

A Longitudinal Investigation of Literacy Achievement and Development in the First Three Years of School

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Introduction

This paper describes a longitudinal study of literacy development in the early years of schooling. Monitoring the development of children's literacy learning in the early years of school poses challenges for educational researchers, including the need for appropriate strategies for identifying the full range of literacy knowledge and skills demonstrated by young learners.

The seven-year national ACER Longitudinal Literacy and Numeracy Study (LLANS) followed the growth in literacy of a single cohort of students across the years of primary school (Meiers, Khoo et al, 2006). A key research question in this study was: "What is the nature of literacy development amongst Australian school children?" The study 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. The longitudinal design made it possible to investigate development and growth by following the same cohort of students across the years of schooling, in order to identify the changes in what students know and can do.

One thousand children from a randomly selected Australia-wide sample of 100 schools formed the cohort for the study. The students were aged between 4.6 and 6 years old at the time of the first assessment. A comprehensive review of assessment approaches, longitudinal studies, and studies of literacy development in the early years of school was undertaken at the commencement of the study (for example, Snow et al, 1998, Tymms. 1999). This review informed the design of the study.

Teachers in the study administered the assessments developed by ACER to the sampled students in their class. Table 1 indicates the timing of the assessments across the seven years of the study. This paper is based on data from Surveys 1-5, the early years of school. In Australia, the first year of school is labelled differently in the different states and territories: Kindergarten, Preparatory, Transition, Reception, or Pre-Primary. The second year of school is Year 1, the third year is Year 2, and so on. In some states, the transition to secondary school takes place after eight years at school; however, for this study, data collection ended at Year 6, taking account of the jurisdictions where students transfer to secondary school after year 6.

Table 1: LLANS data gathering schedule

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

Term 4	Term 4					
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The literacy assessment tasks

The literacy 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. The literacy tasks focused on critical aspects of literacy, including concepts of print, phonemic awareness, phonics, fluency, comprehension and writing. The literacy tasks were administered by teachers in a one-on-one interview situation. The tasks included many hands-on activities and authentic texts, for example, quality children's picture storybooks.

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 assessment tasks were presented in a common format for Surveys. The assessment booklets provided columns for recording student responses on the right-hand side of the marking guide as shown in Table 2. All assessments were conducted in one-to-one interview situations.

The following examples of assessment tasks from the first five surveys show the range of achievement assessed. Table 2 show an item designed to assess children's comprehension of a picture story book read aloud by the teacher.

Table 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.</p> <p><i>Do not discuss the pictures. Acknowledge the child's comments (if any) but do not engage in conversation.</i></p> <p><i>Read Precious Eggs to the child again.</i></p> <p><i>Close the book when you have finished reading it. Put the book aside.</i></p> <p>Now tell me the story that I read you.</p> <p><i>If the child tells the story of the bush rat prompt them to tell you about the two birds.</i></p>	
	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 (e.g. 'They had a nest, blossoms made them sneeze, then they went home. The eggs hatched into little baby birds'.)
	Tells a different story.
	no attempt

Table 3 shows the marking guide for a comprehension assessment item from Survey 2, also based on a picture story book. This question was designed to assess children's understanding of the nature of the surprise at the end of the story. In this book, much of the action is conveyed through the illustrations.

Table 3: Marking Guide: Explaining the title

Instructions and questions	Marking guide
<p>The book is called <i>Handa's Surprise</i>.</p> <p>Why is Handa surprised?</p>	
	understands new fruit is a surprise. e.g. She put in fruit and found tangerines...
	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.

In Survey 2, students were asked other comprehension questions, such as the item that asked for an explanation of key events (Table 4).

Table 4: Explaining key events, Survey 2

At the end of Prep, students listened to the teacher read the picture story book, <i>Handa's Surprise</i> . With the book open at the turning point in the narrative, the students were asked: <i>Why is this important in the story?</i>	Other	Describes action without explaining importance	Recognises importance of the fruit in the story
	29%	35%	36%

In Survey 5, when the students were in their third year at school, they read a short illustrated text independently, and were asked to explain the main idea of the story. Table 5 shows the range of responses.

Table 5: Explaining the main idea, Survey 5

Students read the simple text, <i>Clever Bird</i> , independently. <i>Explain the trick the rich farmer played on Mo Chin.</i>	Other	Refers to farmer giving Mo Chin boiled stones , no elaboration	Restates text giving detailed explanation
% correct	23%	28%	50%

Table 6 shows the full range of tasks for Survey 3. Each of the five surveys assessed these aspects of literacy.

Table 6: Literacy assessment tasks, Survey 3

Making Meaning from Text	<p>After reading <i>Kitty Cat Plays Inside</i></p> <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 <p>After listening to the teacher read <i>The Magical Bicycle</i></p> <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’: <i>like, bike, hike, spike, strike, likes, liked, likely</i> and <i>likeness</i> • read unfamiliar words composed of phonetically regular segments: <i>satin, sandal, seminar, satellite</i> and <i>sentimental</i> • 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 <i>big, come, played</i> and <i>basket</i>

Table 7 shows a task from the fourth survey, administered at the end of the second year at school. This item was based on a simple reading text that students read independently.

Table 7: 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. <i>It tell you all about a mouse’s teeth.</i>
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. <i>a cage, water bottle, food dish, mouse food, litter</i>

In Survey 5, student had listened to the teacher read the picture story book *The Deep*, by Australian author, Tim Winton. Students listened to the story, and answered some questions. Then 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. Table 6 shows the marking guide used to assess the content of the students' written texts, and the percentage of students scored at the different levels.

Table 8: Marking Guide: Writing content

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

The relative difficulty of items was a key consideration in developing each survey. Figure 1 shows the item variable map for Survey 1. Item variable maps were constructed from Rasch estimates for each of the five Surveys. On the right hand side of the map, item step thresholds are shown ranked on a logit scale according to the estimates of their difficulty, from the easiest (at the bottom of the map) to the most difficult (at the top of the map). This example is the item variable map for the first survey.

On Figure 1, the distribution of students' performances and the distribution of item difficulties are at about the same level. This 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.

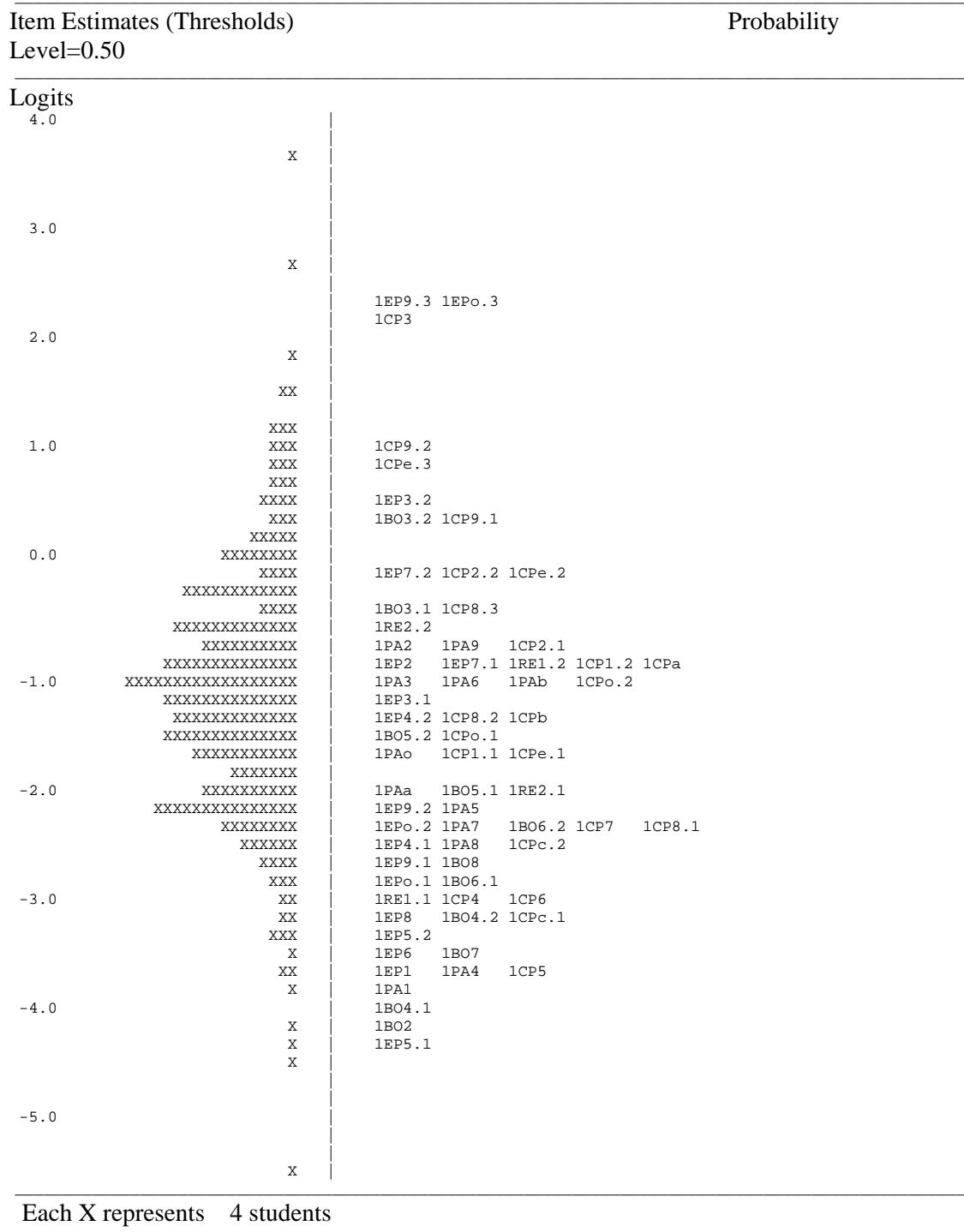


Figure 1: LLANS Literacy scale. Item Map for Survey 1

Literacy measurement scales

In order to measure progress over time in literacy, it was necessary for the students' performance in each survey to be measured on the same scale. A LLANS Literacy Scale was constructed, covering the full range of proficiency as assessed using easier tasks in the first year of school and more difficult tasks in the subsequent years.

Assessment data collected in the five LLANS surveys provided information needed for the calibration of the LLANS items and the LLANS instruments. The assessments were vertically equated to construct a long measurement scale to measure developing literacy achievement. 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 was constructed and used to provide measures across the surveys.

Since the Rasch (Rasch, 1960) item difficulties and student performance estimates were defined on the same scale, it was possible to relate the performance levels along the literacy scale to the skill demands at those levels based on the assessment tasks. Descriptions of the skill demands along the literacy scale continuum were developed, making it possible to put the students' progress and development in context.

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 in literacy in the first year at school, and to track students' achievement progress over time. Figure 2 shows growth and change for students at the beginning and end of the first year at school.

SCALE DESCRIPTION AND ACHIEVEMENT DISTRIBUTIONS
First Year of School

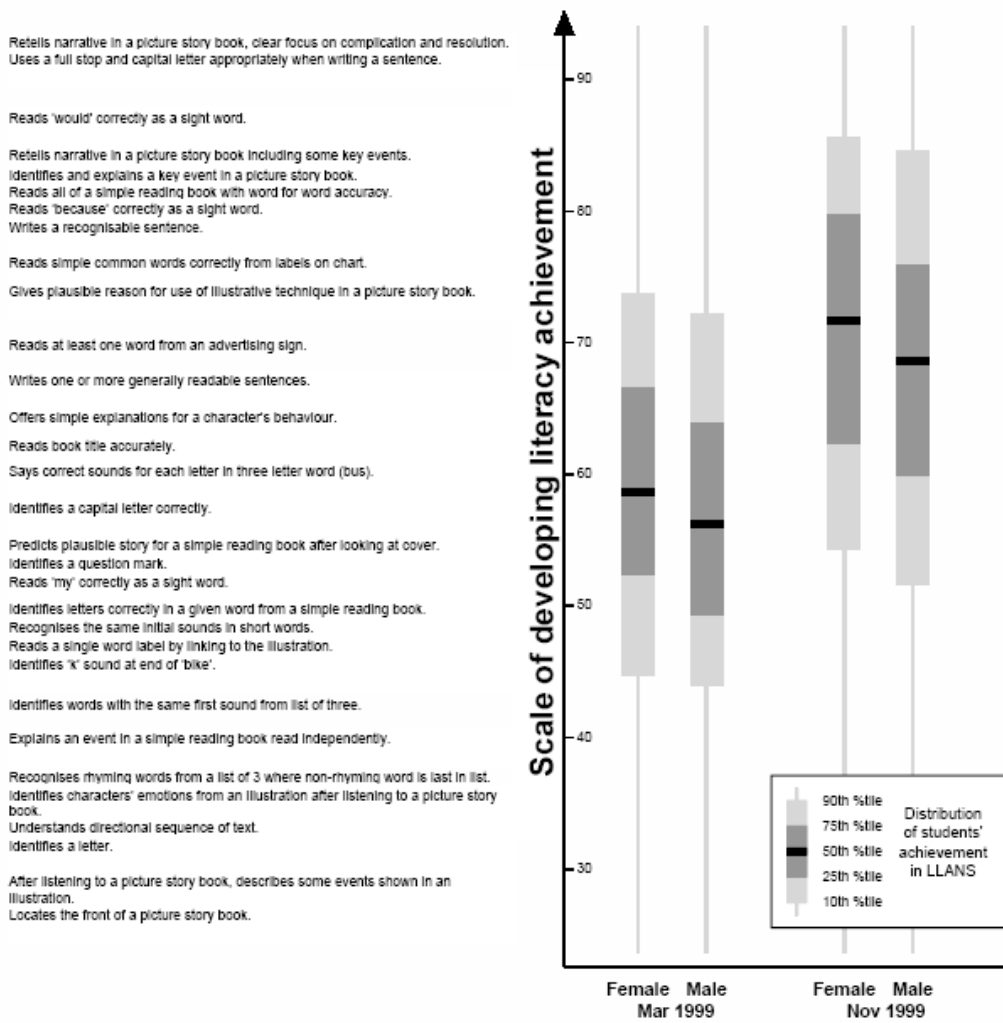


Figure 2: LLANS Scale description and achievement distributions

The achievement distributions of all students in the two surveys conducted in the first year of school are shown in Figure 2. The scale of developing literacy achievement shown in Figure 2 is based on data collected during the students' first year of school. The data from the two surveys was calibrated onto a single scale.

Descriptions of skills assessed in Surveys 1 and 2 are shown on the left of Figure 2. 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. These estimates have been empirically derived from the data.

The four shaded bands on the right hand side of Figure 2 show the distribution of performance of boys and girls in the whole cohort of students 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.

Growth in literacy achievement in the first year of school can be seen by comparing the position of the median scores for the cohort on the scale. A comparison of the bands showing the middle 80% shows 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 2 also shows the wide distribution of achievement across the whole cohort as measured against the literacy scale. Although all 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.

Figure 3 shows growth in the second year at school, for boys and girls. Growth in literacy achievement in the second year of school can be seen by comparing the position of the median scores for the cohort on the scale. A comparison of the bands showing the middle 80% shows that girls and boys in the cohort made progress in literacy achievement between March and November in their second year at school, in the aspects of literacy assessed in the surveys. This evidence shows that although all 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 it can be seen that there is a slight difference between the median scores for boys and girls. Overall, however, the bands that include the distribution of achievement for the middle 80% of boys and girls overlap, indicating that overall, there is little difference.

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 students in this cohort 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 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 second year of school, 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.



Longitudinal Literacy and Numeracy Study (LLANS)

SCALE DESCRIPTION AND ACHIEVEMENT DISTRIBUTIONS

Second Year of School

Controls a variety of simple and complex sentences in own writing.
 Spells 'basket' correctly.
 Writes a well connected piece showing recognisable structure, eg narrative, recount.

Writes simple sentences joined with simple conjunctions eg like, but, then.
 Controls selected content. Includes specific details in own writing.
 Writes several sentences, with consistent and accurate use of full stops and capital letters.
 Identifies key events in a story after listening to a picture story book.
 Uses and controls a variety of common punctuation.
 Correctly pronounces words that require blending of at least 3 syllables.
 Includes one or more complex sentences in own writing.
 Uses context to provide meaning for unfamiliar words in informational text, eg segments and blends to pronounce unfamiliar words correctly eg tactical.
 Reads simple reading book (repetitive structure, varied content) with word for word accuracy.
 Writes readable text, many words spelled correctly and errors are plausible.
 Identifies main idea and provides one or more details after listening to a story.
 Generalises about meaning of an image in the conclusion to a picture story book.

Writes a single sentence using an initial capital letter and final full stop.

Expresses more than one idea in own writing.
 Writes generally readable text, spelling plausible though many errors.
 Identifies words in quotation marks within a simple reading book, understands the purpose.
 Locates relevant information after hearing an information text read aloud.
 Locates specific information in a simple informative reading book read independently.
 Reads all or most of simple reading book with moderate accuracy.
 Listens to an informational text, and identifies specific information, but little detail.
 Manipulates sounds in words, eg takes out the b in bend - what word is left?
 Makes some errors in the construction of simple sentences.
 Manipulates sounds in words eg swaps c in camp with l to make lamp.
 Reads 2 to 3 pages of a simple reading book. Limited maintenance of meaning.
 Identifies main character and situation from looking at front cover of a simple reading book.

Spells initial sounds in common words correctly.
 Gives a literal interpretation of illustration from a picture story book.

Understands character's situation from text and pictures.

Makes a general comment about an illustration after listening to a picture story book.

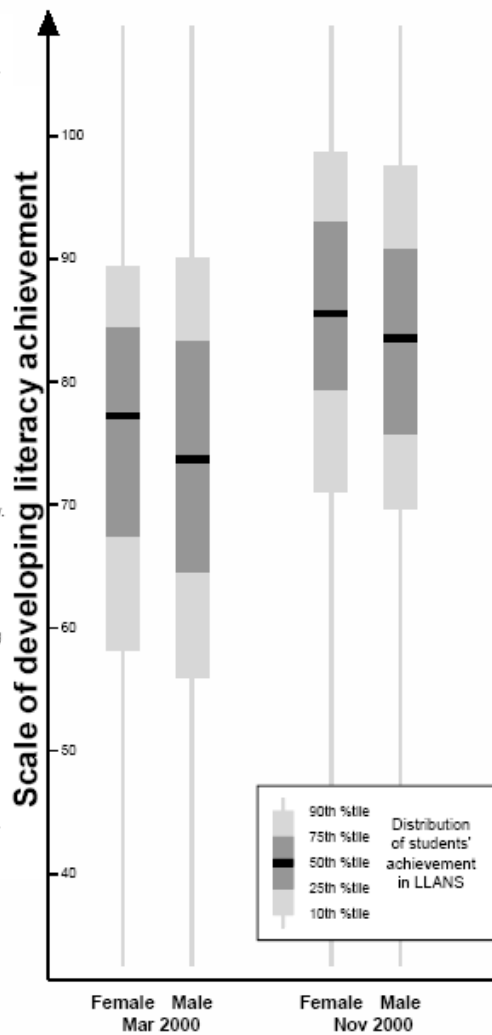


Figure 3: LLANS Scale description and achievement distributions

Figure 4 shows achievement distributions of all students in the five surveys conducted in the first three years of school.



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.

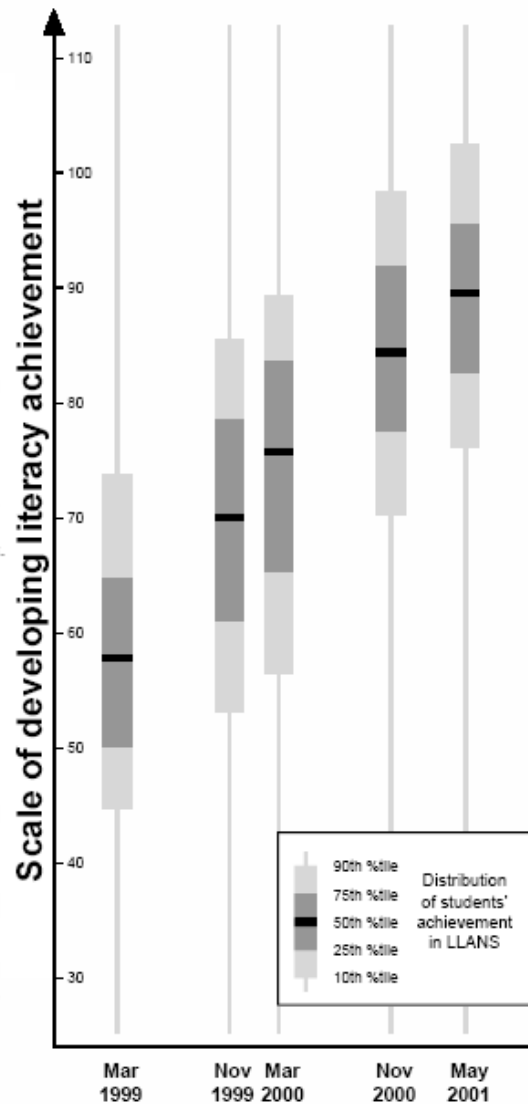


Figure 4: LLANS literacy scale description and achievement distributions for the first three years of school

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 to compare the growth trajectories of subgroups.

Figure 5 shows the individual progress map in literacy development for a child. Individual student performance in literacy was estimated for each assessment on the LLANS Literacy Scale. The performance of the child is shown against the overall performance distribution of the LLANS cohort. 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.



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.

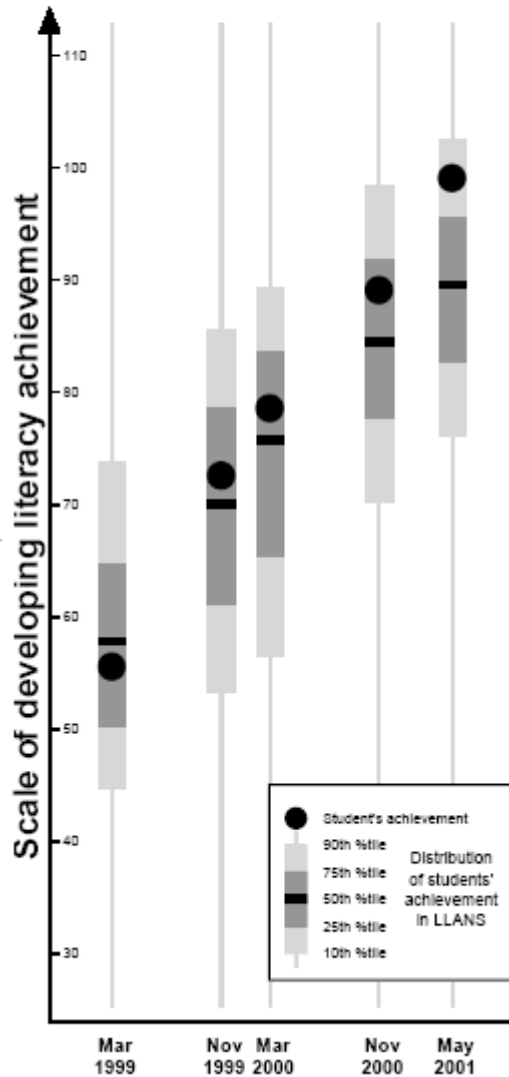


Figure 5: An Individual Literacy Progress Map

Key findings and further research

Analysis of the assessment data from the cohort of students in the LLANS project showed a wide distribution of literacy achievement at school entry and through the first three years of school. All students in the cohort made progress in literacy achievement over the first three years of school. A wide distribution of literacy 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.

The development of a linked set of literacy assessment instruments for the early years was a significant outcome of the first phase of the study. The focus of the literacy assessment tasks on key aspects of literacy learning in the early years of school has been a significant strength of the study. 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.

A major outcome of the longitudinal study has been the recognition of the potential value of the linked set of early years literacy assessment tasks in a variety of research contexts.

They have provided a model for two system-wide assessments of progress in the early years of schooling. These linked assessment tasks and the scale have also been used in other research studies to identify students' progress over time for the purposes of investigating the effectiveness of teaching approaches and interventions.

In two recent Australian research studies, analysis of growth in performance on the assessment tasks from the beginning to the end of the first and second school years was undertaken to provide an evidential link between student outcomes and teaching practices (Louden, Rohl et al, 2005; Louden, Rohl, & Hopkins, 2008).

The LLANS literacy assessment tasks and scale are now available for further research into literacy development.

Further reading

A full account of the first three years of the LLANS can be found in the ACER research monograph:

Meiers, M., Khoo, S.T., Rowe, K., Stephanou, A., Anderson, P., Nolan, K. (2006). *Growth in Literacy and Numeracy in the First Three Years of School*. ACER Research Monograph No. 61. Camberwell: Australian Council for Educational Research

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