>gold</i>

SORTING AND GRAPHING

To assess students' ability to sort objects and represent this graphically the student was given a collection of plastic shapes of apples, fish and butterflies in three different colours. The student was first asked to sort the pieces by shape. The teacher then gave the student a grid with a picture of each shape below the grid. The student was asked to make a graph starting by adding a fish to the grid. If necessary, the teacher showed the student where to put the fish, and then asked the student to complete the graph by putting all the pieces in the right boxes.

The student was then asked to compare the groups. Finally all the pieces were taken off the grid and the student was asked to sort the pieces in a different way.

**WHAT STUDENTS COULD DO AT THE END OF THE FIRST YEAR OF SCHOOL**

The following section highlights some of the students' achievements in each of the aspects of numeracy assessed in this survey.

NUMBER

Students' skills in reciting numbers improved over their first year of school. Two thirds of the students could now count on from 32 to 47 (67%). Many more students were able to give the number before and the number after for a wider range of numbers than they could at the beginning of the year.

Table 4.6: Reciting Numbers

% correct	Task
95%	number just after seven
87%	number just after sixteen
82%	number just after thirty-two
83%	number just before five
77%	number just before twelve
68%	number just before twenty-six

A difficult item in this survey was counting back from 24. The teacher stopped the student at 17. Thirty per cent of students were able to do this.

Most students counted collections under thirty accurately. Eighty-three per cent accurately counted a collection of 18 counters. Seventy-five per cent of students accurately counted 27 stars on a bar graph.

MEASUREMENT

Students were given a bundle of four ribbons of different lengths: 80 cm, 60 cm, 50 cm and 30 cm. Almost every student could compare the ribbons to find the longest (99%) and the shortest ribbon (97%). Many could find the ribbon that matched the length of the lower edge of the assessment booklet (77%). The most difficult task was to combine two ribbons to match the length of the longest ribbon. Only 49 per cent of students were able to do this.

CHANCE AND DATA

Almost all the students were able to interpret the information shown on the bar graph of favourite stars.

Table 4.7: Chance and data task

% correct	Task
93%	which coloured star did the largest number of children choose?
92%	how many children chose blue as their favourite?
95%	which coloured star did the smallest number of children choose?
92%	which coloured star did exactly four children choose?

It was considerably more difficult for students to calculate the difference in the number of children in groups. The teacher told the student that more children chose silver stars than red, indicating the columns as she said this. She then invited the student to say how many more children chose silver than red. One third of the students (33%) correctly gave the difference, however almost half (49%) counted the number in the larger group.

Many students were able to add a star in the colour of their choice to the bar graph. Eighty-four per cent of the students placed their star in the correct row and column. An additional 16 per cent placed the star in the correct column but not the correct row.

STUDENTS' PERFORMANCE ON SURVEY 2 ITEMS

Figure 4.2 shows the numeracy item variable map for Survey 2⁷. On the right hand side of the map the item steps of the items are shown ranked on a logit scale according to the estimates of their step thresholds, from the easiest (at the bottom of the map) to the most difficult (at the top of the map). The left hand side of the map shows the distribution of the student's performances relative to the items. Each X represents three students.

In Survey 2 the following specific item labels were used:

- 2CA – ordinal number items using the grey road and car pieces
- 2CO – counting items
- 2RI – measurement items using ribbons
- 2FA – chance and data items using coloured stars and the favourite chart
- 2CC – number and measurement items using counters, clips and ribbons
- 2PP – chance and data items using coloured shapes
- 2NP – number items using counters and numerals and prices sheets.

⁷ For further detail about item variable maps see the section 'Item variable maps' on page 15.

The item steps at the top of the map were the most difficult for this group of students: 2NPo.2 was for working out the price of two pencils from a price sheet; 2NP9 was for working out which item cost most on a price sheet. 2COo.2 tested students' ability to count backwards from 24. The item 2FA5 asked students to work out, from a bar graph, the differences between two columns (*how many more children chose silver than red?*).

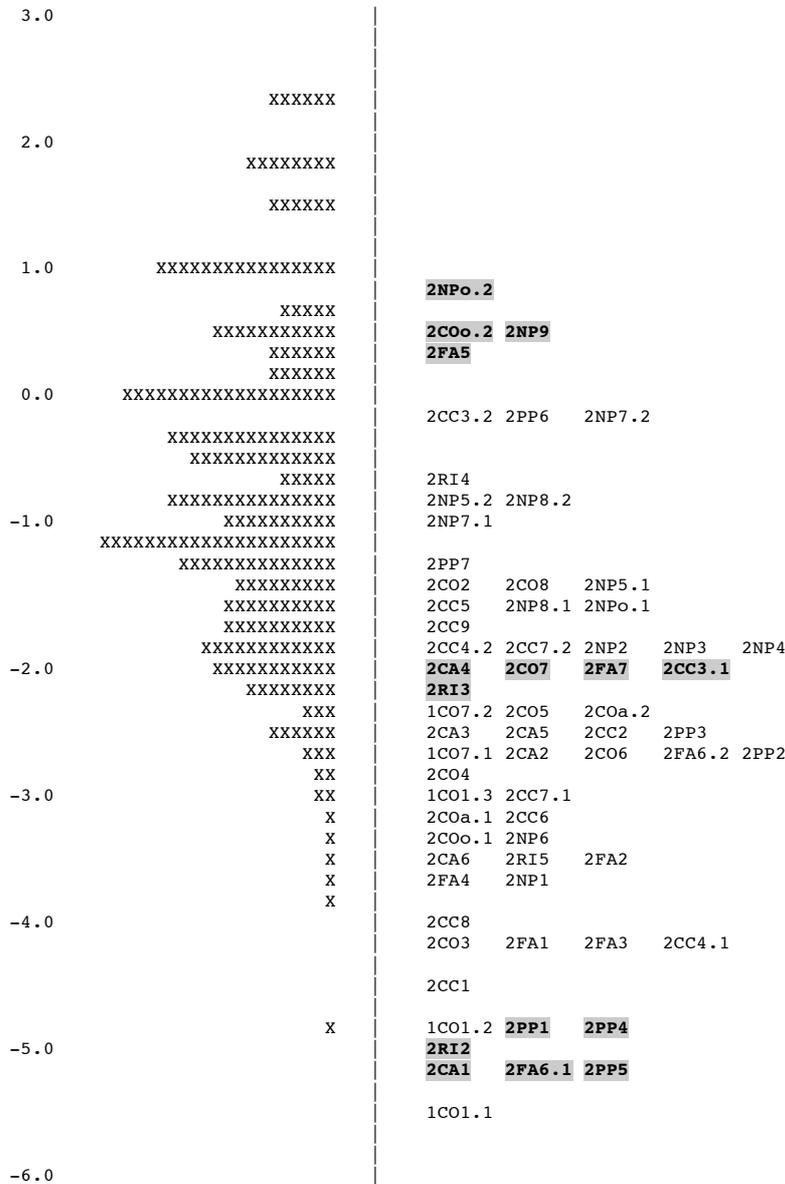
In the middle of the map, 2CA4 asked students to name the position of one car in a line; 2CO7 asked for the number just before 12; 2FA7 asked students to count all the stars of a chart. 2CC3.1 was a counting item, asking students to use counters to work out how many more counters would need to be added to four to make seven. 2RI3 asked students to choose the ribbon from a bundle of coloured ribbons that was about the same length as the assessment book.

The easiest item steps, located at the bottom of the map included those of a link item from Survey 1, and two items involving sorting the plastic pieces: 2PP1 (sorting the three different kinds of pieces into piles) and 2PP4 (*which thing is there most of – butterflies, fish or apples?*). Other items at the bottom of the scale included 2CA1 (which car is first in line), 2FA6.1 (adding to the correct column in a bar graph), 2PP5 (*are there more butterflies or more apples?*), and 2RI2, identifying the shortest ribbon in the bundle.

Comparing the distribution of students' performances and the distribution of items on the map indicates that some of the items were very easy for these children at the end of the first year of school.

Item Estimates (Thresholds) Probability Level = 0.50

Logits



Each X represents 3 students

Figure 4.2: LLANS Numeracy Item Map for Survey 2

NUMERACY PERFORMANCE IN THE FIRST YEAR OF SCHOOL

The scale of developing numeracy achievement shown in Figure 4.3 is based on data collected in 1999 during the students' first year of school. The assessment tasks from Survey 1 and Survey 2 were calibrated onto a common Numeracy Scale. This LLANS Numeracy Scale is a linear transformation from the logit scale.

Descriptions of skills assessed in Surveys 1 and 2 are shown on the left of Figure 4.3. A selected sample of skill descriptions has been used to describe performance at different points on the scale. Each description refers to one item. The descriptions have been selected from the whole range of items in both surveys. The placement of the skill descriptions shows the estimated level of difficulty of a particular skill relative to other skills.

The four shaded bands on the right hand side of Figure 4.3 show the distributions of performance of boys and girls in their first year at school in Surveys 1 and 2. The shaded bands represent the middle 80 per cent of students. The darker shading represents the middle 50 per cent. The black line towards the middle of the darker band represents the median score.

Average growth in numeracy achievement in the first year of school can be assessed by comparing the position of the median scores across the two surveys. A comparison of the bands showing the middle 80 per cent indicates that girls and boys in the cohort made progress in numeracy achievement between March and November in their first year at school, in the aspects of numeracy assessed in the surveys.

Figure 4.3 also shows the wide distributions of achievement in Surveys 1 and 2. Although, on average, the students in the study made progress in numeracy in their first year at school, there was a wide distribution of achievement at the beginning of the school year, and this wide distribution was again found at the end of the school year.

Survey 1 provided baseline data for the study. This survey was conducted early in the students' first year at school, and provides a picture of the wide range of numeracy skills and knowledge that children already have at school entry. It can be seen that students in this cohort around the 50th percentile were likely to be able *to add data from several pieces to a bar graph, and count back from 10 by ones*. Students who achieved above the 90th percentile were likely to be able *to read cents and dollar combinations and identify highest values*. Students whose achievement fell in the 10th percentile were likely to be able *to identify a different attribute of two objects, identify numbers under 10 correctly, and identify a square*.

By the end of the first year of school, in November 1999, students around the 50th percentile were likely to be able *to subtract numbers under 10 without given materials*. Students who achieved around the 75th percentile were likely to be able *to read prices involving dollars and cents*. Students whose achievement was around the 10th percentile were likely to be able *to identify numbers under 75 and add, using materials with a collection under 10*.

The relative performance of boys and girls is shown in Figure 4.3. The bands on the left represent the achievement of the girls, and those on the right the achievement of the boys in the cohort. The spread of achievement was greater for boys than girls on both occasions. Boys in the 75th percentile in Survey 2 achieved more than girls in the 75th percentile. Comparison of the median scores indicates that girls achieved at a slightly higher level than boys in Survey 1 on school entry, but girls and boys achieved at almost the same level in Survey 2. Overall, however, there is little difference.

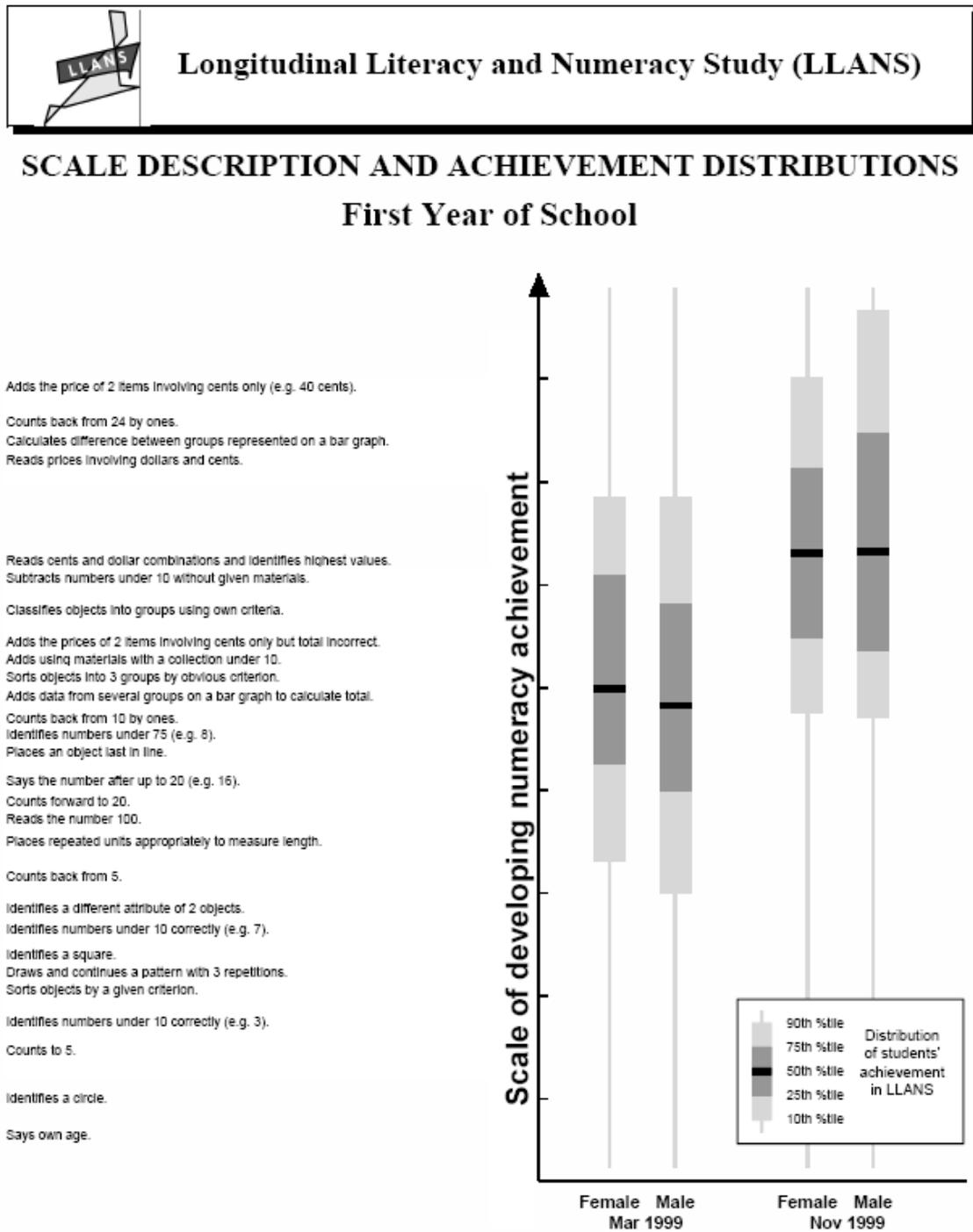


Figure 4.3: LLANS Numeracy Scale description and achievement distributions for the first year of school

THE SECOND YEAR AT SCHOOL: NUMERACY

Two numeracy assessments were completed by the children in their second year at school. Survey 3, the third LLANS numeracy assessment, was administered in March 2000 by the children's teachers early in their second year at school. Survey 4, the fourth numeracy assessment, was administered towards the end of the school year in November 2000. Both assessments were conducted in one-to-one interviews by the students' own teachers.

NUMERACY: THE THIRD SURVEY

The third numeracy survey included five sets of activities. As far as possible, each set of activities was presented in a context that was likely to be familiar to the students. Table 4.8 shows the strands of mathematics that were assessed in this survey, and the tasks related to each strand. These four strands were assessed in Survey 2, and their inclusion in Survey 3 provided continuity between the surveys.

Table 4.8: Numeracy assessment tasks, Survey 3

Number	<ul style="list-style-type: none"> • count items in three groups of ten • identify coin combinations to make twenty-five cents • calculate how many five cent coins will make twenty cents • add twenty cents, ten cents and five cents mentally • write numbers (12,47) • count forwards by twos from two to twenty-four and by tens from ten to one hundred and fifty • calculate ten more than sixty • identify a dollar coin and give the value of a fifty cent coin • identify the coin of highest value in a collection • bend a pipe cleaner in half • indicate how to cut a circle in half • indicate how to share a pizza between four people • indicate where to cut a kite shape and a fish shape in half
Space	<ul style="list-style-type: none"> • locate adjacent objects on a map and locate and count objects on a map • identify the direction of a path • identify a point a path reaches and misses • copy the layout of objects from a map onto a grid • make a small and a larger square from matchsticks • calculate how many matchsticks are needed to make a square given three on one side • make a small and a larger triangle from matchsticks
Measurement	<ul style="list-style-type: none"> • identify the longest of six rods and order rods by length • estimate which rod matches a given length and check estimates • estimate the number of matchsticks that would fit in a line between two given points
Chance and Data	<ul style="list-style-type: none"> • count the number of items in a group and identify two groups of the same size on a bar graph • calculate the total if two groups on a bar graph were combined • calculate the difference between two groups on a bar graph

NUMBER SEQUENCE

Students' knowledge of number sequences was assessed by asking them to count forwards by twos and by tens and to count on by ten. Students' were asked to write some two-digit numbers in numerals.

COUNTING

Students' counting strategies were assessed by asking teachers to observe whether students counted by groups or individually when counting cakes grouped ten to a tray.

MONEY

Pictures of coins were used to assess students' knowledge of money and their ability to calculate with money. Students were asked to identify a coin, give the value of a coin, find the coin *worth the most*, identify coin combinations to make specific amounts and add coins.



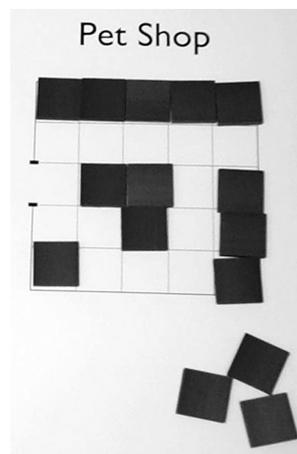
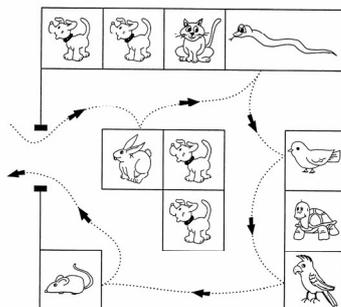
FRACTIONS

Pipe cleaners and pictures of a pizza and biscuits formed the basis of some tasks assessing students' understanding of fractions and lines of symmetry. The teacher asked the student to fold a pipe cleaner exactly in half, place the pipe cleaner to show where to cut a pizza in half and place pipe cleaners to share the pizza equally between four people. The student was also asked to show where to cut a kite shaped biscuit to share it equally between two people and to do the same with a fish shaped biscuit.

LOCATION AND DIRECTION

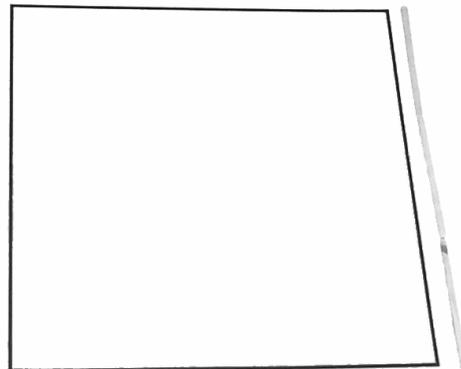
A simple map of a pet shop was the basis of a series of tasks used to assess students' ability to interpret information about location and direction. The map showed the door of the shop and the cages for several different animals. A path showed where the pet shop owner had gone that morning when he fed some of the animals. Students answered questions about the map and then they were asked to copy the plan of the cages onto a grid using tiles that were the same size as the cages.

Pet Shop



SQUARES AND TRIANGLES

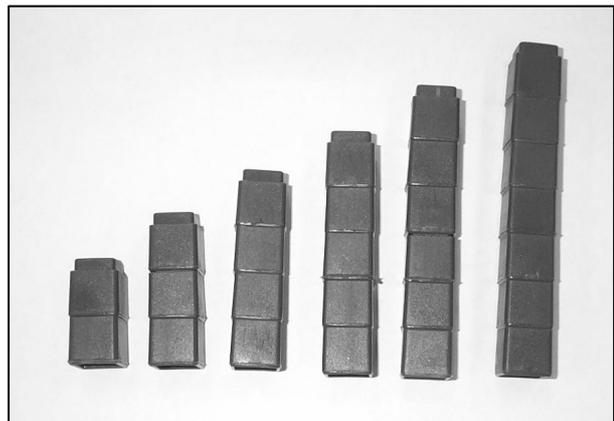
Students' understandings about squares and triangles were assessed in tasks using matchsticks. The teacher asked the student to make a small square with the matchsticks, to check that they knew about squares, and then to make a larger square with multiple matches. This allowed students to demonstrate understandings about the properties of squares that were not necessarily clear when they used one match stick per side. The teacher showed the students a printed square, placed three matchsticks along one edge and then asked students to calculate the number of matchsticks they needed to make this square.

Matchstick Square

To assess estimation skills students were asked how many matchsticks would fit in a line between two given points. Students were also asked to make a small and a large triangle from matchsticks.

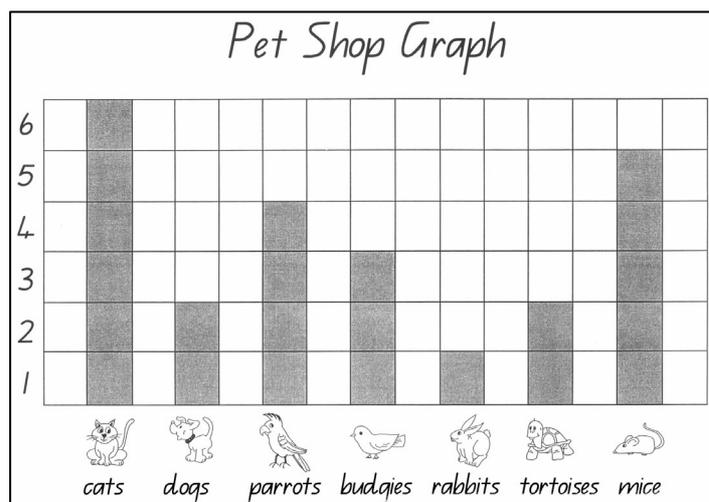
LENGTH

Students were asked to demonstrate some of their understandings about length with a set of rods made from between two and seven plastic blocks. Students found the longest rod, ordered the rods by length, estimated which rod matched a given length and checked the accuracy of their estimates.

*INTERPRETING GRAPHS*

Students' ability to interpret a bar graph was assessed with a display showing the animals that had been sold in the pet shop over a week.

Students were asked to identify the size of groups, compare groups and combine groups.



WHAT STUDENTS COULD DO AT THE START OF THE SECOND YEAR OF SCHOOL

The students' responses to the assessment tasks showed a range of achievement. The following section highlights some of the students' achievements in each of the strands assessed in this survey.

NUMBER

The teachers were asked to observe whether the student appeared to count by tens or not. The student was shown a picture of trays of cakes and asked to count one tray. Ninety-two per cent of students were able to count ten cakes. The teacher then confirmed that there were ten cakes on each tray and asked the student to count all the cakes on the three trays. The marking guide is shown in Table 4.9.

Table 4.9: Marking Guide: Number

Instructions and questions	Marking guide
<p>There are ten cakes in each row.</p> <p>How many cakes are there altogether?</p>	<ul style="list-style-type: none"> <li data-bbox="751 763 1307 824">• “Thirty” answered without pointing and counting individual cakes <li data-bbox="751 846 1307 907">• “Thirty” answered by pointing and counting individual cakes <li data-bbox="751 929 1307 965">• other <li data-bbox="751 987 1307 1016">• no attempt

Thirty-six per cent of students gave the correct answer without appearing to count by ones. A further 34 per cent of students clearly pointed or counted by ones to arrive at the correct answer.

Almost every student was able to identify a one-dollar coin (97%), and a further two per cent selected the two-dollar coin. When shown the 50 cent coin 77 per cent of students said that it had a value of 50 cents but knowing the value of this coin did not have a lot of meaning for some. Only 46 per cent of students recognised that the two-dollar coin was *worth the most*. An additional 34 per cent said the 50 cent coin was worth the most. These students appeared to be confused either between the size and value of a coin or between the value of dollars and cents.

Sixty per cent of the students identified coin combinations that added up to 25 cents. Most of these students chose a 20 cent and a five cent coin (37%) but quite a few (23%) used multiples such as two tens and one five cent coin. (Twenty-nine per cent of the students added 20 cents, ten cents and five cents), which was the most difficult option.

Most students correctly wrote some two digit numbers twelve (83%) and 47 (90%). Some of these students reversed one or more of the digits – i.e. the number 2 or 7 was written backwards (4%, 12%).

For the counting tasks, the teacher told the student where to begin counting and then let them keep going. The teacher either stopped the student at a given number or at any point where the student was clearly unable to continue. Forty-two per cent of students were able to count forwards by twos from two to 24. A further 30 per cent were correct up to 12. Most students could count forwards by tens but only a few were able to get to 150 as the results in Table 4.10 show.

Table 4.10: Marking Guide: Counting

% correct	Counting forwards by tens starting from ten
21%	correct to 150
44%	correct to 100
19%	correct to 50

When asked what number is ten more than 60, 22 per cent of students were able to answer 70 immediately, suggesting these students were able to count by tens. A further 24 per cent of students arrived at the correct answer after some thought.

SPACE

Most students found it very easy to find the animal closest to the snake on a map of a pet shop (92%) or count how many dogs were shown on the map (97%). Students were told that dotted lines represented the path taken by the shop owner when he gave the animals some food. They were also told the arrows on the path showed the direction he went. Almost all the students could trace the shop owner's path moving in the direction of the arrows (94%). But fewer students were able to interpret events represented by the path. Fifty-five per cent identified which animal was first to get food and 67 per cent of students were able to identify all three of the animals that did not get any food.

Most students could copy the layout of cages shown on the pet shop map onto a blank grid using tiles that were the same size as the cages. Seventy-six per cent of students placed all 12 tiles correctly on the grid. A further six per cent placed the perimeter tiles correctly and a further five per cent placed the middle tiles correctly. These judgements were made by the students' teachers, who used the provided marking guide, shown in Table 4.11.

Table 4.11: Marking Guide: Space

Instructions and questions	Marking guide
<p>Take tiles off map.</p> <p>Put Pet Shop Grid in front of child and move map so both can be seen.</p> <p>This is a plan of the pet shop.</p> <p>Indicate Pet Shop Grid.</p> <p>Here is the door. Indicate gap on grid.</p> <p>Put tiles on the plan to show where all the cages are.</p> <p>The child may put tiles on the map initially but remind them they need to put the tiles on the grid.</p>	<ul style="list-style-type: none"> • complete - all twelve tiles placed correctly on grid • places nine tiles correctly around perimeter but incorrect in the middle • places three tiles correctly in middle but incorrect around perimeter • other • no attempt

Students were asked to read information about the sales at the pet shop from a bar graph. Many students could count a group of six (74%) and combine a group of four and a group of three to find the total (70%). Slightly fewer students recognised two groups of the same size that were separated (61%).

STUDENTS' PERFORMANCE ON SURVEY 3 ITEMS

Figure 4.4 shows the numeracy item variable map for Survey 3⁸. On the right hand side of the map the item steps in the survey are shown ranked on a logit scale according to the estimates of their step thresholds, from the easiest (at the bottom of the map) to the most difficult (at the top of the map). The left hand side of the map shows the distribution of the students' performances relative to the items. Each X represents four students.

In Survey 3 the following specific item labels were used:

- 3NU – number items using coins and a picture of cakes
- 3CO - counting items
- 3PS – space and chance and data items in the Pet Shop activities
- 3MA – space and measurement items using matchsticks
- 3RP – measurement and space items using rods, pipe cleaners and a picture of biscuits and a pizza.

The item steps at the top of the map were the most difficult for this group of students. It is interesting to note that some of the number and price items from Survey 2 (2NPo and 2NP9), used as link items in this survey, were still found difficult by many students. Survey 3 item steps located at the top of the scale included 3NU8 (*if you had 20 cents, ten cents and five cents, how much money would you have altogether?*); 3CO4.3 (correctly counting by tens to 150); 3CO5.2 (immediate answer to the question *what number is ten more than 70?*); 3NU7 (*how many five cent coins do you need to make 20 cents?*).

Item steps around the middle of the map also included those of link items from Survey 2. Survey 3 item steps at this level included 3NU4 (when shown a 50 cent coin, asked *what is this coin worth?*); 3CO2.2 (*write the number 47*); 3CO4.1 (correctly counting by tens to 50); 3PS6.2; (*identifying size of cage without putting tiles on the grid*); 3PS8 (*reading number of cats sold from graph of animals sold last week*); and 3RP8.2 (*bending pipe cleaner exactly in half*).

The easiest item steps located at the bottom of the map included those of link items from Survey 2. Survey 3 item steps located at the lower end of the scale included 3RPa.1 (*show me where to cut so all of this biscuit (kite shape) is shared equally between two people*); 3RPb.1 (*show me where to cut so all of this biscuit (fish shape) is shared equally between two people*); 3NU3 (identifies one dollar coin from picture of coins); 3PS2 (correct counting of dogs in pet shop); 3PS3 (traces dotted line in direction of arrows).

On this map, a comparison of the distribution of students' performances with the distribution of the item difficulties shows that this assessment survey was somewhat easy for this group of students, and could have been improved by including more difficult items.

⁸ For further detail about item variable maps see the section 'Item variable maps' on page 15.

NUMERACY: THE FOURTH SURVEY

The fourth survey for numeracy included five sets of activities, and was administered in Term 4, 2000. Table 4.12 shows the strands of mathematics that were assessed, and the tasks related to each strand. The same four strands assessed in Surveys 2 and 3 were included in this survey. The students were at the end of their second year at school, and were assessed in a one-to-one interview by their teacher.

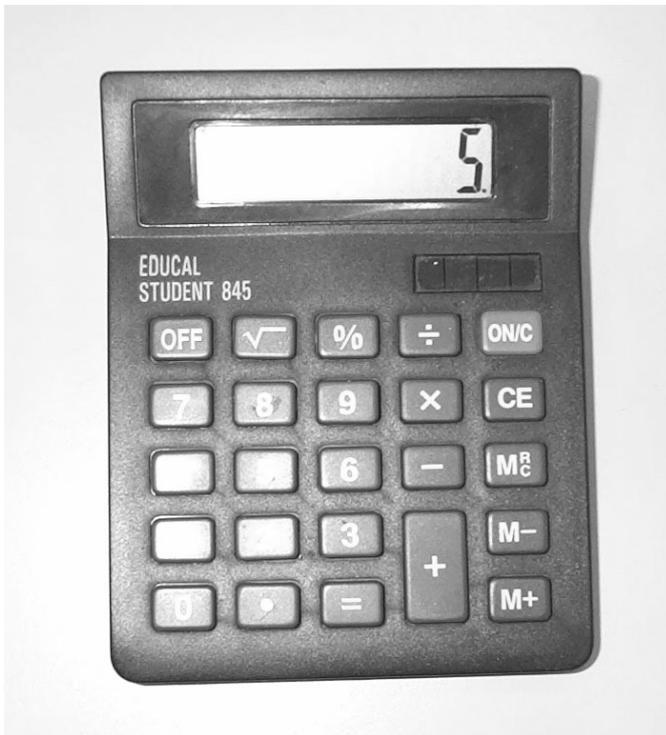
Table 4.12: Numeracy assessment tasks, Survey 4

Number	<ul style="list-style-type: none"> • make and count items in three groups of four and calculate how many groups of two can be made from three groups of four • calculate total for three groups of five and four groups of five and make five equal groups • put 15 counters into equal groups of 3 • give missing number in an even count by twos pattern (12) • give missing number in an odd count by twos pattern (9) • give adjacent missing numbers in a count by fives pattern (15, 20) • give adjacent missing numbers in an off-sequence count by tens pattern (55, 65) • add mentally ($9 + 7$, $8 + 6$) and subtract mentally ($11 - 8$) • show numbers on a calculator (5, 10), read numbers on a calculator screen (31, 206) and make the biggest number possible on a calculator screen • use calculator to find a total ($9 + 16 + 23$), how many left ($23 - 14$) and how many more ($30 - 16$) • recognise numbers represented with bundles of ten and units (14, 65) • subtract eleven with base ten materials and add on from sixty-five to seventy-five with base ten materials • add double digit numbers mentally or with materials ($43 + 22$, $38 + 24$) • calculate how many more to make eighty from fifty-seven • order numbers from smallest to largest: 8, 12, 21, 37, 61, 106, 185 • select numbers within the range 1 to 49
Space	<ul style="list-style-type: none"> • make a large square with multiple small square tiles • copy a shape with tiles • identify a rectangle from four quadrilaterals and describe the attributes of a rectangle
Measurement	<ul style="list-style-type: none"> • identify the shape with the largest area using tiles as a unit and give a reason for choice • identify which shape is possible to cover exactly with tiles • estimate the area of a shape in tiles (9) and check estimate
Chance and Data	<ul style="list-style-type: none"> • read data from a check list • represent data on a bar graph

GROUPS AND NUMBER SEQUENCE

Students' understanding of groups was assessed by asking students to make groups and count by groups using large plastic counters. The teacher noted whether or not the student appeared to use an efficient strategy of counting by groups or if they appeared to count by ones. Knowledge of number sequences was assessed by asking students to provide the missing number or pairs of numbers in sequences written on a chart.

The student was asked to perform an addition and a subtraction problem mentally and to place seven numbers ranging from eight to 185 in numerical order.

*USING THE CALCULATOR*

Students were given a calculator, shown how to turn it on and clear the screen and then asked to make numbers, read numbers from the screen and make the biggest number they could.

The teacher asked the student to add two numbers mentally and use the calculator to check if they were correct. A sheet with pictures of farm animals was the basis of some operations students were asked to perform on the calculator such as finding the total and calculating differences.

PLACE VALUE

Items designed to assess students' understanding of place value were based on plastic drinking straws tied in bundles

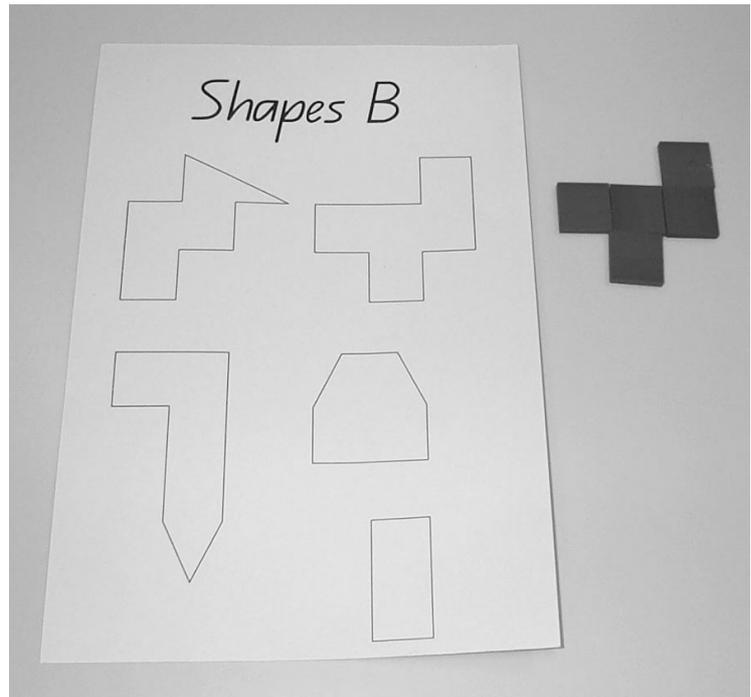
of ten with rubber bands. The student was invited to check that a bundle contained ten straws before beginning the tasks. The student was asked to identify numbers and make numbers using bundles and single straws. To assess whether or not the student used efficient strategies by working with tens, students were asked to subtract eleven straws and also to add on from 65 to make 75. In each instance the teachers' marking guide differentiated those students who used a bundle for ten straws and those who only used single straws. The student was invited to calculate double-digit addition and subtraction problems mentally or to use the straws to perform these operations

SQUARES AND RECTANGLES

Small wooden square tiles were used to assess students' understandings about the properties of squares and rectangles and to measure area. The tiles were all the same colour. The student made a large square with tiles, identified which of four quadrilaterals was a rectangle, giving a reason for their choice, and made an exact copy of one of an outlined shape with tiles.

AREA

To assess understandings about area, the student covered some shapes so the tiles fitted exactly, and then identified which shape *covered the most paper* and explained why. The student was asked to estimate the number of tiles that would cover a notepad exactly and to then check the accuracy of their estimate.



Survey

	 car	 walk	 bike	 bus
John				✓
Claire	✓			
Bill			✓	
Sam				✓
Ali	✓			
Tara		✓		
Jessie		✓		
Vin	✓			

DATA

This set of activities assessed students' ability to read data from a check-list and to represent that data on a graph. The teacher gave the student a chart showing which children travelled to school by car, on foot, by bike or by bus.

The student was asked to read some information from the chart. The teacher then gave the student a grid, marked with each of the transport categories and some small dot stickers. The student was asked to use the checklist to make a graph showing how the students came to school.

WHAT STUDENTS COULD DO AT THE END OF THE SECOND YEAR OF SCHOOL

The following section highlights some of the students' achievements in each of the strands of mathematics assessed in this survey. The set of numeracy tasks in the survey made it possible to identify the range of achievement within the whole cohort of students.

NUMBER

By the end of the second year of school, almost all students could follow instructions to make groups of four (93%) with 12 counters and to count the number of groups (92%) they made. It was much more difficult for students to make a specified number of equal sized groups. Given 15 counters, 51 per cent of students were able to make five equal groups as requested, but 41 per cent were confused and made three groups of five counters.

A quarter of the students seemed able to apply their knowledge of groups to calculate how many groups of two could be made from three groups of four, these students gave the correct answer quickly. Half the students appeared to use less efficient strategies, as shown in Table 4.13.

Table 4.13: Grouping

% correct	How many groups of two could you make with these counters? (counters were arranged as four groups of three)
25%	six, answered quickly without counting
52%	six, answered after some thought or by counting or separating counters

About a third of the students (37%) appeared to realise that they could count by fives to quickly calculate the total when three groups of four counters had each been increased by one counter but almost half (47%) counted all or most of the counters individually. The instructions for this task are shown in Table 4.14.

Table 4.14: Marking Guide: Counting task 1

Instructions and questions	Marking guide
Ensure counters are still in three groups of four before proceeding. I will put one more counter in each group. Add one counter to each group so they are clearly seen as groups of five. Now how many counters are there altogether?	<ul style="list-style-type: none"> fifteen, answered without counting individual counters
	<ul style="list-style-type: none"> fifteen, answered after counting all or most of the counters
	<ul style="list-style-type: none"> other
	<ul style="list-style-type: none"> no attempt

Approximately three quarters of the students were able to give the missing numbers in sequences counting by twos, fives and tens. Students were shown the written sequences. The easiest task was with a sequence counting forwards by twos. The more difficult task was an off-sequence counting forwards by tens as shown in Table 4.15.

Table 4.15: Counting

% correct	Task
84%	What number comes next? 2, 4, 6, 8, 10, __,
73%	What number comes next? 1, 3, 5, 7, ____,
74%	What two numbers go here? 5, 10, __, __, 25, 30,
68%	What two numbers go here? 35, 45, __, __, 75, 85

Sixty-two per cent of students were able to mentally add numbers over ten, adding nine and seven. Forty-nine per cent could mentally subtract eight from 11.

Fifty-nine per cent of the students were able to order seven numbers printed on cards (8, 12, 21, 37, 61, 106, 185). The same percentage of students were able to identify which of these numbers were between one and 49.

SPACE

Most students were able to name a square from the time they came to school and by the end of the second year of school, 93 per cent could identify a rectangle from a collection of four quadrilaterals. But only about two thirds of the students appeared to understand the particular properties of a square and a rectangle which differentiate it from other rectangles. When students were asked to use small square tiles to make a large square, 65 per cent made a square but 30 per cent made a rectangle. Only 32 per cent of the students were able to describe the properties of a rectangle as being pairs of sides of different lengths and right angles, saying for example, *These lines are both long and these ones are short. All the corners are square.*

MEASUREMENT

Most students recognised the larger of several areas. When shown three shapes, which they had covered exactly with square tiles, many students (78%) identified the shape which *covers the most paper*, but only some (60%) could explain that this shape covered more paper because it had more tiles. Thirty per cent of the students had excellent skills in estimating an area in tiles. These students correctly estimated that nine tiles would cover a notepad exactly. A further 43 per cent were reasonably close, they estimated between six and 12 tiles. Almost every student (96%) accurately measured the area of the notepad with the tiles to check their estimate.

CHANCE AND DATA

Most students found it easy to read data from a check-list showing different forms of transport some children used to get to school. Ninety-two per cent were able to read across from a given name and identify the mode of transport. Eighty-seven per cent were able to add the two marks in one column to find the total number of children who came to school by bus. Students were asked to present the data shown on the check-list as a bar graph. The students were given a grid marked with the categories of transport and sticky dots. About two thirds of the students made a bar graph accurately for at least two columns, placing three dots correctly for the cars (62%) and two dots for walking (65%). Additional students placed the correct number of dots in each of these columns but did not start from the base line or place the dots consecutively (19%, 18%).

STUDENTS' PERFORMANCE ON SURVEY 4 ITEMS

Figure 4.5 shows the numeracy item variable map for Survey 4⁹. On the right hand side of the map the item steps are shown ranked on a logit scale according to the estimates of their step thresholds, from the easiest (at the bottom of the map) to the most difficult (at the top of the map). The left hand side of the map shows the distribution of the student's performances relative to the items. Each X represents three students.

In Survey 4 the following specific item labels were used:

- 4GP – items involving groups and patterns
- 4TI – shape items using tiles
- 4CA – number items using the calculator
- 4SS – number items using straws
- 4TR – chance and data items based on a transport survey.

The item steps at the top of the map were the most difficult for this group of students. Survey 4 item steps located at the top of the scale included those of calculator items and counting items. These item steps included 4CAo (*use the calculator to calculate how many pigs are needed to have 30 when there are already 16*); 4CA5.2 (*make the biggest number possible on the calculator – eight digits, all nines*); 4SS6.2 (*correct answer to the question what is 43 and 22 more? without using additional straws*); 4SS7.2 (*Here are 57 straws: how many more straws do I need to make 80? - answers 23 by adding 3 loose straws and 2 bundles of 10*).

Item steps around the middle of the map included a small number of item steps from Survey 3. Those in Survey 4 at this level included 4TI1.2 (*uses small square tiles to make a big square*); 4CA4.2 (*reads 206 on screen as two hundred and six*); 4CA6.2 (*correctly calculates eight and six without using calculator*); 4TR6.2; (*places correct number of dots in appropriate column on bar graph to represent information from a survey*); 4GPo (*correctly completing a number pattern*).

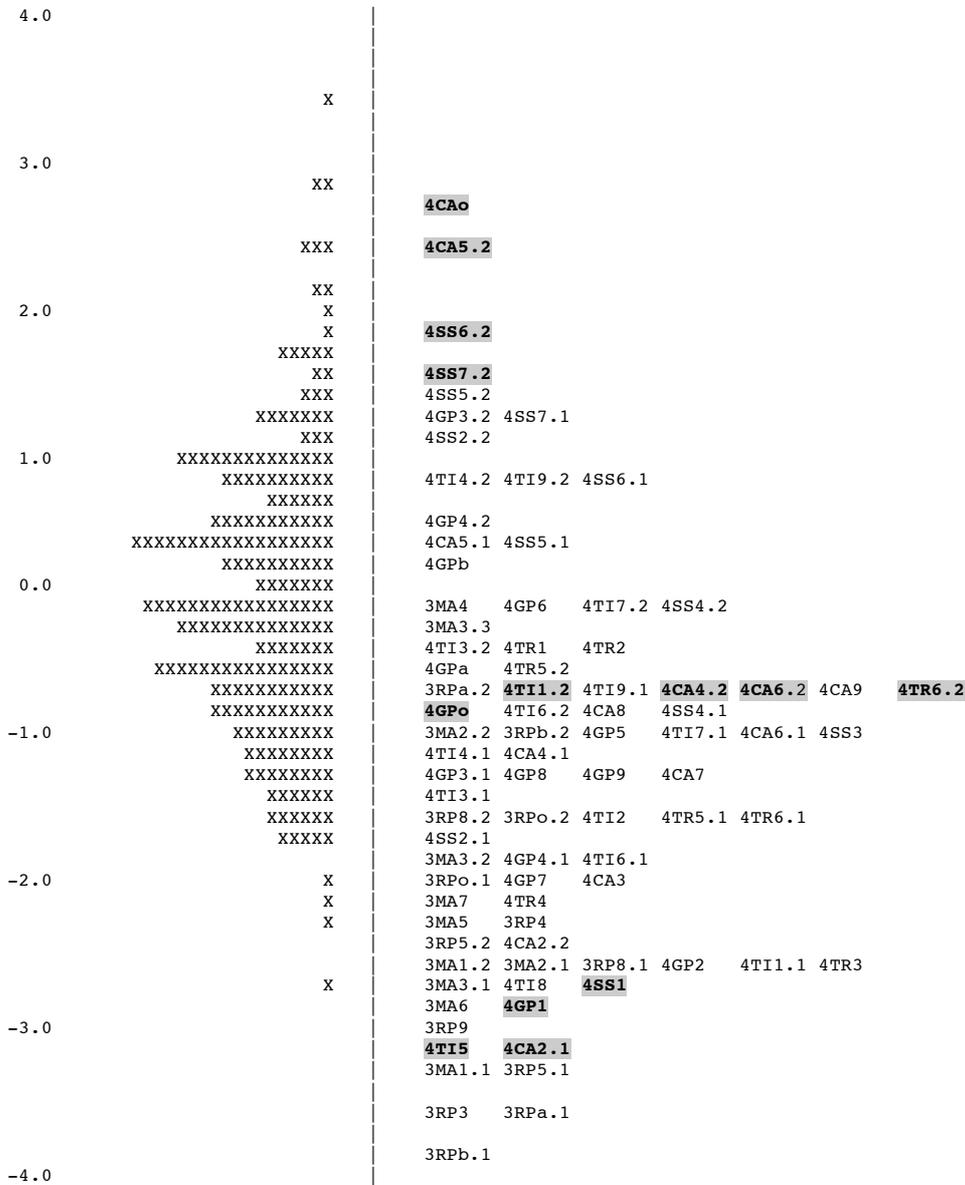
The five easiest item steps located at the bottom of the map were from Survey 3. Survey 4 item steps located at the lower end of the scale included 4CA2.1 (*makes the number 10 on the screen at first attempt*); 4TI5 (*correctly uses tiles to check number needed to cover note pad*); 4GP1 (*puts 12 counters in groups of four*); 4SS1 (*correctly answers 14 to question about how many straws in one bundle and four loose straws*).

Comparing the distribution of students' performances and the distribution of the item difficulties shows that there are many item steps located at the lower end of the scale. This indicates that this assessment survey was somewhat easy for this group of students, and could have been improved by including more difficult items.

⁹ For further detail about item variable maps see the section 'Item variable maps' on page 15.

Item Estimates (Thresholds) Probability Level = 0.50

Logits



Each X represents 3 students

Figure 4.5: LLANS Numeracy Item Map for Survey 4

NUMERACY PERFORMANCE IN THE SECOND YEAR OF SCHOOL

The scale of developing numeracy achievement shown in Figure 4.6 is based on data collected in 2000 during the students' second year at school. The assessment tasks from these surveys were calibrated onto the LLANS Numeracy Scale.

Descriptions of skills assessed in Surveys 3 and 4 are shown on the left of Figure 4.6. A selected sample of skill descriptions has been used to describe performance at different points on the scale. Each description refers to one item. The descriptions have been selected from the whole range of items in both surveys. The placement of the skill descriptions shows the estimated level of difficulty of a particular skill relative to other skills.

The four shaded bands on the right hand side of Figure 4.6 show the distributions of performance of boys and girls in their second year at school in Surveys 3 and 4. The shaded bands represent the middle 80 per cent of students. The darker shading represents the middle 50 per cent. The black line towards the middle of the darker band represents the median score.

Average growth in numeracy achievement in the second year of school can be seen by comparing the position of the median scores across the two surveys. A comparison of the bands showing the middle 80 per cent indicates that girls and boys in the cohort made progress in numeracy achievement between March and November in their second year at school, in the aspects of numeracy assessed in the surveys.

Figure 4.6 also shows the wide distributions of achievement in Surveys 3 and 4. Although, on average, the students in the study made progress in numeracy in their second year at school, there was a wide distribution of achievement at the beginning of the school year, and this wide distribution was again found at the end of the school year. This was also the case in the first year of school.

Average growth in numeracy achievement at the beginning and end of the second year of school can be seen by locating the positions of the median scores across the two surveys. The median scores show that girls and boys in the cohort made progress in numeracy achievement between March and November in their second year at school, in the range of aspects of numeracy assessed in the surveys. There is a slight difference between the median scores for boys and girls. The median score for boys was slightly higher than the median score for girls in both surveys. Boys showed a wider spread of achievement than girls in March, and a slightly wider spread in November.

It can be seen that students in this cohort, at the beginning of their second year at school, achieving around the 50th percentile were likely to be able to sequence one and two digit numbers correctly from smallest to largest. Students whose achievement fell in the 10th percentile were likely to be able *to add information to a bar graph*.

By the end of the second year of school, in November 2000, students around the 50th percentile were likely to be able *to make equal groups out of a given number of units*. Students who achieved around the 75th percentile were likely to be able *to identify attributes of a rectangle*. Students whose achievement was around the 10th percentile were likely to be able *to continue a counting pattern of 2*.



Longitudinal Literacy and Numeracy Study (LLANS)

SCALE DESCRIPTION AND ACHIEVEMENT DISTRIBUTIONS

Second Year of School

Uses a calculator to make the biggest number possible - uses 8 digits, all 9's.

Adds 2 two digit numbers using materials.

Adds on from a 2 digit number to calculate total using materials.

Calculates how many groups can be made from a collection without counting individual units (e.g. make 6 groups of 2).
Subtracts a 2 digit number from a 2 digit number using materials.

Applies counting by fives to collections structured in groups of five.
Identifies attributes of a rectangle.

Calculates the number 10 more than a given number after some thought.
Makes equal groups out of a given number of units.
Estimates the number of units required to measure a short length.
Reads cents and dollar combinations and identifies highest values.

Sequences 1 and 2 digit numbers correctly from smallest to largest.
Constructs a square or triangle with multiple units per side.

Identifies where to cut to share equally for shapes with one line of symmetry.
Counts forward by tens to 100.
Continues counting pattern of 2 (e.g. 1,3,5,7).
Counts forward by twos to 12.
Cuts a circular shape to share equally between 4 people.
Adds information to a bar graph.
Reads information from a pictograph.
Identifies a one dollar coin from a mixed coin collection.
Estimates which object from a collection of 6 matches a short length.
Writes 2 digit numbers but may reverse.
Reads and interprets information from a bar graph.
Constructs a triangle using one unit per side.

Identifies a rectangle.

Makes the number 10 on a calculator screen but requires several attempts.
Estimates then checks the number of units required to cover a given item.

Follows arrows on a path on a plan.

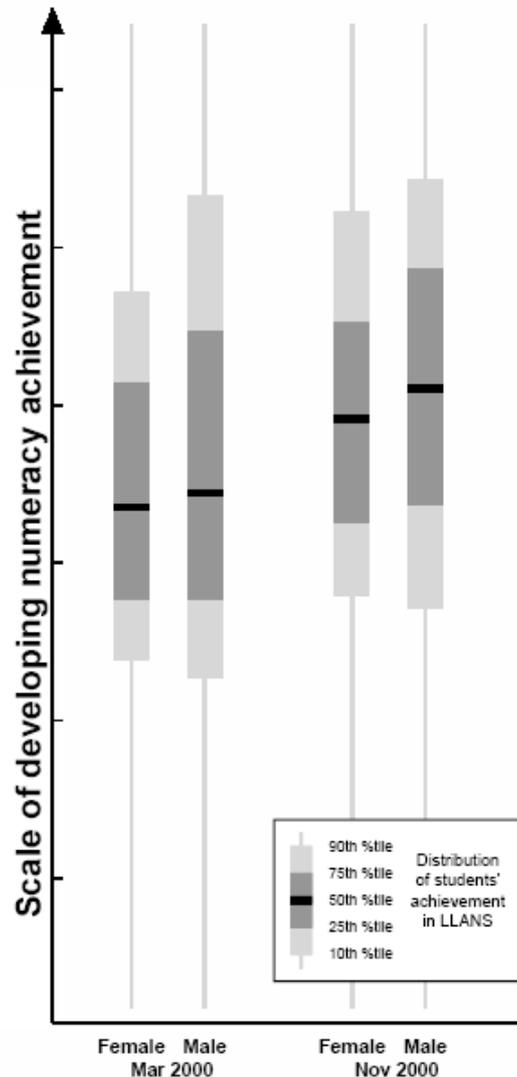


Figure 4.6: LLANS Numeracy Scale description and achievement distributions for the second year of school

THE THIRD YEAR AT SCHOOL: NUMERACY

The fifth numeracy assessment was administered in April 2001, in the second term of the students' third year at school. Consistent with the practice established in Surveys 1-4, Survey 5 was administered in a one-to-one interview situation by the students' teachers. In the first two years of schooling, students had completed two assessments, one in Term 1 and the other in Term 4. In the third year of school, one survey was conducted in Term 2.

NUMERACY: THE FIFTH SURVEY

Table 4.16 shows the strands of mathematics that were assessed in this survey and the tasks related to each strand. As in previous surveys, four strands of mathematics were assessed: number, space, measurement, and chance and data.

In order to make links with the pen and paper assessments in future surveys, one of the link activities was a pen and paper task that students undertook independently. The other five sets of activities were all administered by the teacher in a one-to-one interview.

PATTERN AND NUMBER

The pattern and number activities were pen and paper assessments. Commonly used worksheet-style tasks were selected so that students would be confident about completing them independently. The teacher offered to read the instructions to the student. The worksheet tasks included filling in the missing numbers in a sequence, writing numerals for numbers given in words, selecting coins to make given amounts and solving some written addition, subtraction and multiplication problems.

MENTAL COMPUTATION

Students were asked to calculate addition and subtraction problems with single digit numbers and two digit numbers under 20. They were also asked to combine groups and calculate how many to add to make a given number.

SQUARE NUMBER PATTERNS

Understandings about square number patterns were assessed by using the blocks. The teacher assisted the student to assemble the blocks as squares using one, four and nine blocks. Students were asked to calculate the number of blocks required for the *next group* and to calculate the number of blocks that would be on one side of the group after that.

SHAPES

Students' understandings about triangles were assessed with tasks based on a set of seven red wooden triangles, including equilateral, isosceles, right-angled and scalene triangles of different dimensions.

Throughout the set of activities the teacher referred to the materials as shapes rather than triangles as one of the initial tasks assessed students' recognition of all the shapes as triangles. The students' were asked to find shapes that fitted exactly on top of each other, sort the shapes and combine given shapes to make rectangles.

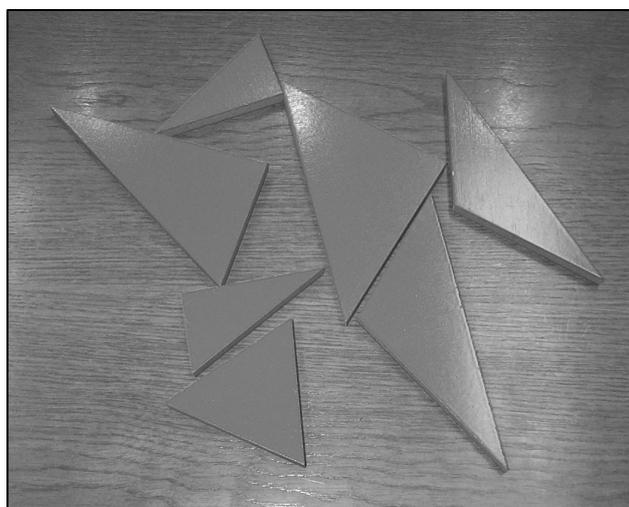
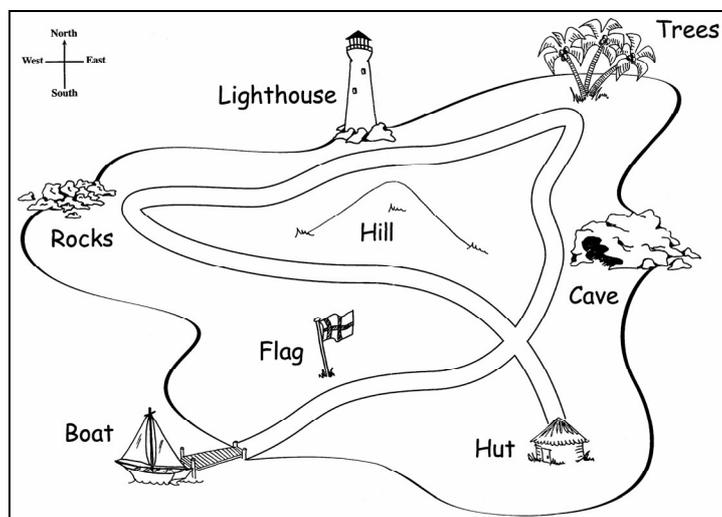


Table 4.16: Numeracy assessment tasks, Survey 5

Number	<p>Pen and paper assessment</p> <ul style="list-style-type: none"> • give missing number in an odd count forwards by twos pattern, in a count forwards by threes pattern, in an off sequence count forwards by tens pattern, in count back by fives pattern and a count forwards by elevens pattern. • write numerals (e.g., forty-three, one hundred and six) • add coins and compare the value of coin collections • identify coins to make amounts (e.g., 25c) • add single and double digit numbers (e.g., $9 + 8$, $16 + 19$) and calculate missing addends (e.g., $9 + _ = 12$) • subtract single from double digit numbers (e.g., $15 - 9$) and multiply single digit numbers (e.g., 3×3) <p>Mental computation</p> <ul style="list-style-type: none"> • add one and two digit numbers (e.g., $9 + 8$, $13 + 12$) and subtract single and double digit numbers (e.g., $8 - 5$, $17 - 13$) • calculate missing addend (e.g., $4 + _ = 11$) and combine groups (e.g., 3 groups of 2) <p>Practical activities</p> <ul style="list-style-type: none"> • calculate the number of blocks for the next group in a pattern of square numbers made with blocks (e.g., 1, 4, 9, shown) • calculate the number of blocks on one side of the next group after 16 in a pattern of square numbers • calculate the difference between 9 and 4
Space	<ul style="list-style-type: none"> • identify a collection of three-sided shapes as triangles • find congruent triangles (shapes that fit exactly on top of each other) • make a rectangle with two right angled triangles and an isosceles triangle • calculate number of blocks required to make a stack shown in a diagram (includes one hidden block) and copy a diagram to make a stack with blocks • follow instructions about location (e.g., between and closer to and identify the shorter of two paths) • apply compass directions to identify the relative position of an object
Measurement	<ul style="list-style-type: none"> • measure the length of a side of a shape with a centimetre ruler • estimate cubes to fill a box when one cube is shown (twelve) and when three cubes are placed in the box (twelve) • measure volume of a box with cubes • order events by time and calculate the difference between times • express analogue time as digital time (7:30) • read information from a calendar and calculate dates for a period of time on a calendar
Chance and Data	<ul style="list-style-type: none"> • sort a collection of red triangles into two groups and describe sort

LOCATION

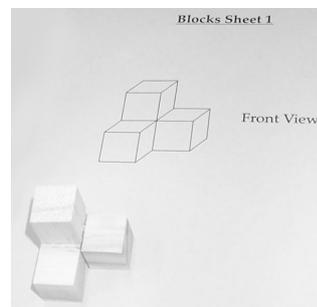
A drawing of a treasure map was used to provide the context for tasks designed to assess students' understandings about location and direction, including interpretation of compass directions.

*TIME*

The students were also asked to use some additional information about travelling dates and times for Sailor Sam to calculate for example, time of arrival, time taken to travel between locations and the date of return.

VOLUME

Measurement of volume was assessed with tasks based on plain wooden cubes. The students were asked to estimate how many blocks were needed to fill a small box, and then to check their estimate. The students calculated how many blocks were needed to make a stack like the one shown in a diagram and then copied the diagram to make the stack.

**WHAT STUDENTS COULD DO IN THE THIRD YEAR OF SCHOOL**

The students' responses to the assessment tasks showed a range of achievement. The following section highlights the range of the students' achievements in each of the strands assessed in this survey.

NUMBER

In the pen and paper assessment, about two thirds of the students filled in single and adjacent missing numbers for counting forwards by threes (61%) and elevens (56%, 60%) and counting backwards by fives (66%). The easiest sequence to fill in the missing number was an odd counting forwards by twos pattern (78%, 81%) and the most difficult was an off sequence counting forwards by tens pattern (55%, 50%).

Students found it easier to write the numerals for two digit numbers than for three digit numbers that included a zero as shown in Table 4.17.

Table 4.17: Number

% correct	Task
84%	write the number for forty-three
80%	write the number for thirty-two
69%	write the number for one hundred and six
55%	write the number for one hundred and seventy

Over three quarters of the students could combine up to four coins to find totals and make given quantities. It was far more difficult for students to calculate the difference in value between two coin collections. When shown the following collection, 80 per cent of students identified *the pile worth more* but only 28 per cent of students were able to say how much more.



Table 4.18 shows the percentage of students who correctly answered some written problems and the percentage of students who correctly answered some mental computation problems. The problems are arranged in order of difficulty with the most difficult at the top and the easiest at the bottom.

Table 4.18: Number: Written/Mental problems

Written problems		Mental computation problems	
% correct	Task	% correct	Task
47%	$16 + 19$	46%	17 take away 13
50%	$10 + 30 - 5$	60%	13 plus 12
55%	$__ + 11 = 23$	63%	add to 4 to make 11
56%	3×3	74%	3 groups of 2
60%	$15 - 9$	77%	9 plus 8
62%	$12 - 6$	85%	8 take away 5
70%	$7 + 17$	90%	20 plus 10
79%	$9 + 8$		
80%	$9 + __ = 12$		

The most difficult tasks in the third year of school survey were based on a pattern counting forwards in square numbers. The teacher and the student placed blocks on a grid to make squares for the numbers one, four and nine. The student was asked how many blocks they needed to make the next group. Only 11 per cent calculated that they would need 16 blocks. However, when invited to make the next group, 34 per cent correctly made a four-by-four array. It was much easier for students to notice the pattern formed by the blocks on one side of each square than the number of blocks required to make the square. Seventy-seven per cent of students calculated that the next group would have five blocks on one side.

At the start of second year 43 per cent of students correctly answered a question about *how many more*. By the third year 66 per cent of students gave the correct answer of five when asked how

many more blocks in one group (9) than another (4). Only 10 per cent gave the size of the larger group.

SPACE

Ninety per cent of students gave the name triangle for an equilateral triangle at school entry, by the third year of school only 48 per cent had realised that all three sided shapes were triangles. These students identified all the different triangles in a collection as triangles. A further 44 per cent identified some but not all of the shapes as triangles. A further eight per cent only recognised one of the shapes as a triangle. Almost all the students were able to find two shapes *which fit exactly on top of each other* (88%). The triangles had been placed on outlines so all students saw them in the same orientation to do this task.

Sixty-eight per cent of students were able to join two right-angled triangles to make a rectangle. It was more difficult to make a rectangle with the two right-angled triangles, plus an isosceles triangle. Forty-seven students could do this and made a rectangle with the three triangles.

Fifty-two per cent of students recognised that a diagram of a stack of blocks included a block that was hidden from view. When asked to use the diagram to make the stack, more students realised that there had to be another block as 69 per cent of students were able to make the stack.

Most students found it easy to follow directions about location. They were able to place a block between the rocks and the trees but closer to the rocks on a treasure map (84%) and indicate the shorter of two paths (84%). Seventy-seven per cent also identified the object they would face if they were on the hill and faced east.

MEASUREMENT

Seventy-three per cent of students used a centimetre ruler to measure the length of the side of a triangle. Of these students, 46 per cent gave the correct length and included the units of measurement, saying 15 centimetres. A further 10 per cent gave the units when prompted but 17 per cent did not know the units.

A quarter of the students demonstrated a high level of skill in estimating volume with a two-centimetre cube as the unit of measurement. These students calculated that 12 cubes would fill a box when all they could see was the box and one cube. A further 57 per cent were able to calculate the volume when shown three cubes in the bottom of the box. Almost all the students (91%) were able to accurately measure the volume of the box in cubes.

Students were shown the times that Sailor Sam arrived at different points on the Treasure Map. Many students recognised which of four events occurred first (77%). But it was harder for them to calculate differences in time in hours (39%) and even more difficult in quarter-hours or minutes (15%).

Thirty-nine per cent of students wrote the digital time for 7:30 when shown an analogue clock with this time.

Eighty per cent of students were able to read a monthly calendar to identify the day of the week given a certain date, but only 41 per cent calculated the date two weeks after a given date.

CHANCE AND DATA

Many students were challenged by the idea of sorting a collection of red wooden triangles into two groups. Forty-seven per cent were able to sort them either by size as large and small or by a long common side length and a short common side length. More than half the students could not find a criterion for sorting.

STUDENTS' PERFORMANCE ON SURVEY 5 ITEMS

Figure 4.7 shows the numeracy item variable map for Survey 5¹⁰. On the right hand side of the map the item steps are shown ranked on a logit scale according to the estimates of their step thresholds, from the easiest (at the bottom of the map) to the most difficult (at the top of the map). The left hand side of the map shows the distribution of the student's performances relative to the items. Each X represents two students.

In Survey 5 the following specific item labels were used:

- 5SH – shape and measurement items involving set of 7 red triangles
- 5BL – space and measurement items using blocks
- 5MC – mental computation items
- 5TM – space, measurement and chance and data items based on treasure map
- 5PA – pattern and number pen and paper items
- 5PB – pattern and number pen and paper items.

The item steps at the top of the map were the most difficult for this group of students. These item steps located at the top of the scale included 5BL6 (continuing a pattern made with blocks); 5BL1 (estimating the number of blocks needed to fill a box); 5TM6 (calculate the duration of an activity: *how long did it take Sam to get from the rocks to the hut?*); 5PA9 (calculating how much more money is in the second of two piles of coins). Some item steps from Survey 4 were also located around the top of the scale, indicating that many students still found these difficult. Two of the Survey 4 calculator item steps were located near the top of the scale.

Item steps around the middle of the map came from a number of link items from Survey 4. Survey 5 item steps at this level included 5PAd ($7+17=$); 5SH8.2 (*using a ruler to measure side of a triangle in centimetres*); 5MC6 (correct answer to mental computation *what is thirteen plus twelve?*); 5MC5; (correct answer to mental computation *What do I have to add to four to make eleven?*); 5BL9 (*how many more blocks are in this group than in this one?*).

Four of the five easiest item steps located at the bottom of the map were of link items from Survey 4. Survey 5 items located around the lower end of the scale included 5SH1, which was the easiest of all the Survey 5 items (*match shapes to outlines on a sheet*); 5SH3 (matching two shapes that are exactly the same); 5MC1 (correct mental computation of twenty plus ten), and 5TM2 (*use your finger to show me the shortest way along a path from the hut to the lighthouse*).

Comparing the distribution of students' performances and the distribution of items on the map indicates that this assessment survey was at an appropriate level of difficulty for this group of students. The map shows a good spread of the items and students' performances.

¹⁰ For further detail about item variable maps see the section 'Item variable maps' on page 15.

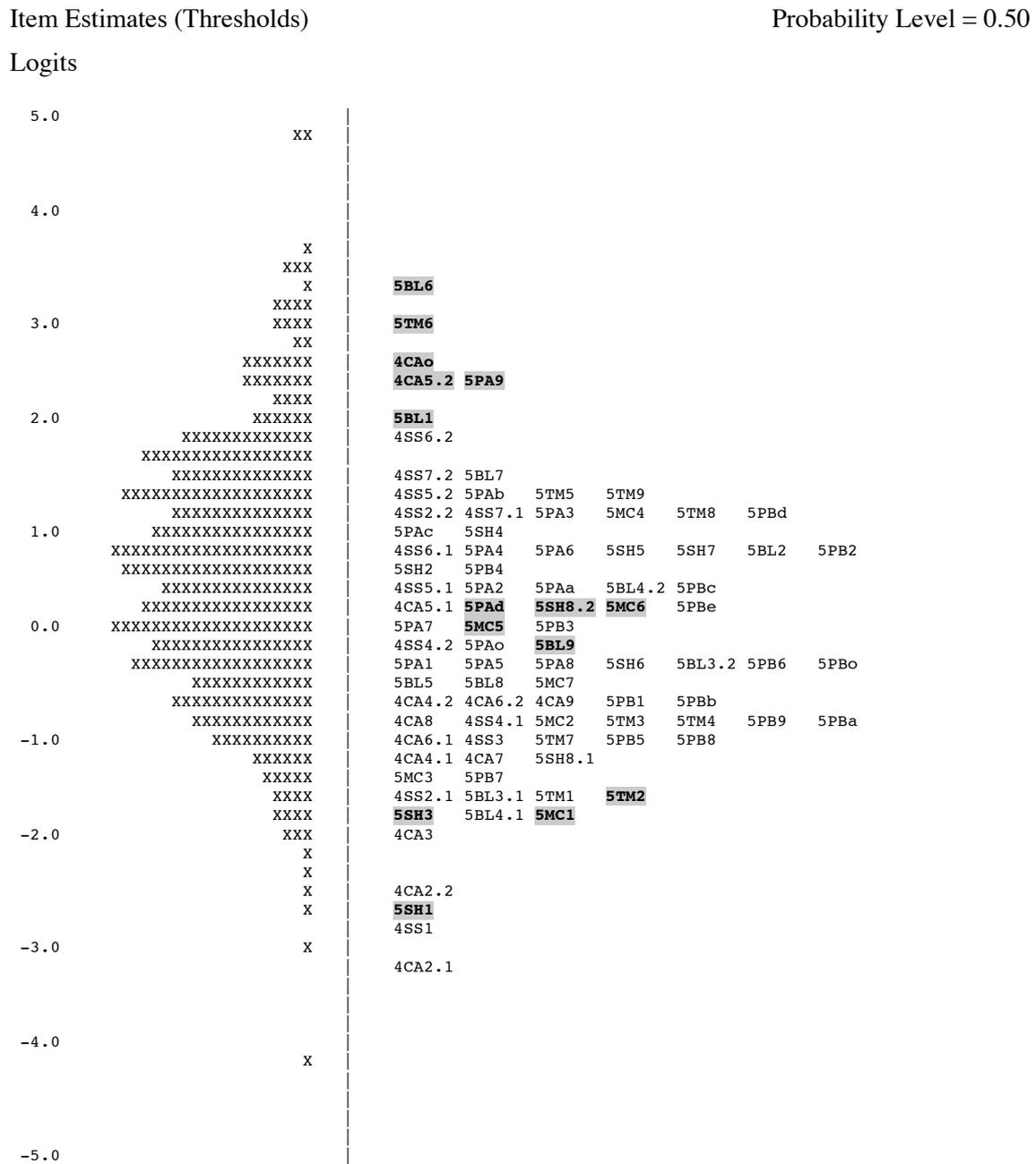


Figure 4.7: LLANS Numeracy Item Map for Survey 5

NUMERACY PERFORMANCE IN THE THIRD YEAR OF SCHOOL

The scale of developing numeracy achievement shown in Figure 4.8 is based on data collected in 2001 during the students' third year of school. Assessment tasks in Survey 5 were calibrated onto the LLANS Numeracy Scale.

Descriptions of skills assessed in Survey 5 are shown on the left of Figure 4.8. A selected sample of skill descriptions has been used to describe performance at different points on the scale. Each description refers to one item. The descriptions have been selected from the whole range of items in both surveys. The placement of the skill descriptions shows the estimated level of difficulty of a particular skill relative to other skills.

The two shaded bands on the right hand side of Figure 4.8 show the distributions of performance of boys and girls in their third year at school in Survey 5. The shaded bands represent the middle 80 per cent of students. The darker shading represents the middle 50 per cent. The black line towards the middle of the darker band represents the median score.

Figure 4.8 shows wide distributions of achievement for the girls and the boys in their numeracy performance in the third year of school.

In Figure 4.8 it can be seen that the boys performed slightly better than the girls. This finding is consistent with the findings from the numeracy Surveys 2, 3 and 4, and indicates that in the early years of schooling, although girls performed slightly better at school entry, boys' achievement was slightly higher than girls in subsequent assessments. The spread of achievement for boys was slightly wider than the spread of the girls' achievement.

The figure displays both student performance and task difficulty. Around the median level of achievement, students were able to *complete a number sentence by subtracting a 1 digit number from a 2 digit number*. Students around the 75th percentile were able to *add two 2 digit numbers then subtract a 1 digit number to calculate total*. Students above the 90th percentile were able to *estimate the number of blocks needed to fill a box*. Students in the 10th percentile could *add two 1 digit numbers mentally*.

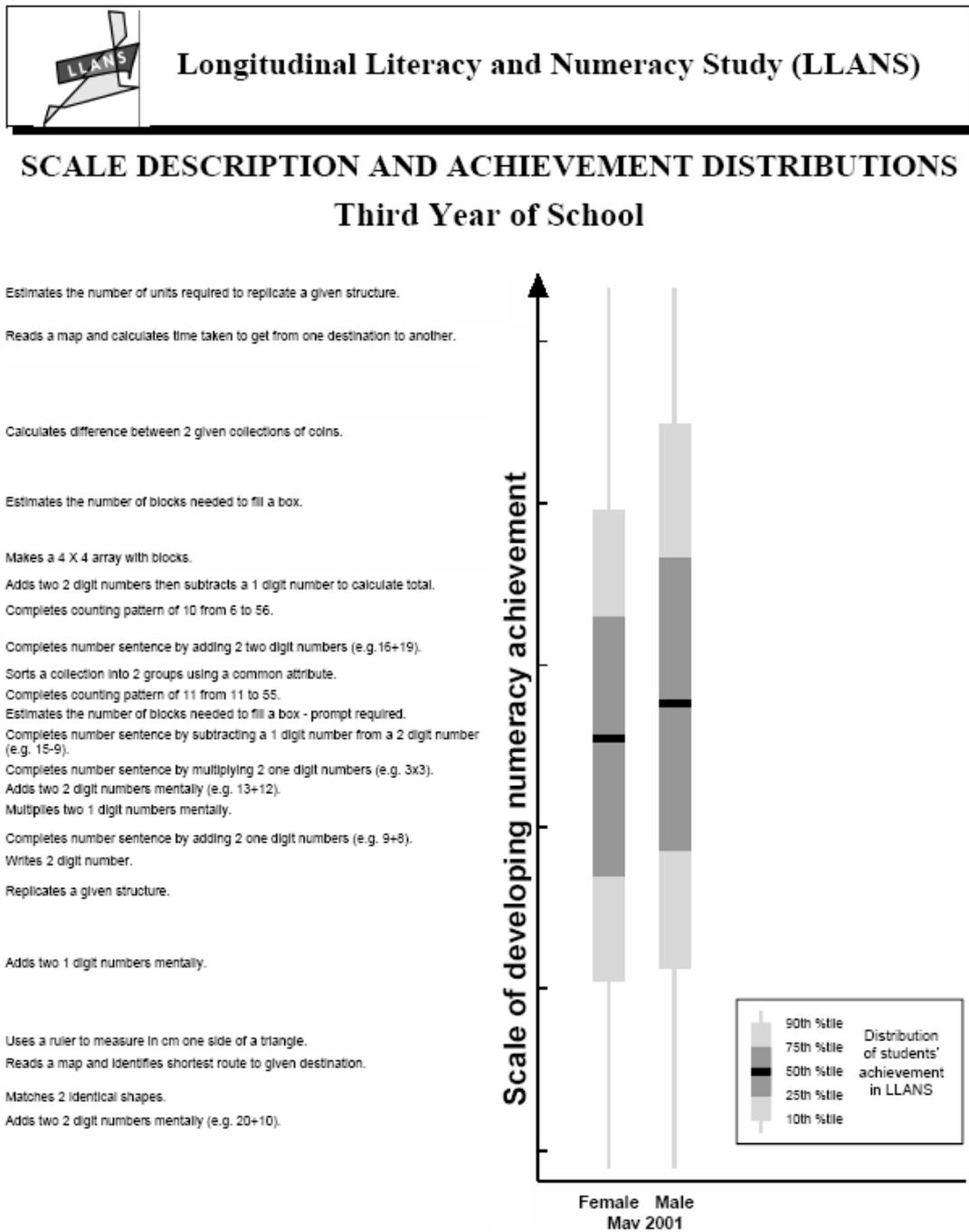


Figure 4.8: LLANS Numeracy Scale description and achievement distributions for the third year of school

5. THE FIRST THREE YEARS OF SCHOOL: LITERACY AND NUMERACY

The literacy and numeracy achievement distributions of the whole LLANS cohort were shown separately for each of the first three years of school in Chapters 3 and 4. The figures at the end of each section in these chapters showed separate achievement distributions for the girls and the boys and a sample of skill descriptions for each year.

In this chapter the students' achievement distributions for literacy and numeracy in the five surveys conducted between March 1999 and May 2001 are shown on a single literacy progress map and a single numeracy progress map. This makes it possible to see the growth over time and to identify general patterns of learning and achievement progress. The progress maps describe how the literacy and numeracy skills of the participating children generally developed over their first three years of school.

STUDENTS' PERFORMANCE ON THE LLANS LITERACY SCALE

The literacy achievement distributions of all students in Surveys 1-5 are shown in Figure 5.1.

Descriptions of skills assessed in Surveys 1- 5 are shown on the left hand side of Figure 5.1. A selected sample of skill descriptions has been used to describe performance at different points on the scale. Each description refers to one item. Only a relatively small selection could be included on Figure 5.1, and so descriptions have been selected from the whole range of items in the five surveys. The placement of the skill descriptions shows the estimated level of difficulty of a particular skill relative to other skills.

The five shaded bands on the right hand side of Figure 5.1 show the distributions of performance of students participating in the study in Surveys 1-5. The shaded bands represent the middle 80 per cent of students. The darker shading represents the middle 50 per cent. The black line towards the middle of the darker band represents the median score for the whole cohort.

The bands have been arranged so that the time between surveys is indicated by the distance between bands. For example, the bands for November 1999 and March 2000 are closer than the bands between March 2000 and November 1999.

From Figure 5.1 it can be seen that there is an upward trend in the median scores for students across the five surveys. There is also an increase in the 10th and the 90th percentile scores over time. Overall the progress map shows a clear pattern of growth in literacy achievement across the first three years of school. It is interesting to note that the amount of growth between Surveys 2 and 3 is less than the amount of growth between Surveys 1 and 2 and Surveys 3 and 4. The shorter period of time between surveys accounts for this difference. Also, the period from November to March includes the long summer vacation, when students are out of school for several weeks. However, although there is less growth, the pattern of growth continues over this period.

The achievement distributions show the considerable range of achievement across the whole cohort of students on each assessment occasion, including the March 1999 assessment at the beginning of the first year of school. Some students performed at a low level on the LLANS Literacy Scale, and some performed at a very high level on the same scale. Around the median level of achievement in March 1999, at the beginning of school, students were able to *identify a capital letter correctly* and to *retell key aspects after listening to a picture story book*. Around the median level in May 2001, in the third year of school, students were able to *explain a character's actions in a simple reading book read independently*. Around the 90th percentile in May 2001, students were able to *write simple sentences joined with simple conjunctions, e.g., like, but, then*.



Longitudinal Literacy and Numeracy Study (LLANS)

SCALE DESCRIPTION AND ACHIEVEMENT DISTRIBUTIONS

First Three Years of School

- Spells correctly some familiar and unfamiliar words eg whiskers.

- Uses and controls a variety of common punctuation in own writing.
- Interprets meaning of a passage of a narrative read aloud.
- Writes a well connected piece showing a recognisable structure eg narrative, recount.
- Writes simple sentences joined with simple conjunctions eg like, but, then.
- Spells some common words with irregular patterns eg basket.
- Identifies key events in a story after listening to a picture story book.
- Pronounces correctly words that require blending of at least 3 syllables.

- Uses a full stop and capital letter appropriately when writing a sentence.
- Explains character's actions in a simple reading book read independently.
- Reads simple reading book (repetitive structure, varied content) with word for word accuracy.
- Explains the overall message of a simple fable.

- Infers information from obvious clues in a simple reading book.
- Explains explicitly stated ideas in a simple reading book.
- Reads simple common words correctly from labels on chart.
- Matches text and meaning accurately in a simple reading book.

- Locates relevant information after listening to an information text read aloud.
- Makes a direct link to meaning of text after viewing illustration in a picture story book.

- Writes one or more simple sentences in response to a task.
- Manipulates sounds in words eg swaps c in camp with l to make lamp.
- Retells key aspects after listening to a picture story book.
- Identifies a capital letter correctly.

- Predicts plausible story for a simple reading book after looking at cover.
- Gives a literal interpretation of illustration from a picture story book.
- Writes about a picture using combination of scribbles and some letters.

- Reads correctly one or two words from the title of a simple reading book.
- Identifies letters correctly in a given word from a simple reading book.

- Identifies words with same first sound from list of three.
- Identifies a word.

- Identifies main character in a simple reading book.

- Describes some main events shown in an illustration after listening to a picture story book.

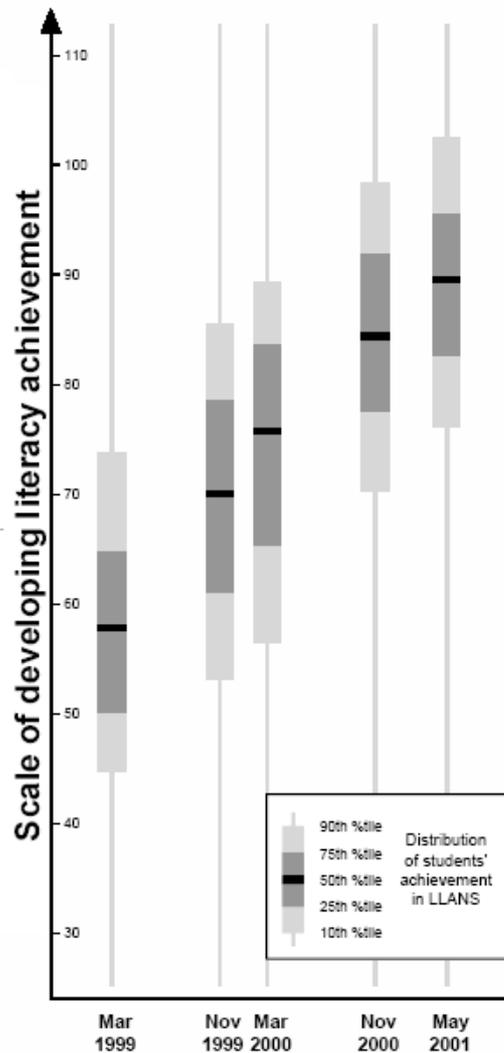


Figure 5.1: LLANS Literacy Scale description and achievement distributions for the first three years of school

STUDENTS' PERFORMANCE ON THE LLANS NUMERACY SCALE

The numeracy achievement distributions of the LLANS cohort in Surveys 1-5 are shown in Figure 5.2. Descriptions of skills assessed in Surveys 1-5 are shown on the left hand side of Figure 5.2. Each description refers to one item. The descriptions have been selected from the whole range of items in all surveys, although only a limited number can be displayed on Figure 5.2. The placement of the skill descriptions shows the estimated level of difficulty of a particular skill relative to other skills.

The five shaded bands on the right hand side of Figure 5.2 show the distributions of performance of students on the five assessment occasions. Each shaded band represents the performance range of the middle 80 per cent of students for the particular assessment. The darker shading in each band represents performance range of the middle 50 per cent. The black line towards the middle of the darker bands represents the median score for the whole cohort.

The bands have been arranged so that the time between surveys is indicated by the distance between bands.

The achievement distributions show the considerable variation in achievement across the whole cohort of students on each assessment occasion. Around the median level of achievement in November 1999, at the end of the first year of school, students were able *to apply counting by fives to a collection structured in groups of five*. Students around the 90th percentile in March 2000, at the beginning of their second year at school, were able *to add the price of 2 items involving cents only*. Students at the 10th percentile in March 2000 could *count back from 10 by ones*.

Figure 5.2 shows that on average, children's numeracy skills developed most rapidly during their first year of school and continued to develop across the five surveys. However, it is interesting to note that there is very little difference between the median scores for November 1999 and March 2000, that is, between the end of the first year of school year and the beginning of the second year, a period that included the summer holidays when students do not participate in regular numeracy teaching programs. This is different than in the case of literacy, where although there was less development between surveys in the same period, there was a small increase in median scores.

The achievement distribution for the first survey in March 1999, indicates a wider variation for the middle 80 per cent of students than in the later assessments. This difference indicates the diversity amongst students at the beginning of the first year of school. Although a considerable variation in achievement is also evident in later assessments, the variation is somewhat less than at the commencement of formal schooling.

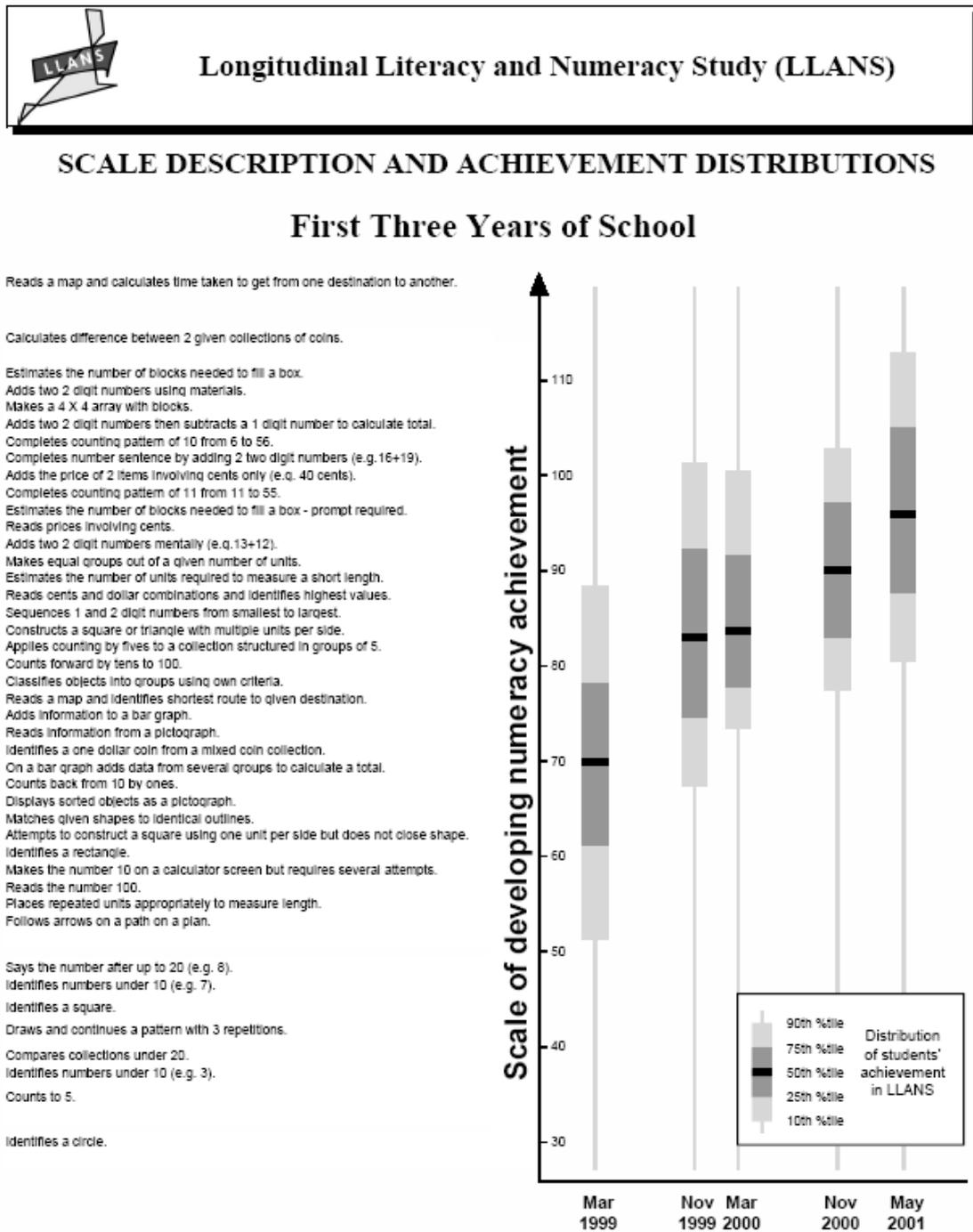


Figure 5.2: LLANS Numeracy Scale description and achievement distributions for the first three years of school

6. LITERACY AND NUMERACY ACHIEVEMENT GROWTH

The LLANS assessment tasks were equated vertically to develop a long measurement scale for literacy and for numeracy. The calibration, equating of assessment tasks and construction of the scales were carried out based on the Rasch partial credit model (Rasch, 1960; Masters, 1982). The long scales make it possible to measure change and to track students' achievement progress over time in literacy and numeracy in the early years. Individual student performance in literacy and numeracy were estimated for each assessment on the LLANS Literacy Scale and the LLANS Numeracy Scale.

This chapter describes variation, and individual differences, in student growth in literacy and in numeracy from Survey 1 (Term 1, first year of school) to Survey 5 (Term 2, third year of school).

INDIVIDUAL DIFFERENCES IN LITERACY AND NUMERACY ACHIEVEMENT GROWTH

Students are likely to differ with respect to their performance at the beginning of the first year at school because of prior learning experiences. Students are also likely to differ with respect to the rate of growth in their performance across time due to differences in motivation, opportunity to learn and learning experiences in school and at home. Growth curve modelling techniques are useful for studying student achievement growth trajectories (Muthén & Khoo, 1998). The method is utilised in modelling literacy and numeracy growth in the LLANS cohort.

The scaled longitudinal data made it possible to model growth trajectories of children's achievement over time to study individual differences and variation in children's development in literacy and numeracy and to compare the growth trajectories across subgroups, such as across gender and across urban/rural school locations.

Figure 6.1 shows the individual progress map in literacy development for a child. The performance of the child is shown against the overall performance distribution of the LLANS cohort. Figure 6.2 shows the individual progress map of a child in numeracy development. Every child follows his or her individual developmental trajectories in literacy and in numeracy.



Longitudinal Literacy and Numeracy Study (LLANS)
INDIVIDUAL LITERACY PROGRESS MAP

First Three Years of School

Student 1

Local Primary School

- Spells correctly some familiar and unfamiliar words eg whiskers.

- Uses and controls a variety of common punctuation in own writing.
- Interprets meaning of a passage of a narrative read aloud.
- Writes a well connected piece showing a recognisable structure eg narrative, recount.
- Writes simple sentences joined with simple conjunctions eg like, but, then.
- Spells some common words with irregular patterns eg basket.
- Identifies key events in a story after listening to a picture story book.
- Pronounces correctly words that require blending of at least 3 syllables.

- Uses a full stop and capital letter appropriately when writing a sentence.
- Explains character's actions in a simple reading book read independently.
- Reads simple reading book (repetitive structure, varied content) with word for word accuracy.
- Explains the overall message of a simple fable.

- Infers information from obvious clues in a simple reading book.
- Explains explicitly stated ideas in a simple reading book.
- Reads simple common words correctly from labels on chart.
- Matches text and meaning accurately in a simple reading book.

- Locates relevant information after listening to an information text read aloud.
- Makes a direct link to meaning of text after viewing illustration in a picture story book.

- Writes one or more simple sentences in response to a task.
- Manipulates sounds in words eg swaps c in camp with l to make lamp.
- Retells key aspects after listening to a picture story book.
- Identifies a capital letter correctly.

- Predicts plausible story for a simple reading book after looking at cover.
- Gives a literal interpretation of illustration from a picture story book.
- Writes about a picture using combination of scribbles and some letters.

- Reads correctly one or two words from the title of a simple reading book.
- Identifies letters correctly in a given word from a simple reading book.

- Identifies words with same first sound from list of three.
- Identifies a word.

- Identifies main character in a simple reading book.

- Describes some main events shown in an illustration after listening to a picture story book.

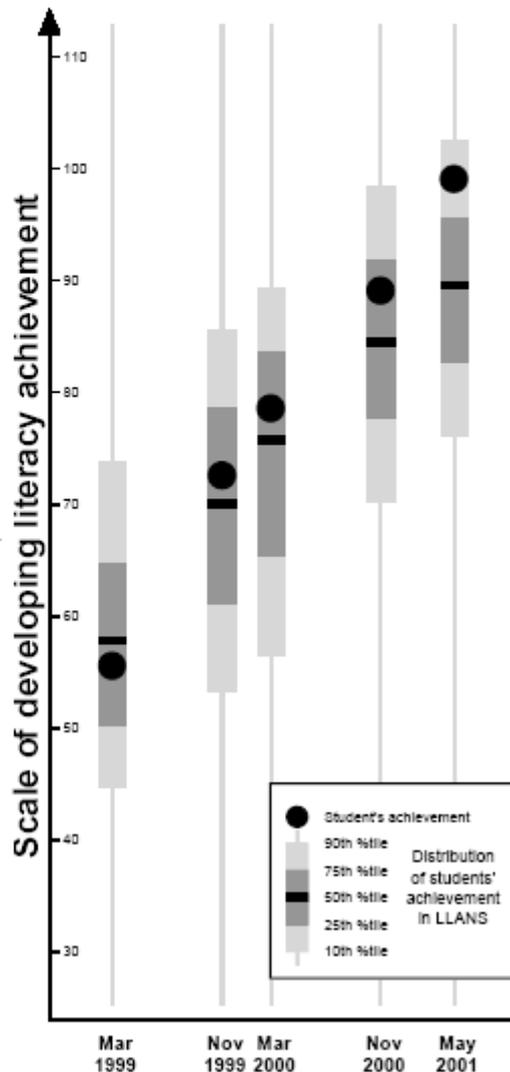


Figure 6.1: An Individual Literacy Progress Map

Longitudinal Literacy and Numeracy Study (LLANS)
INDIVIDUAL NUMERACY PROGRESS MAP

First Three Years of School

Student 1
Local Primary School

Reads a map and calculates time taken to get from one destination to another.

Calculates difference between 2 given collections of coins.

- Estimates the number of blocks needed to fill a box.
- Adds two 2 digit numbers using materials.
- Makes a 4 X 4 array with blocks.
- Adds two 2 digit numbers then subtracts a 1 digit number to calculate total.
- Completes counting pattern of 10 from 6 to 56.
- Completes number sentence by adding 2 two digit numbers (e.g. 16+19).
- Adds the price of 2 items involving cents only (e.g. 40 cents).
- Completes counting pattern of 11 from 11 to 55.
- Estimates the number of blocks needed to fill a box - prompt required.
- Reads prices involving cents.
- Adds two 2 digit numbers mentally (e.g. 13+12).
- Makes equal groups out of a given number of units.
- Estimates the number of units required to measure a short length.
- Reads cents and dollar combinations and identifies highest values.
- Sequences 1 and 2 digit numbers from smallest to largest.
- Constructs a square or triangle with multiple units per side.
- Applies counting by fives to a collection structured in groups of 5.
- Counts forward by tens to 100.
- Classifies objects into groups using own criteria.
- Reads a map and identifies shortest route to given destination.
- Adds information to a bar graph.
- Reads information from a pictograph.
- Identifies a one dollar coin from a mixed coin collection.
- On a bar graph adds data from several groups to calculate a total.
- Counts back from 10 by ones.
- Displays sorted objects as a pictograph.
- Matches given shapes to identical outlines.
- Attempts to construct a square using one unit per side but does not close shape.
- Identifies a rectangle.
- Makes the number 10 on a calculator screen but requires several attempts.
- Reads the number 100.
- Places repeated units appropriately to measure length.
- Follows arrows on a path on a plan.

- Says the number after up to 20 (e.g. 8).
- Identifies numbers under 10 (e.g. 7).
- Identifies a square.
- Draws and continues a pattern with 3 repetitions.
- Compares collections under 20.
- Identifies numbers under 10 (e.g. 3).
- Counts to 5.
- Identifies a circle.

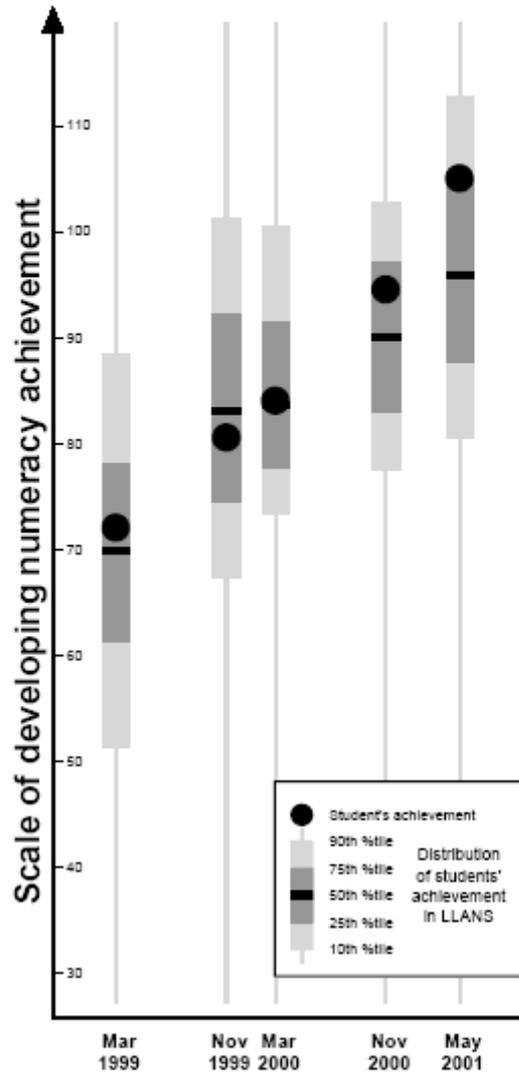


Figure 6.2: An Individual Numeracy Progress Map

INDIVIDUAL GROWTH TRAJECTORIES

A basic idea behind growth modelling is that individuals differ in their growth over time. There are individual differences in the starting performance and there are individual differences in the rate of growth over time. Figure 6.3 illustrates the idea of individual growth trajectory over time. In this case, the growth trajectory takes a linear (straight line) trend that is approximated by the performance of this student across the assessment occasions. Figure 6.4 shows the growth trajectories for four individuals. For each individual, the starting performance and the growth rate characterise the linear growth trajectories. The four individuals start at different points and grow at different rates.

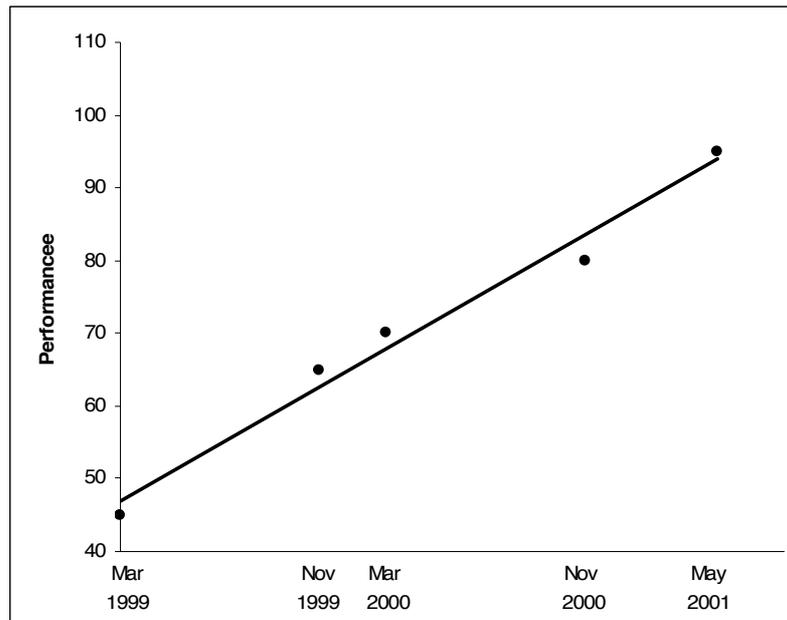


Figure 6.3: An individual growth trajectory

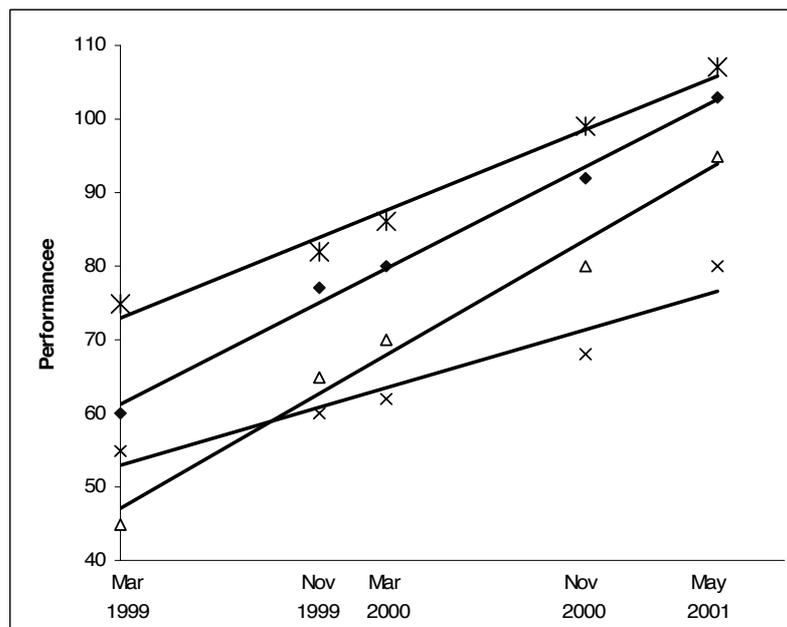


Figure 6.4: Individual variation in growth trajectories

For the LLANS cohort, visual inspection of the individual child growth trajectories indicated an approximately linear pattern in literacy growth and also in numeracy growth from Survey 1 to Survey 5. Figure 6.5a shows the literacy growth trajectories across the five assessment occasions for 20 children. Figure 6.5b shows the corresponding numeracy growth trajectories for the same 20 children. Growth is described as a linear trend here. The children started at different points (initial performance) on the scale at Survey 1 and grow at different rates (growth rate). In both literacy and numeracy development, there are variations in the initial performance and in the growth rate. These variations give rise to growth trajectories that show individual differences in development over time.

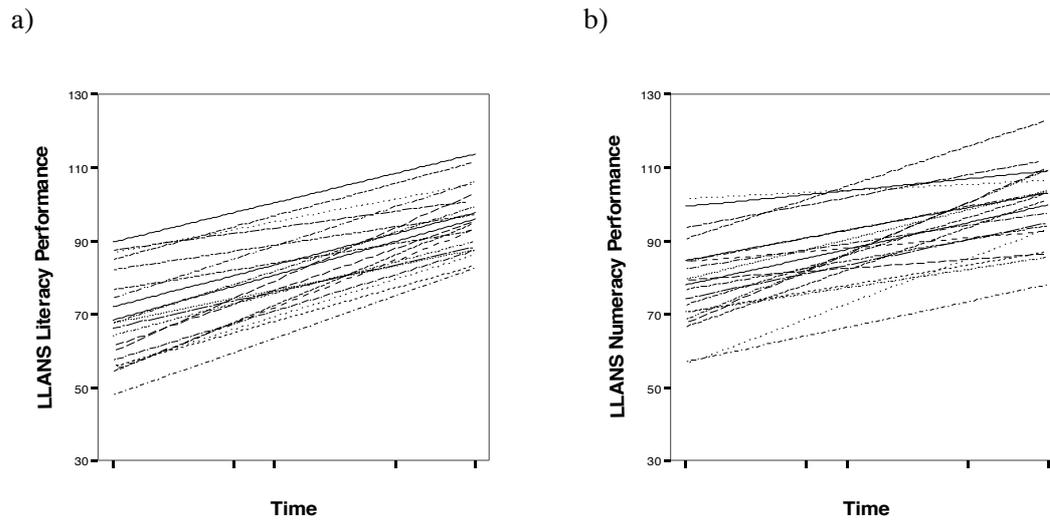


Figure 6.5: Individual growth trajectories in literacy and numeracy

The visual inspection suggests that linear individual growth models can be used to describe the development of literacy and in numeracy over time. Literacy growth and numeracy growth were modelled across the 5 assessment occasions using hierarchical data with assessments within individuals and individuals within schools.

The first objective of modelling individual differences in the growth trajectories was to estimate the average growth trajectory and the amount of variation in the trajectories among individuals and across schools. The second objective was to compare the growth trajectories of male and female children and the growth trajectories of children at urban schools to those at rural schools. The third was to assess how closely associated the growth in literacy development was to the growth in numeracy development.

Results of the analyses are described in the next section. Growth model specifications and estimation details are described in a separate technical report (Khoo, 2006).

MODELLING LITERACY GROWTH

The estimated average literacy performance of the LLANS cohort in Term 1 of the first year at school was 59.0 units on the LLANS Literacy Scale and the estimated average growth rate was about 13.8 units per year thereafter. There was a significant variation (variance = 121.15) in the initial performance in Term 1 of the first year. About 46% of this variation lies between schools and 54% of the variation lies between children within schools. This indicates that the level of development in literacy can be very different across schools even at the time of school entry. There was also significant variation (variance = 5.79) in the growth rate of literacy development. A large percentage (95%) of the variation in growth rates is between schools, and only 5% is between children within schools. This indicates that schools play a very important role in literacy development. The children within schools might start at different points of development but they would tend to have nearly the same growth rates.

The average growth trajectories in literacy development were essentially the same for the rural and urban schools. There were no significant differences. There was a small but significant difference between the boys and the girls in their literacy achievement level at the start of school. The girls did slightly better than the boys. There were no significant gender differences in the literacy growth rates in the first three years of school as can be seen in Figure 6.6. This shows the average overall growth trajectory in literacy and the average growth trajectories for the boys and for the girls. The average trajectory of the boys and that of the girls ran parallel because of the similar growth rates.

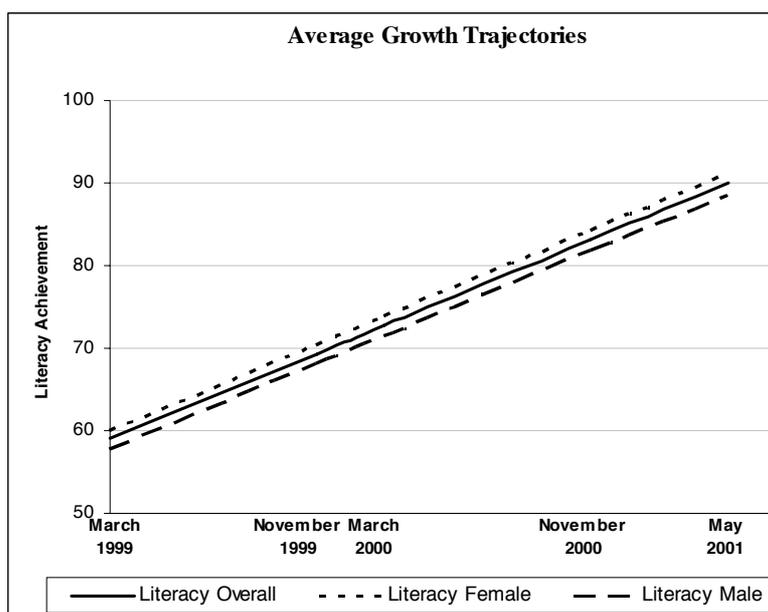


Figure 6.6: Average growth trajectories in literacy development (Survey 1 to Survey 5)

MODELLING NUMERACY GROWTH

The average numeracy performance of the LLANS cohort in Term 1 of the first year at school was 72.8 units on the LLANS Numeracy Scale and the average growth rate was about 10.9 units per year. There was a significant variation (variance = 160.29) in the initial performance in Term 1 of the first year. About 37% of the variation lies between schools and 63% of the variation lies between children within schools. This indicates that, as in literacy, the level of development in numeracy was different across schools at the time of school entry, though the percentage of between-school variation in numeracy was not as large as that in literacy. There was also a significant variation (variance = 9.63) in the growth rate of numeracy development. A large 75% of the growth rate variation lies across schools and 25% lies between children within schools. The between-school proportion of variation in the growth rate, although not as large as in literacy, was still very substantial.

As in literacy development, there were no significant differences in the average growth trajectories in numeracy development between the rural and urban schools. The performance patterns were essentially the same. There was also very little difference between the boys and the girls in their numeracy achievement level at the start of school. But there was a significant difference in the numeracy growth rates. The boys sustained a faster growth rate than the girls. Figure 6.7 shows the average overall growth trajectory in numeracy and the average growth trajectories for the boys and for the girls. On average, the boys and the girls started at nearly the same point, but their average trajectories diverged slightly because the boys averaged a faster rate.

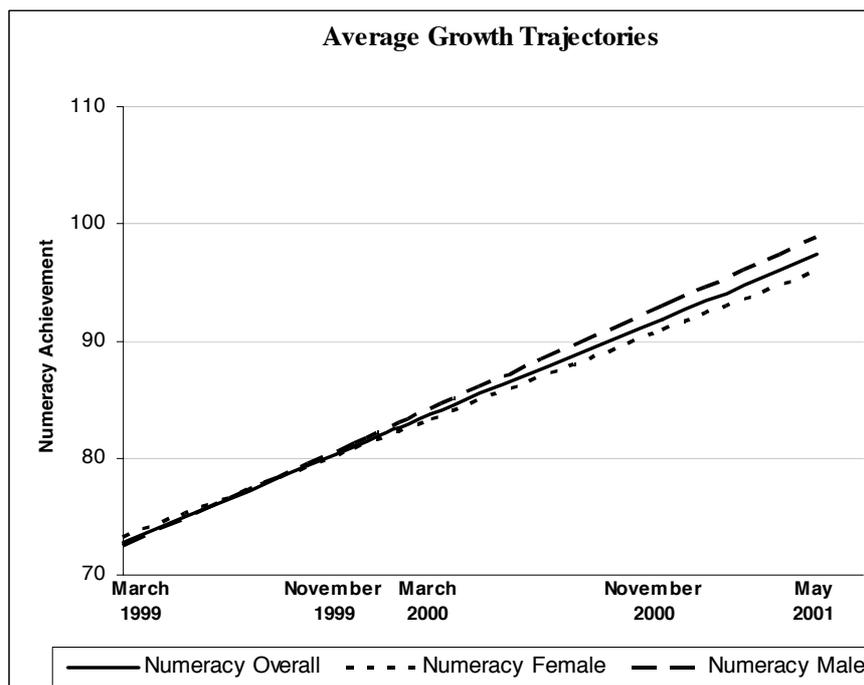


Figure 6.7: Average growth trajectories in numeracy development (Survey 1 to Survey 5)

ASSOCIATION OF LITERACY AND NUMERACY GROWTH

At each LLANS assessment from Survey 1 to Survey 5, the correlation between the performance in literacy and the performance in numeracy was moderate to high. This showed that children who did well in literacy also did well in numeracy. The correlations ranged between 0.59 and 0.79. The correlation between literacy and numeracy achievement was especially high for Survey 1 at school entry. These cross-domain (across literacy and numeracy) correlations were nearly in the same range as the cross-survey correlations within literacy (ranged from 0.63 to 0.71) and within numeracy (ranged from 0.58 to 0.69). In all cases, the association decreased over time showing that the performance in literacy was more consistent with the performance in numeracy at the first year of school and grew less consistent in subsequent years.

The correlation between the literacy and the numeracy growth rates was positive and moderately high ($r = 0.44$). This showed that the association between the literacy growth rate and the numeracy growth rate was not as strong as the association of the Year 1 starting performance of literacy and numeracy. This was consistent with the observation that the high correlations of observed literacy and numeracy scores decreased over time.

SUMMARY

These results showed that a large proportion of variation in the trajectories lie between schools. The girls achieved slightly better than the boys in literacy through the first three years of school and the boys progressed slightly faster than the girls in numeracy. There were no significant differences between children in the metropolitan schools and children in the non-metropolitan schools in terms of their literacy and numeracy development in the first three years at school. At the start of Year 1, children who scored high in literacy had the tendency to also score high in numeracy while children who had not developed as far in literacy at the start of school also would tend to be in the early stage of development in numeracy. The growth rates in literacy and numeracy in the subsequent years were moderately associated. The development in literacy and numeracy had the tendency to move in the same direction, but was not necessarily in tandem.

7. LITERACY AND NUMERACY IN THE FIRST THREE YEARS OF SCHOOL: CONCLUSIONS

This seven-year longitudinal study of literacy and numeracy development followed a cohort of Australian students from the beginning of primary school until Year 6. The first three years of the study encompassed the critical early years of schooling when students acquire key foundational skills.

The LLANS study has provided a range of insights into development in literacy and numeracy in these early years. The assessment tasks and the measurement scales developed in the study have provided rigorous instruments for assessing student performances in literacy and numeracy, and for measuring change and tracking students' progress over time.

LITERACY AND NUMERACY ASSESSMENT IN THE EARLY YEARS

The development of a linked set of literacy assessment instruments and a linked set of numeracy assessment instruments for the early years was a significant outcome of the first phase of the study. Each set of literacy and numeracy assessment tasks was designed to be administered to individual students, with the teachers recording students' responses to each item. The assessment tasks focused on key aspects of literacy and numeracy that research indicates are related to literacy and numeracy learning in the early years of school. The tasks developed for the first two years of the study provided assessments for the beginning and end of each school year for students in the first and second years of formal schooling. The tasks developed for the third year of school provided assessments during the second term of the school year.

THE LLANS SCALES OF DEVELOPING LITERACY AND NUMERACY ACHIEVEMENT

Measurement scales for literacy and for numeracy across the first three years of school were constructed based on the calibrations and linking of the assessment tasks. Descriptions of the skill demands along the literacy and numeracy scales continua were developed in order to put students' achievement and development in context. These skill descriptions capture the nature of development in literacy and numeracy. The scales provide a means of measuring change and tracking student development in literacy and numeracy over time.

STUDENT ACHIEVEMENT IN LITERACY AND NUMERACY

A wide distribution of literacy and numeracy achievement was noted at school entry and this continued through the first three years at school. This key finding indicates the complexity of the task of providing appropriate learning opportunities for all students.

LITERACY

The first survey was conducted early in the first year at school, and provided a picture of the diversity of literacy skills and knowledge amongst the cohort at school entry. Students whose achievement was around the middle of the distribution in this survey were likely to be able to *identify a capital letter correctly*. Students whose achievement was high in the distribution were likely to be able to *retell a narrative in a picture story book including some key events*. Students whose achievement was in the lower range of the distribution were likely to be able to *locate the front of a picture story book*, and *understand the directional sequence of text*.

The second survey took place at the end of the first year of school. At this time, students whose achievement was around the middle of the distribution in this survey were likely to be able to *read simple common words from labels on a chart*, and *write one or more generally readable sentences*. Students whose achievement was high in the distribution were likely to be able to *read all of a*

simple reading book with word for word accuracy, read 'would' as a sight word, and write a recognisable sentence. Students whose achievement was in the lower range of the distribution were likely to be able to identify letters correctly in a given word from a simple reading book, and identify words with the same first sound from a list of three words.

Early in the second year of school, when Survey 3 was conducted, students whose achievement was around the middle of the distribution in this survey were likely to be able to *write a single sentence using a capital letter and a full stop*. Students whose achievement was high in the distribution were likely to be able to *identify key events after listening to a picture story book*. Students whose achievement was in the lower range of the distribution were likely to be able to *give a literal interpretation of an illustration in a picture story book, and spell initial sounds in common words*.

Survey 4 was conducted at the end of the second year of school. By this time, students whose achievement was around the middle of the distribution in this survey were likely to be able to *read a simple reading book (with predictable structure, varied content) with word for accuracy, and write readable text with many words spelt correctly*. Students whose achievement was high in the distribution were likely to be able to *use context to provide meaning for unfamiliar words in an informational text, and to include one or more complex sentences in their own writing*. Students whose achievement was in the lower range of the distribution were likely to be able to *express more than one idea in their own writing, and to locate specific information in a simple informative reading book read independently*.

Survey 5 was conducted in May of the students' third year at school. By this time, students whose achievement was around the middle of the distribution were likely to be able to *explain character's actions in a simple reading book read independently*. Those students whose achievement was high in the distribution were likely to be able to *use and control a variety of common punctuation in their own writing, and write simple sentences joined with simple conjunctions, e.g., like, but, then*. Students whose achievement was in the lower range of the distribution were likely to be able to *read 2-3 pages of a simple reading book with limited maintenance of meaning*.

NUMERACY

There was a considerable variation in numeracy achievement across the whole cohort of students on each assessment occasion in the first three years of school.

In the first survey, which was conducted early in the students' first year at school, students whose achievement was around the middle of the distribution in this survey were likely to be able to *add data from several pieces to a bar graph, and count back from 10 by ones*. Students whose achievement was high in the distribution were likely to be able to *read cents and dollar combinations and identify highest values*. Students whose achievement was in the lower range of the distribution were likely to be able to *identify a different attribute of two objects, identify numbers under 10 correctly, and identify a square*.

By the end of the first year of school, students whose achievement in the second survey was around the middle of the distribution were able to *apply counting by fives to a collection structured in groups of five and to subtract numbers under 10 without given materials*. Students whose achievement was high in the distribution in this survey were likely to be able to *read prices involving dollars and cents*. Students whose achievement was in the lower range of the distribution were likely to be able to *identify numbers under 75 and to add, using materials with a collection under 10*.

The third survey was conducted at the beginning of the second year at school, and students whose achievement was around the middle of the distribution were likely to be able to *sequence 1 and 2 digit numbers correctly from smallest to largest*. Students whose achievement was high in the distribution were likely to be able to *add the price of 2 items involving cents only*. Students whose achievement was in the lower range of the distribution were likely to be able to *count back from 10 by ones*, and to *be able to add information to a bar graph*.

By the end of the second year of school, when the fourth survey was conducted, students whose achievement was around the middle of the distribution were likely to be *able to make equal groups out of a given number of units*. Students whose achievement was high in the distribution were likely to be able to *identify attributes of a rectangle*. Students whose achievement was in the lower range of the distribution in this survey were likely to be able to *continue a counting pattern of 2*.

The fifth survey took place in the second term of the students' third year at school. Students whose achievement was around the middle of the distribution in this survey were able to *complete a number sentence by subtracting a 1-digit number from a 2-digit number*. Students whose achievement was high in the distribution were likely to be able to *add two 2-digit numbers then subtract a 1-digit number to calculate total* and to *estimate the number of blocks needed to fill a box*. Students whose achievement was in the lower range of the distribution were likely to be able to *add two 1-digit numbers mentally*.

INDIVIDUAL DIFFERENCES IN LITERACY AND NUMERACY ACHIEVEMENT GROWTH

Individual student performances in literacy and numeracy were estimated for each assessment on the LLANS Literacy Scale and on the LLANS Numeracy Scale. Individual differences in student growth trajectories across the first three years of school were investigated.

It was found that there was significant variation in the students' developmental trajectories in literacy and in numeracy. There was significant individual variation in the performance at school entry and there was significant individual variation in the literacy growth rate and in the numeracy growth rate. Students started at different points and developed at different rates.

The girls performed better at school entry in literacy but not in numeracy. There were no significant gender differences in literacy growth rate in the first three years of school resulting in girls achieving slightly better, on average, than boys in literacy throughout the three years. Boys progressed slightly faster than girls in numeracy, resulting in the boys performing better than the girls, on average, at the end of the three years even though their numeracy performance was about the same at school entry.

LINKS BETWEEN LLANS AND OTHER STUDIES

The linked literacy and numeracy assessment tasks, the LLANS Literacy Scale and the LLANS Numeracy Scale are useful for studying literacy and numeracy development in the early years. They have been used by a number of other research projects for studying children's growth in literacy and numeracy and in teacher effectiveness studies.

The LLANS literacy and numeracy assessments tasks have been used in another ACER longitudinal study monitoring growth in literacy and numeracy achievement in a group of Indigenous students who commenced school in 2000 (Frigo *et al.*, 2004).

The LLANS literacy assessments tasks have been used in a national study of effective literacy teaching practices (Louden, W., Rohl, M., Barratt-Pugh, C., Brown, C., Cairney, T., Elderfield, J., House, H., Meiers, M., Rivalland, J., & Rowe, K., 2005). A representative sample of children in

the first and second years of school completed the LLANS literacy assessment tasks at the beginning and at the end of the school year. The assessments provided an evidential link between student outcomes and teaching practices in this study. An analysis of growth in performance on the assessment tasks from the beginning to the end of the school year enabled the researchers in this project to identify classrooms where students had made better progress in literacy than expected.

The LLANS literacy assessment tasks were used in the same way in a further state-based study of effective teaching practices conducted by the same research team (Louden, et al) in 2005-2006 in Western Australia.

The LLANS literacy assessment tasks are also being used to assess four cohorts of students in four year levels in the Northern Territory. This is a three-year longitudinal study investigating the effectiveness of four different literacy approaches, including a bilingual program for Indigenous students. This evaluation, managed by the Department of Employment, Education, and Training Northern Territory commenced in 2006.

LLANS IN THE MIDDLE AND LATER YEARS OF PRIMARY SCHOOL

The LLANS continued into the middle and later years of primary school, concluding the assessments of literacy and numeracy achievement of the whole cohort in term 2, 2005, when the students were in their seventh year at school. A subsequent report will present the findings for the next four years of school.

REFERENCES

- Adams, M. J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, Massachusetts: MIT Press.
- Basic Skills Agency & National Foundation for Educational Research. (1998). *Family numeracy adds up: Lessons from the family numeracy pilot program*. London: The Basic Skills Agency.
- Blatchford, P., & Cline, T. (1992). Baseline assessment for school entrants. *Research Papers in Education*, 7(4), 247-268.
- Brooks, G., Flanagan, N., Henkhuzens, Z., & Hutchison, D. (1999). *What works for slow readers? The effectiveness of early intervention schemes*. Slough: National Foundation for Educational Research.
- Brown, M. (2000). *What kinds of teaching and what other factors accelerate primary pupils' progress in acquiring numeracy?* Paper presented at the Improving Numeracy Learning: ACER Research Conference 2000, Brisbane.
- Browne, E (1994). *Handa's Surprise*. London: Walker Books Ltd.
- Chin, C. (1996). *Clever Bird*. Glenview, Illinois: Celebration Press, ScottForesman.
- Clarke, D., & Cheeseman, J. (2000). *Some insights from the first year of the early numeracy research project*. Paper presented at the Improving Numeracy Learning: ACER Research Conference 2000, Brisbane.
- Clay, M. (1993). *An observation survey of early literacy achievement*. Auckland: Heinemann.
- Clough, M. (2000). *Monkey on the Roof*. South Melbourne: Nelson ITP (Thomson Publishing Co.).
- Crévola, C. A. M., & Hill, P. W. (1998a). Developing and testing a whole-school, design approach to improvement in early literacy, *11th International Congress for School Effectiveness and Improvement*. Manchester, UK.
- Crévola, C. A. M., & Hill, P. W. (1998b). Initial evaluation of a whole school approach to early literacy: Prevention and intervention. *Journal of Education for Students Placed at Risk*, 3(2), 133-157.
- Crévola, C. A. M., & Hill, P. W. (1998c). The role of reading recovery in a whole-school approach to early literacy, Symposium on sustained improvement in early literacy outcomes for students in disadvantaged schools, *11th International Congress for School Effectiveness and Improvement*. Manchester, UK.
- Curriculum Corporation. (1994a). *English: A curriculum profile for Australian schools*. Carlton: Curriculum Corporation.
- Curriculum Corporation. (1994b). *Mathematics: A curriculum profile for Australian schools*. Calton: Curriculum Corporation.
- Curriculum Corporation. (1998). *Literacy benchmarks: Years 3 & 5 writing, spelling and reading*. Carlton: Curriculum Corporation.
- Curriculum Corporation. (1999). *Assessment of literacy and numeracy in the early years of schooling*. Canberra: Department of Education, Training and Youth Affairs.
- Curriculum Corporation. (2000a). *Literacy benchmarks: Years 3, 5 & 7 writing, spelling and reading*. Carlton: Curriculum Corporation.
- Curriculum Corporation. (2000b). *Numeracy benchmarks: Years 3, 5 & 7*. Carlton: Curriculum Corporation.
- David, T., Raban, B., Ure, C., Gouch, K., Jago, M., & Barriere, I. (2000). *Making sense of early literacy: A practioner's perspective*. Stoke-on-Trent: Trentham Books.
- Department of Education Community and Cultural Development Tasmania. (1997). *Flying start program*. Hobart: Department of Education, Community and Cultural Development.

- Department of Education, Training and Employment, South Australia. (1999). *School entry assessment. Planning for learning*. Adelaide: Department of Education, Training and Employment.
- Department of Employment, Education, Training and Youth Affairs. (1998). *Literacy for all: The challenge for Australian schools. Commonwealth literacy policies for Australian schools*. Canberra: Department of Employment, Education, Training and Youth Affairs.
- Department of Education, Training and Youth Affairs. (2000). *Numeracy, a priority for all: Challenges for Australian schools*. Canberra: Department of Education, Training and Youth Affairs.
- Doherty, B. (1995). *The Magical Bicycle*. London, UK: Picture Lions, HarperCollins Publishers Ltd.
- Education Department of Western Australia. (1994). *Reading developmental continuum*. Melbourne: Longman Cheshire.
- Frigo, T., Corrigan, M., Adams, I., Hughes, P., Stephens, M., & Woods, D. (2004). *Supporting English literacy and numeracy learning for Indigenous students in the early years*. Camberwell: Australian Council for Educational Research.
- Gould, P. (2000). *Count me in too: Creating a choir in the swamp*. Paper presented at the Improving Numeracy Learning: ACER Research Conference 2000, Brisbane.
- Green, P. J., Hoogstra, L. A., Ingels, S. J., Greene, H. N., & Marnell, P. K. (1997). *Formulating a design for the ECLS: A review of longitudinal studies*. Washington DC: US Department of Education. National Center for Education Statistics.
- Hill, S., Comber, B., Loudon, W., Rivalland, J., & Reid, J. (1998). *100 children go to school - connections and disconnections in literacy development in the year prior to school and the first year of school*. Canberra: Department of Employment, Education, Training and Youth Affairs.
- Holdaway, D. (1979). *Foundations of literacy*. Sydney & Auckland: Ashton Scholastic.
- Khoo, S. T. (2006). *LLANS technical report: Scale construction and growth modelling*. Camberwell: Australian Council for Educational Research.
- Lindsey, G., & Desforges, M. (1998). *Baseline assessment: Practice, problems and possibilities*. London: David Fulton Publishers.
- Loudon, W., Rohl, M., Barratt-Pugh, C., Brown, C., Cairney, T., Elderfield, J., House, H., Meiers, M., Rivalland, J., & Rowe, K. (2005). *In teachers' hands. Effective teaching and learning practices in the early years of schooling*. Canberra: Australian Government Department of Education, Science and Training.
- Loudon, W., et al. (2005). In teachers' hands: Effective literacy practices in the early years of schooling. *Australian Journal of Language and Literacy*, 28(3) - whole of issue.
- Masters, G.N. (1982). A Rasch model for partial credit scoring. *Psychometrika*, 60, 523-547.
- Masters, G., & Forster, M. (1997). *Mapping literacy achievement. Results of the 1996 national school English literacy survey*. Canberra: Department of Employment, Education, Training and Youth Affairs.
- Meade, A., Cubey, C., Wylie, C., & Hendricks, A. (1995). *Competent children and their teachers: Learning about trajectories and other schemas*. Wellington: New Zealand Center for Educational Research & Education Faculty, Victoria University of Wellington.
- Ministerial Council on Education, Employment, Training and Youth Affairs. (1999). *The Adelaide declaration on national goals for schooling in the twenty-first century*.
- Mosenthal, P.B., Pearson, P., Barr, R., & Kamil, M.L. (Eds.) (2000). *Handbook of reading research* (Vol. III). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Munro, J. (1998). *Assessing and teaching phonological knowledge*. Camberwell: Australian Council for Educational Research.

- Muthén, B. O., & Khoo, S.-T. (1998). Longitudinal studies of achievement growth using latent variable modeling. *Learning and Individual Differences, 10*(2), 73-102.
- Neuman, S. B., & Roskos, K. A. (Eds.). (1998). *Children achieving: Best practice in early literacy*. Newark, Delaware: International Reading Association.
- New Zealand Ministry of Education. (1997). *School entry assessment: Guide for teachers*. Wellington: Learning Media.
- Raban, B. (1998). Reading skills: Emergent literacy. In V. K. Edwards & D. Corscon (Eds.), *Encyclopaedia of language and education: Literacy* (Vol. 2). Boston, NJ: Kluwer Academic Publishers.
- Raban, B., & Ure, C. (1996). *Assessing young learners: An introduction to methods of assessing new school entrants*. Carlton, Victoria: Board of Studies.
- Rasch, G. (1960). *Probabilistic models for some intelligence and attainment tests*. Chicago: University of Chicago Press.
- Robinson, F. (1993). *Meet My Mouse*. Glenview, Illinois: Scott, Foresman and Company, HarperCollins Publishers.
- Rowe, K. J. (1991). The influence of reading activity at home on students' attitudes towards reading, classroom attentiveness, and reading achievement: An application of structural equation modelling. *British Journal of Educational Psychology, 61*(1), 19-35.
- Rowe, K. J. (1997). Factors affecting students' progress in reading: Key findings from a longitudinal study. In S. L. Swartz & A. F. Klein (Eds.), *Research in Reading Recovery* (pp. 53-101). Portsmouth: Heinemann.
- Smith, A. (2000). *Kitty Cat Plays Inside*. South Melbourne: Nelson ITP (Thomson Publishing Co.).
- Snow, C. E., Burns, S. M., & Griffin, P. (Eds.) (1998). *Preventing reading difficulties in young children*. Washington DC: National Academy Press.
- Swartz, S. (1999). *Sea Turtles*. South Melbourne: Pearson Education Australia Pty Ltd.
- Victoria Department of Education, Employment, and Training. (2000). *The early numeracy research project*. Melbourne: Victoria Department of Education, Employment and Training.
- Willis, S. (2000). *Strengthening numeracy: Reducing risk*. Paper presented at the Improving Numeracy Learning: ACER Research Conference 2000, Brisbane.
- Winton, T. (1998). *The Deep*. Western Australia: Fremantle Arts Centre Press.
- Wolfendale, S. A. (1993). *Baseline assessments: A review of current practice, issues and strategies for effective implementation*. Stoke-on-Trent: Trentham Books.
- Wylie, C. (1996). *Five years old and competent*. Wellington: New Zealand Council for Educational Research.
- Wylie, C., & Else, A. (1998). *Six years old and competent*. Wellington: New Zealand Council for Educational Research.
- Wylie, C., & Thompson, J. (1998). *Competent children at 6: Families, early education, and schools*. Wellington: New Zealand Council for Educational Research.

LLANS PAPERS, 1998-2006

- Darkin, L., Meiers, M., & Nolan, K. (2005). *Scribbles, signs and stories. Learning to Write*. Camberwell: Australian Council for Educational Research.
- Meiers, M. (2004). Australian assessment in literacy and numeracy. *Literacy Today* Number 41, December, London: National Literacy Trust.
- Masters, G.N., Meiers, M., & Rowe, K. (2003). Understanding and monitoring children's growth. *Educare News*, May, 52-53.
- Stephanou, A., Meiers, M., & Forster, M. (2000). *Constructing scales for reporting growth in numeracy: the ACER Longitudinal Literacy and Numeracy Study*. Conference Proceedings, ACER Research Conference 2000, Brisbane.
- Meiers, M. (2000). Assessing literacy development and achievement: the importance of classroom assessments. *Australian Language Matters*, 8 (3), Aug/Sept, Melbourne: Language Australia.
- Meiers, M. (1998). A New Australian Longitudinal Literacy and Numeracy Survey. *Australian Language Matters*, 6 (4), 14.