Exploring Issues in Mathematics Education

An Evaluation of the Early Numeracy Project 2001

Gill Thomas and Jenny Ward
Dunedin College of Education: Te Kura Akau Taitoka

Acknowledgments
This evaluation was funded by the New Zealand Ministry of Education.

Sincerest thanks are extended to the students, teachers, principals and facilitators
who participated so willingly in the evaluation of the project.

Thanks also to Jenny Young-Loveridge, The University of Waikato, for peer reviewing the final draft.

The views expressed in this evaluation report do not necessarily represent the views of the
New Zealand Ministry of Education.

First published 2002 by the:

Ministry of Education
PO Box 1666
Wellington
New Zealand

ISBN 0-477-04777-7
Dewey number 372.707

Further copies may be ordered from Learning Media Customer Services, Box 3293, Wellington.
Freephone 0800 800 565, freefax 0800 800 570. Please quote item number 04777.

Authors: Dr Gill Thomas and Jenny Ward, Dunedin College of Education: Te Kura Akau Taitoka
Cover design: Base2
Photographs: Glenn Jowitt and Adrian Heke
Production: Learning Media Limited, PO Box 3293, Wellington, New Zealand.

Contents

Executive Summary

The Numeracy Development Project is positioned within the context of the Ministry of Education's Literacy and Numeracy strategy and reflects the key themes of that strategy: clarifying expectations, improving professional capability and involving the community. A feature of the Numeracy Development Project is its dynamic and evolutionary approach to implementation. The project continues to be informed by developing understandings about students learning of number and what constitutes effective professional development and effective facilitation.

The Numeracy Development Project 2001 consists of four projects, which span years 1 to 10 of schooling. They are the Early Numeracy Project, Continuing Support, the Advanced Numeracy Project and the Numeracy Exploratory Study. This report evaluates the impact of the 2001 Early Numeracy Project (ENP), which focused on students in the first three years of school and followed the successful implementation of the Count Me In Too (CMIT) pilot project in 2000. The ENP involved approximately 40 facilitators, 450 schools, 2000 teachers and 40,000 students.

The Number Framework forms the core of the ENP professional development programme by providing teachers with a knowledge of how students acquire number concepts, an increased understanding of how they can assist students make progress and an effective means to assess students' levels of thinking in number.

The ENP research addressed two main aims. The first was to examine the impact of the ENP on the participating facilitators, principals, teachers and students. The second was to investigate the practices of "effective" teachers of early number in 10 case-study classes.

Key Findings

- Students made significant progress against The Number Framework, regardless of gender, age, ethnicity, region or decile. This progress was greater than that expected to occur naturally over time.

- The size of the gains made was strongly linked to the students' starting points on The Number Framework. Students starting at the lower stages of the framework made greater gains, which suggests that the higher stages are "larger steps" for students to make.

- Although all students made similar gains, there were marked differences between subgroups of students, when their number profiles, expressed as stages on The Number Framework, were compared. The decile of the school and the ethnicity of the student were strongly related to the number profiles. There were larger proportions of students in high decile schools and students of Asian or New Zealand European descent at the higher stages of The Number Framework.

- The mean SEAL scores of students from schools that participated in the numeracy project for two years are slightly higher than those from schools that were only involved for one year regardless of age or ethnicity. Pacific Islands students had the greatest difference, with a mean SEAL score 0.37 of a stage higher in the schools that have participated for two years.

- The results suggest that the transition from early to advanced additive strategies is challenging and is one that a significant proportion of seven-year-olds are unable to make, irrespective of years of participation in the numeracy projects.

- A strong correlation exists between number knowledge and number strategy. Students who demonstrate more complex number strategies are almost without exception those who have a stronger understanding of numeral identification and number sequences.

- Participating teachers responded positively to the ENP, reporting increases in confidence and enthusiasm for teaching maths. Teachers also noted increased enjoyment of maths as a subject.

- Teachers reported increases in their maths content and pedagogical knowledge, with the key development being an increased understanding of The Number Framework. Teachers changed their classroom programmes to accommodate their new knowledge in a wide variety of ways, increasing their focus on students' development of number strategies and knowledge, utilising more effective grouping and using equipment more appropriately.

- The professional development programme was very well received, with the most helpful element found to be in-class modelling by the facilitator and the least helpful elements identified as the requirement to produce a large number of resources and the layout and size of the resource folder.

- The majority of CMIT schools involved in the ENP believed they had been able to sustain the developments that occurred as a result of their involvement in the CMIT project in 2000, noting teacher interest and enthusiasm and the implementation of the Advanced Numeracy Project (ANP) as crucial to sustaining developments. The ANP was seen as having school-wide benefits, namely a more unified, consistent and collaborative approach, which helped to ensure continuity.

- Principals and teachers in CMIT schools involved in the ENP generally believed that their students' achievement in number continued to improve.

- Two types of classroom interaction were identified as central to the effective teaching of early number. These involved teachers asking students to explain their thinking, and waiting for them to do so, and the use of questioning and explanations of other students to help students' progress in their thinking.

- The common planning practices underlying the effective teaching of early number included: clearly defining objective(s) for each teaching session, focusing learning, selecting an appropriate learning activity and posing questions to students. These objectives were made explicit to the students.

Chapter One: Background to the Project

Introduction

This report evaluates the impact of the Early Numeracy Project (ENP) on the participating facilitators, principals, teachers and students. It also reports on case studies of a sample of teachers whose students had made effective learning gains in number during the Count Me In Too (CMIT) pilot project in 2000.

> *The world-wide focus on numeracy has highlighted the importance of high-quality mathematics programmes, which emphasise both numerical knowledge and advanced mental strategies. (*Ministry of Education, 2001c*)*

This statement by the New Zealand Secretary for Education and the revised National Administration Guideline (NAG 1i(b)), which states that schools are required to develop programmes to give "priority to student achievement in literacy and numeracy, especially in years 1–4", provide a strong rationale for the current project.

The ENP sits within the framework of the Numeracy Development Project, part of the Ministry of Education's Literacy and Numeracy Strategy[1] that began development in 1998. The strategy has three key themes: clarifying expectations about learners' achievements, developing professional capability and developing community capability. The ENP fits within the former two of these themes.

In addition to the ENP, the Numeracy Development Project includes projects at other levels of the Curriculum: Continuing Support (years 1–3), the Advanced Numeracy Project (years 4–6) and the Numeracy Exploratory Study (years 7–10). In total, these projects involve approximately 3350 teachers, 2000 of these being participants in the ENP and the remainder being involved in the other smaller projects.

The ENP builds on the success of the Count Me In Too (CMIT) pilot project, which was implemented in 2000. The following sections in this chapter seek to give a background to the ENP by looking into the research basis for these numeracy projects, identifying the major findings from the CMIT evaluation and describing how the ENP has evolved from the CMIT pilot project.

Models of Early Number Learning

Research into children's understanding of number over the last decade suggests that there are identifiable progressions in how children develop number concepts (Carpenter et al, 1999; Clarke and Cheeseman, 2000; Cobb et al, 1997; Fuson et al, 1997; Jones et al, 1996; Steffe,

[1] For information about the Literacy and Numeracy Strategy visit Te Kete Ipurangi – The Online Learning Centre [www.tki.org.nz/e/literacy].

1992; Wright, 1998; Young-Loveridge, 1999). These progressions have led to the development of models, or frameworks, of early number development that provide useful pedagogical frameworks for teachers. This is based on the assumption that if a teacher can identify where a student is on a framework, and can then identify the next step for the student, then teaching should be more effective.

The Piagetian notion that there is a sequence of mutually exclusive stages to learning underpins some of the number frameworks proposed in the literature (for example, Steffe, 1992), while other frameworks suggest a more flexible and non-hierarchical development of mathematical thinking (for example, Carpenter et al, 1999; Clarke and Cheeseman, 2000). There are many similarities and interrelationships in the frameworks developed, with most addressing the key concepts of counting, number sequencing, numeral identification, place value, grouping and partitioning. While there is debate about the finer details of the key concepts, it is generally accepted that there are two broad areas of understanding (Ministry of Education, 2001b). One is based on a unitary, or "by ones", concept of number and counting strategies, while the other is based on multi-unit, or composite-unit, understanding of number and partitioning strategies.

Professional Development and Effective Teaching Practices

In light of the view that professional development programmes can improve outcomes for students, much work has gone into identifying key elements of effective programmes (for example, Clarke and Cheeseman, 2000; Fullan and Hargreaves, 1992; Stephens, 2000). In a review that links professional development programmes with improved teacher capability, Parsons (2001) identifies the following as characteristics of quality programmes:

- *the systematic identification of needs*
- *a focus on the real world of the classroom, that is, the dynamic of the learner, content knowledge, assessment and pedagogy*
- *links to the gathering, analysis and use of high quality assessment data and school development initiatives*
- *opportunities for modelling, observation, coaching, critique and reflection, and the use of action research approaches*
- *a school based approach over time that fosters collaboration and collegial support*
- *effective facilitation, and ongoing guidance and support from within and outside the school*
- *the involvement and commitment of school leadership*
- *connection with the school and wider community*
- *rigorous evaluation based on both quantitative and qualitative data, which provides evidence of the impact of professional development on student achievement, teachers' knowledge, beliefs and expectation* (page 15)

These findings are in line with the current professional development policies of the Ministry of Education and can be seen in the professional development models, which underpin the Numeracy Development Project.

Parallel to the work involved in identifying key factors of effective professional development programmes is a body of research that aims to identify the teaching practices of effective teachers of numeracy. An important project in this area was conducted by King's College London (Askew et al, 1997). It explored the knowledge and beliefs that underpinned the practices of effective teachers and found that what distinguished highly effective teachers from

other teachers was a set of beliefs that were the basis of a particular series of classroom practices. These concerned what it means to be numerate, the relationship between teaching and students' learning of numeracy and which presentation and intervention strategies are effective. In addition to a well-developed set of beliefs, the "highly effective teachers of numeracy themselves had knowledge and awareness of conceptual connections between the areas which they taught in the primary mathematics curriculum" (Askew et al, 1997, page 3).

Further to this work, the team at King's College is now involved in the Leverhulme Numeracy Research Programme, aimed at developing understanding of the causes of underachievement in numeracy to help raise standards. This project spans five years and includes a large-scale core project and five smaller-scale focus projects. It is due to finish late 2002. Although the project is incomplete, initial findings indicate that classroom observation of teacher practices alone is insufficient to predict student achievement. A simple framework is being developed to help predict student achievement based on the relationships between teachers and maths, teachers and students and students and maths.

Count Me In Too Pilot Project 2000

Count Me In Too (CMIT) was introduced in New Zealand in 1999 as part of a centrally funded professional development contract delivered by the Auckland College of Education. The contract incorporated frameworks of number from the original CMIT programme, which was a major school-based and systemic initiative of the New South Wales Department of Education and Training. Understanding was also gained from the Mathematics Recovery Programme (Wright et al, 1996), which itself draws heavily on the work of Les Steffe and others at the University of Georgia (Steffe and Cobb, 1988). The success of the Auckland contract and the response to CMIT presentations at a mathematics advisers hui in 1999 led to the pilot project in 2000. Important aspects of this pilot project were the Learning Framework for Number and the Schedule for Early Number Assessment.

Results from the CMIT pilot project were impressive (Ministry of Education, 2001a). Student number knowledge development was evaluated using the Learning Framework for Number, with clear and positive growth observed in the five aspects of number assessed, irrespective of age, region, decile or ethnicity. Although all students made similar gains, there were marked differences between the subgroups when their profiles, expressed as stages on the Learning Framework for Number, were compared. The number profiles of students were higher in higher decile schools or when students were of New Zealand European or Asian descent.

Participating teachers reported developments in their professional knowledge as a result of their involvement in the project and changed their classroom practices to accommodate their new knowledge and understandings. They were overwhelmingly positive about the project, citing increases in their enthusiasm and confidence in teaching mathematics. It was regarded as an excellent professional development initiative and received positive response from principals, facilitators and parents.

Based on the success of CMIT, the ENP developed in a number of ways. The Learning Framework for Number and the diagnostic assessment tool were reviewed and updated. (See Description of the Early Numeracy Project Assessment below for more details on this diagnostic assessment tool.) Draft teacher resource folders and videos were developed, and the ENP professional development programme, a key feature of the project's implementation, was reviewed and refined.

Description of The Number Framework

The Number Framework used in the ENP 2001 was developed from the Learning Framework for Number, used in the CMIT pilot project. The Number Framework forms the core of the ENP professional development project by providing teachers with:

- *an effective means to assess students' current levels of thinking in number;*
- *guidance for instruction;*
- *knowledge of how children acquire number concepts and an increased understanding of how they can assist children to progress.* (Ministry of Education, 2001c)

The Number Framework contains two main sections: strategy and knowledge. The strategy section looks at how students solve number problems, focusing on the mental processes they employ. Seven different strategy stages are described, with increasing levels of sophistication. The seven stages fit within two broader bands: counting and part-whole strategies.

The knowledge section outlines the key items of knowledge students need to acquire and has been categorised under four content domains:

- numeral identification
- number sequence and order
- grouping/place value and basic facts
- written recording.

The two sections of strategy and knowledge are seen as dependent on one another, with students needing to make progress in both areas simultaneously.

For a more detailed description of The Number Framework see Appendix A.

Description of the Early Numeracy Project Assessment

The Early Numeracy Project Assessment (ENPA) is a diagnostic tool designed to give teachers quality information about the knowledge and mental strategies of their students, as aligned to The Number Framework.

Individual interviews are conducted with the role of the teacher being to elicit a student's most sophisticated strategy and then determine where each of the student's responses is categorised within The Number Framework. The ENPA tool enables the teacher to develop a number profile for each student. This profile has five components:

- The Stages of Early Arithmetic Learning (SEAL) (This relates to the student's level of sophistication in counting and other strategies to solve addition and subtraction problems.)
- Facility with forward number word sequences (FNWS)
- Facility with backward number word sequences (BNWS)
- Ability to identify numerals (NID)
- Understanding of the place value nature of the number system (BTS).

Having teachers assess and monitor the development of students through the ENPA interviews is an integral component of the ENP. Teachers use the initial and subsequent assessment to

make decisions regarding learning experiences necessary for individual students and groups of students, in order to help them to advance through the stages and levels of The Number Framework.

A copy of the ENPA interview is included as Appendix B.

Overview of the Early Numeracy Project Professional Development Programme

While the majority of the ENP was school and syndicate based, the participating teachers were grouped in clusters for the purposes of the after-school professional development programme. Each full-time facilitator worked with approximately 100 teachers, tailoring the series of after-school professional development workshops and in-class visits to meet the needs of individual schools and teachers. Although there was variability in the way the workshops were delivered by the facilitators, they generally followed a similar sequence:

- Workshop 1: Introduction to The Number Framework and the Numeracy Development Project
- Workshop 2: Introduction to and use of the ENPA
- Workshop 3: Review of ENPA videotapes to clarify diagnostic issues
- Workshop 4: Planning and resources
- Workshop 5: Feedback, project evaluation and looking forward.

Teachers within each participating school were expected to work co-operatively as a team within their established syndicate groupings. Teachers from small schools were expected to work collaboratively in a cluster group to develop collegial support structures. In every school, the principal was expected to demonstrate a personal commitment to the project by offering support to teachers involved by providing appropriate resourcing and by regularly reporting to the Board of Trustees and the local community.

The delivery of the programme involved participating teachers assessing all of their students on two occasions at least fifteen weeks apart. Acknowledging that change takes time, teachers needed to ensure that sufficient time was allocated in the mathematics programme to allow for a focus on the development of the students' number concepts and skills. Schools participated in the programme in two phases. The first phase schools participated during Terms 1 to 3, while the second phase schools participated during Terms 2 to 4. The timeline for the 2001 programme is summarised in the following table.

Project Timeline	
December 2000	Facilitator training session one (three days)
February 2001	Facilitator training session two (three days)
Term 1 – Term 3	Phase One Schools • workshops 1–2 • initial ENPA completed by April 23 • workshop 3–4 • three to five in-class visits by facilitators • workshop 5 • final ENPA completed by October 12.
Term 2 – Term 4	Phase Two Schools • workshops 1–2 • initial ENPA completed by July 20 • workshop 3–4 • three to five in-class visits by facilitators • workshop 5 • final ENPA assessment completed by November 30.

Chapter Two: Methodology

Aims of the Early Numeracy Project Evaluation

The research evaluation of the ENP had two main aims. The first was to examine the impact of the ENP on the participating facilitators, principals, teachers and students. The second was to investigate the practices of "effective" teachers of early number in 10 case-study classes.

The first component of the evaluation focused on the effectiveness of the facilitators' training programme and the impact of the ENP on the professional knowledge of the facilitators. The evaluation was designed to address the following questions:

1 Does the ENP have an impact on the facilitators' professional knowledge? If so, what impact?
2 Is the training programme for facilitators effective? If so, in what ways? If not, what should be changed?

The second component of the evaluation focused on the impact of the ENP on the professional knowledge of the participating teachers. In addition to relying on teachers' self-reports of change to their knowledge and practices, the evaluation examined the knowledge and practices of 10 teachers. More specifically, it addressed the following questions:

3 Does the ENP have an impact on teachers' professional knowledge? If so, what form does this impact take?
4 What experiences and factors do teachers report as influencing any impacts?
5 Do teachers perceive that changes in their professional knowledge have an impact on their classroom practices? If so, how?
6 What characterises "effective" teaching of early number?

The third, and arguably most important, component of the evaluation examined the impact of ENP on the numerical development of participating students. It examined the following questions:

7 What progress do students make on The Number Framework?
8 Is progress linked to gender, age, ethnicity, region or school decile level?
9 Is achievement on The Number Framework linked to gender, age, ethnicity, region or school decile level?
10 Is achievement on The Number Framework linked to participation in the 2000 CMIT pilot project?

In addition to examining the ENP results of all students, a group of students from each of the case-study classes were interviewed about their classroom experiences.

Design and Methodology

The evaluation had three approaches. The first approach involved collecting data from all students and facilitators and from a random sample of participating teachers and principals. The second was a case-study approach involving 10 teachers and 60 of their students. The third

approach involved assessing the students, teachers and principals from 22 schools randomly selected from those who had participated in the CMIT pilot project in 2000.

Approach One: All Early Numeracy Project Participants

The research evaluation of ENP in 2001 involved all of the schools that had been accepted into the ENP project through a School Support Services contract offered on behalf of the Ministry of Education. This included approximately 40 facilitators, 2000 teachers, 450 principals and 40,000 students. All of the teachers with year 1–3 students from each participating school were obliged to participate.

The training programme for 23 "new" facilitators included participating in three training days in December 2000, three training days in February 2001 as well as two further regional training days during that year. The remaining 17 facilitators had participated in the CMIT pilot project and completed the Advanced Numeracy Project (ANP) training in December 2000 and February 2001. The 23 new facilitators were asked to complete two questionnaires designed to give feedback on their perception of the effectiveness of the ENP training programme and the project generally. The first questionnaire was distributed at the conclusion of the second ENP training meeting in February. The second questionnaire was sent to the 23 "new" facilitators at the conclusion of the project. Both questionnaires were completed anonymously and returned to the researcher by mail to maintain the participants' confidentiality. Summaries of all project questionnaires are included as Appendix C.

Questionnaires were sent to the teachers and principals in 50 randomly selected schools in September 2001. The questionnaires were designed to collect relevant demographic and biographical details about participants and to elicit their perceptions about the programme's effectiveness.

All students in the classes of the participating teachers were assessed twice using the ENPA tool, initially at the completion of the teachers' training programme and then after 15–20 weeks of being involved in the teaching programme that followed the initial ENPA. The participating teachers were required to submit the results of both the initial and final ENPA. The results were submitted electronically using a secure website. In addition to the results of the ENPA, the following personal information was collected about each student: gender, date of birth and ethnicity. The date of birth datum was used to calculate the age of each student as at 1 May 2001. As the students were linked to schools, their performance could also be reported with respect to region and decile. For the purposes of this report, the deciles have been grouped into three bands. Deciles one to three form the low decile band, deciles four to seven form the medium decile band and deciles eight to ten form the high decile band.

This report examines the results of 15,037 students in Phase One schools. These are the schools that participated in the ENP during terms 1–3 and had submitted final ENPA results by 12 October 2001. Phase Two schools participated in terms 2–4 and did not submit final ENPA results until 30 November 2001. Tables 2.1 and 2.3 illustrate the biographic and demographic profiles of the students in the Phase One schools, which form the sample of students for this report. Table 2.3 reports on the spread of the students according to region. The regions are defined by the branch of School Support Services that was responsible for the delivery of the ENP professional development under contract to the Ministry of Education.

Table 2.1: Profile of ENP students by age and gender

	Age (in yrs)				
	5	6	7	8	Total
Female	14% (2161)	17% (2489)	15% (2207)	2% (338)	48% (7195)
Male	15% (2330)	18% (2677)	16% (2442)	3% (393)	52% (7842)
Total	30% (4491)	34% (5166)	31% (4649)	5% (731)	100% (15037)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table 2.2: Profile of ENP students by ethnicity and school decile

	Ethnicity					
Decile	Asian	NZ European	Māori	Other	Pacific Islands	Total
Low	1% (153)	12% (1751)	11% (1631)	1% (169)	7% (1117)	32% (4821)
Medium	1% (146)	32% (4879)	8% (1183)	1% (126)	1% (191)	43% (6525)
High	1% (176)	21% (3111)	2% (230)	1% (127)	0% (47)	25% (3691)
Total	3% (475)	65% (9741)	20% (3044)	3% (422)	9% (1355)	100% (15037)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table 2.3: Profile of ENP students by region

Region	
Auckland	34% (5085)
Christchurch	21% (3122)
Dunedin	14% (2094)
Massey	7% (1014)
Waikato	14% (2134)
Wellington	11% (1588)
Total	100% (15037)

Note: Percentages have been rounded to the nearest whole number where necessary.

Approach Two: Effective Teachers of Early Number

The case-study approach was intended to provide information on how students are taught in the transition from counting to part-whole strategies. The case-study teachers were selected from teachers who, in the 2000 CMIT pilot project, had demonstrated that they were effective in terms of being able to "move" students from counting to part-whole strategies. For logistical reasons, the case-study teachers were selected from three cities only. A list was compiled of teachers in these cities who, during the 2000 pilot project, had at least six students make the transition from counting to part-whole strategies. The facilitators who worked with these teachers in 2000 were shown the list and asked to comment on the teachers in terms of their effectiveness. This led to the removal of six teachers from the largest list (city C) and two from the city A list. All other teachers were considered by the facilitators to be worthy of inclusion. Three of the remaining 10 teachers from city A and three of the eight teachers from city B were randomly selected and invited to participate. The 30 teachers in city C were grouped into seven geographical clusters and then one of these clusters of four teachers was randomly selected.

The case-study research involved three visits to each teacher. The first visit gathered relevant biographical details to allow a contextual story to be constructed for each case study. It included questions related to each teacher's perception and expectation of ENP, their philosophies of teaching and learning mathematics and the knowledge they have that enables them to teach number "effectively". The outlines for each of the visits are included as Appendix D. The remaining two visits involved classroom-based observations and follow-up interviews with both the teacher and targeted group of students. The focus for each of the interviews was a video-replay of the teaching session that had just been conducted.

Approach Three: Count Me In Too Follow-up

Twenty-five of the 80 schools that participated in the CMIT pilot project were invited to participate in a follow-up study. Twenty-two schools accepted the invitation. These schools were all provided with the same material as ENP participants and were invited to attend meetings with the ANP project, which was operating in 2001.

Questionnaires were sent to the principals and teachers of year 1–3 students from these schools. The questionnaires were designed to collect relevant demographic and biographical details about participants and to elicit perceptions about the project's effectiveness in the second year of its implementation. The schools were also asked to submit the "strategy" stage, as assessed on the ENPA, for each of their year 1–3 students to the project website by 12 October. Tables 2.4 to 2.6 illustrate the biographic and demographic profiles of the students in the Phase One schools that formed the sample of students for this report.

Table 2.4: Profile of CMIT students by age and gender

	Age				
	5	6	7	8	Total
Female	17% (298)	15% (261)	14% (236)	1% (18)	47% (813)
Male	20% (353)	17% (303)	15% (262)	1% (10)	53% (928)
Total	37% (651)	32% (564)	29% (498)	2% (28)	100% (1741)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table 2.5: Profile of CMIT students by ethnicity and school decile

	Ethnicity					Total
Decile	Asian	European	Māori	Other	Pacific Islands	
Low	9	176	126	8	42	361
	3%	49%	35%	2%	12%	100.0%
Medium	10	677	101	23	16	827
	1%	82%	12%	3%	2%	100.0%
High	46	443	36	14	14	553
	8%	80%	7%	3%	3%	100.%
Total	65	1296	263	45	72	1741
	4%	74 %	15%	3%	4%	100.0%

Note: Percentages have been rounded to the nearest whole number where necessary.

Table 2.6: Profile of CMIT students by region

Region	
Auckland	26% (449)
Christchurch	24% (421)
Dunedin	4% (70)
Massey	3% (46)
Waikato	17% (302)
Wellington	26% (453)
Total	100% (1741)

Note: Percentages have been rounded to the nearest whole number where necessary.

Chapter Three: Student Results

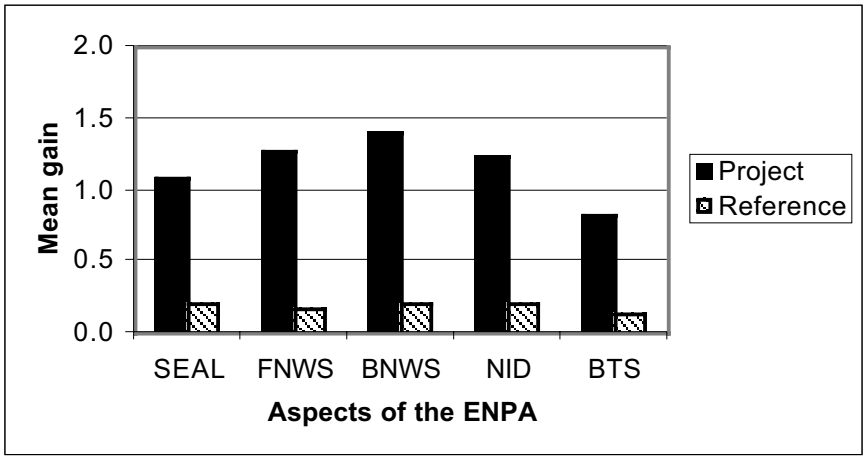
A significant aim of the ENP evaluation was to examine the achievements and progress of the students in relation to The Number Framework. As outlined in Chapter One, the students were assessed on five aspects of number: SEAL, FNWS, BNWS, NID and BTS. In this chapter, the student results are discussed in five sections. The first section presents an overview of the findings in terms of mean gains. This will help orient the reader for the more detailed analysis in the following sections. The second section examines the progress of students in relation to the variables of gender, age, ethnicity, school region and school decile. The gains analysis reported in these first two sections assumes that the stages of The Number Framework can be treated as being on an interval scale. This assumption is critically examined in the third section of this chapter, which focuses on the Stages of Early Arithmetic Learning (SEAL) and looks at the progress of students with reference to their starting points on The Number Framework. The fourth section explores the relationships that exist between the strategy and knowledge aspects of The Number Framework. The final section investigates the achievement of students from a sample of schools who participated in the CMIT pilot project and addresses issues of sustainability of project benefits over the longer term.

As data are reported on approximately 15000 students, there are large numbers in each sample, even when they are analysed by subgroups according to biographic and demographic variables. Sample size raises issues related to practical versus statistical significance on the reporting of results. With such large samples, even the smallest differences can be statistically significant. For example, a difference of 0.1 in the mean gain of two subgroups is significant at the 0.001 level. While the 0.1 difference is statistically significant, a difference of one-tenth of a stage on The Number Framework is not meaningful in any practical sense. Therefore, throughout this chapter, results are reported in terms of the practical significance of any observed differences in groups. A practical difference is considered to be any difference greater than 0.2 of a stage.

Overview of the Findings

Student progress on The Number Framework has been impressive. There was strong positive growth in the five aspects of number learning assessed, irrespective of the students' gender, age, ethnicity or the school's region or decile. This improvement in number learning appears to be the direct result of participation in the ENP project as the gains are greater than those expected to occur naturally over time. Students who were assessed as being at the top stage of a particular aspect assessed at the initial ENPA have been excluded from the gains analysis as it was not possible for them to make any further gains in that area.

Figure 3.1: Mean gains by all students



Overall, the trend was for students to make gains of approximately one stage on each of the five aspects assessed (Figure 3.1). With the exception of Base Ten strategies, which had a mean gain of 0.8 of a stage, the mean gains for the aspects assessed all lay between 1.1 and 1.4 stages.

Although there was no assigned reference or control group, the profile of students at the start of the project provides a degree of control for comparing against the profile of the students of the same age at the end of the project. Figure 3.1 compares the growth that occurred, in each aspect, over the six-month duration of the project with the growth that would have been expected to occur naturally over time. The first bar for each aspect shows the mean gains made over the project. The second bar represents the reference group and illustrates the gains that would have been expected by students over a six-month period prior to the implementation of the ENP. As is clearly shown, the gains made on each aspect of number learning during the project exceeded the gains that would have been expected in the students' previous classroom programmes by between 0.7 and 1.2 stages.

Table 3.1 shows that while the highest proportion of students made gains of one stage, the gains ranged from zero[2] to four stages.

[2] It needs to be noted that the project website effectively restricted students from "regressing" between ENP assessments. This restriction was intended to alert teachers to incorrect data entries for students at the final assessment. Four schools contacted the researcher asking for lower final results to be entered for a number of their students. In all but three cases, the "regression" was considered to be the result of an inaccurate initial assessment, which was subsequently amended. The researcher entered a lower final score for the three students who had regressed.

Table 3.1: Number of stages gained

	Number of stages gained						
	0	1	2	3	4	5	6
SEAL	30%	41%	22%	6%	1%	0%	0%
FNWS	15%	51%	27%	7%	0%	-	-
BNWS	15%	42%	33%	9%	1%	-	-
NID	18%	50%	24%	8%	0%	-	-
BTS	44%	34%	18%	4%	0%	-	-

The pattern of gains is similar to that found in the CMIT pilot project, although a direct comparison of gains is hampered by the different number frameworks used in the two projects.

The Progress of Students within Subgroups

Of particular interest throughout the evaluation was the impact that the project would have on the achievement of Māori and Pacific Islands students. The gains according to ethnicity are clustered around 1 across all components of The Number Framework and support the notion that the ENP project is effective in raising the achievement of all students (Table 3.2). The only gains that differed by more than 0.2 of a stage were between Asian and Māori students on the FNWS. Differences of more than 0.2 of a stage are indicated by asterisks in the following tables. The greatest total gains were made in the BNWS (1.39) and the smallest in the BTS (0.82).

Table 3.2: Mean stage gains by ethnicity

	Mean gains				
Ethnicity	SEAL	FNWS	BNWS	NID	BTS
Asian	1.09	1.46*	1.55	1.28	0.88
Māori	1.06	1.24*	1.39	1.25	0.83
NZ European	1.10	1.26	1.39	1.20	0.80
Pacific Islands	1.07	1.31	1.39	1.28	0.86
Other	1.09	1.27	1.39	1.26	0.80
Total	1.09	1.27	1.39	1.22	0.82

* differences in gains greater than 0.2 of a stage

The gender and age of the student appeared to have no impact on the effectiveness of the project. Table 3.3 illustrates that very similar gains were made by boys and girls on the five aspects of number that were assessed.

Table 3.3: Mean stage gains by gender

	Mean gains				
	SEAL	FNWS	BNWS	NID	BTS
Female	1.08	1.24	1.37	1.18	0.79
Male	1.09	1.29	1.41	1.27	0.84
Total	1.09	1.27	1.39	1.22	0.82

Table 3.4 indicates that the five- and six-year-olds made slightly greater gains than the older students, which may reflect the different "size" of the stages in the framework. The notion of different-sized stages is explored in greater detail in the third section of this chapter.

Table 3.4: Mean stage gains by age

Age (in yrs)	Mean gains				
	SEAL	FNWS	BNWS	NID	BTS
5	1.15*	1.31	1.45	1.31*	0.88
6	1.17	1.24	1.37	1.20	0.84
7	0.97	1.21	1.32	1.10*	0.74
8	0.82*	1.27	1.36	1.16	0.72
Total	1.09	1.27	1.39	1.22	0.82

* differences in gains greater than 0.2 of a stage

The ENP was implemented throughout New Zealand by approximately 40 facilitators working for the six School Support Services who had contracts with the Ministry of Education to deliver the project to schools in their regions. Apart from the two exceptions asterisked in Table 3.5, the gains between regions were separated by less than 0.2 of a stage, which represents little difference in practical terms.

Table 3.5: Mean stage gains by school region

Region	Mean gains				
	SEAL	FNWS	BNWS	NID	BTS
Auckland	1.09	1.30	1.38	1.23	0.80
Waikato	0.98*	1.25	1.43	1.19	0.74*
Massey	1.01	1.32	1.30	1.23	0.79*
Wellington	1.18	1.29	1.44	1.37	1.00*
Christchurch	1.06	1.18	1.36	1.18	0.81
Dunedin	1.20*	1.31	1.46	1.21	0.81
Total	1.09	1.27	1.39	1.22	0.82

* differences in gains greater than 0.2 of a stage

Table 3.6 provides a summary of the mean gains made by decile. There was a high degree of similarity in the mean gains made by students in each of the decile bands with no more than 0.11 of a stage separating the gains in each aspect.

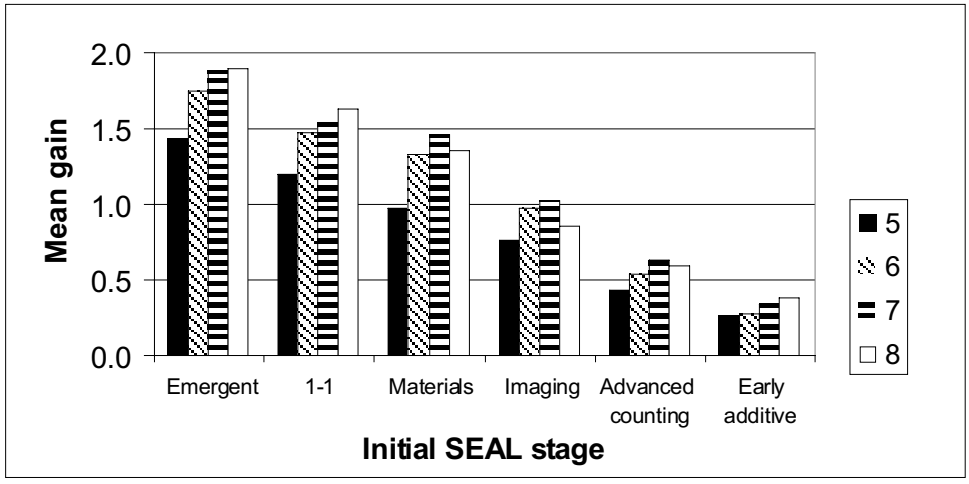
Table 3.6: Mean gains by school decile

Decile	Mean gains				
	SEAL	FNWS	BNWS	NID	BTS
High	1.04	1.25	1.37	1.25	0.85
Medium	1.09	1.27	1.38	1.20	0.78
Low	1.15	1.30	1.45	1.24	0.82
Total	1.09	1.27	1.39	1.22	0.82

Number Strategies

The Stages of Early Arithmetic Learning (SEAL) are central to The Number Framework. These are the strategies or mental processes that students use to solve number problems. The seven strategies assessed by the ENPA can be broadly grouped into two categories: counting strategies and part-whole strategies. Counting strategies include the first five stages: emergent, one-to-one counting, counting from one on materials, counting from one by imaging, and advanced counting. The part-whole strategies include the two stages of early additive and advanced additive. A full description of these stages is included in Appendix A. The first part of this section investigates the notion that the SEAL stages are of different sizes and therefore the gains made by students will depend on their starting points. Figure 3.2 links the mean gains made on the SEAL to the initial SEAL stage of students. As clearly illustrated, the gains are greatest for the lower SEAL stages, which suggests that these stages are indeed "smaller" or easier to progress through. Students assessed as emergent at the initial assessment made mean gains of 1.56 stages, compared to 0.33 for students assessed initially as being at the early additive stage. It is interesting to note that older students make greater gains than younger students regardless of their starting stage.

Figure 3.2: Mean gains on the SEAL linked to initial stage and age



The remainder of this section examines the progress that students made on the SEAL and has a particular focus on the percentage of students in each subgroup who made the transition from counting to part-whole strategies. This transition has been identified by researchers and educators as being critical to success in mathematics (Clarke and Cheeseman, 2000; Wright, 1998; Young-Loveridge, 1999).

Table 3.7 illustrates the percentages of students by age at each stage of the SEAL at the initial and final assessments. The percentages of students using part-whole strategies (early and advanced additive) are shaded. At the time of the initial interview, 7% of the students were part-whole in their use of number strategies. By the end of the project, this had increased to 23% and, as could be expected, the majority of these students were the seven- and eight-year-olds. Correspondingly, the percentage of students who were assessed as emergent had decreased from 14% to 2% over the duration of the project.

Table 3.7: Percentage of students by age on the SEAL

Age (in yrs)		SEAL stage						
		Emergent	One-to-one	Materials	Imaging	Advanced counting	Early additive	Advanced additive
5	Initial	29% (1302)	38% (1691)	21% (963)	7% (300)	4% (197)	1% (35)	0% (3)
	Final	5% (246)	16% (725)	40% (1788)	18% (808)	16% (724)	4% (175)	1% (25)
6	Initial	11% (547)	21% (1068)	33% (1694)	14% (703)	19% (974)	3% (152)	1% (28)
	Final	2% (81)	5% (261)	22% (1148)	19% (981)	33% (1708)	16% (828)	3% (159)
7	Initial	4% (165)	7% (325)	23% (1076)	16% (740)	37% (1726)	11% (531)	2% (86)
	Final	0% (22)	2% (86)	9% (414)	13% (596)	34% (1565)	34% (1575)	8% (391)
8	Initial	2% (18)	6% (46)	16% (120)	16% (114)	39% (286)	17% (125)	3% (22)
	Final	1% (4)	1% (9)	7% (50)	13% (98)	32% (232)	34% (246)	13% (92)
Total	Initial	14% (2032)	21% (3130)	26% (3853)	12% (1857)	21% (3183)	6% (843)	1% (139)
	Final	2% (353)	7% (1081)	23% (3400)	17% (2483)	28% (4229)	19% (2824)	4% (667)

Note: Percentages have been rounded to the nearest whole number where necessary.

Figure 3.3 presents the initial and final breakdown of SEAL scores as a cumulative frequency distribution and clearly shows a decrease in the percentage of students at the lower stages and a corresponding increase in those at the higher stages.

Figure 3.3: Percentage of students at each SEAL stage by project status

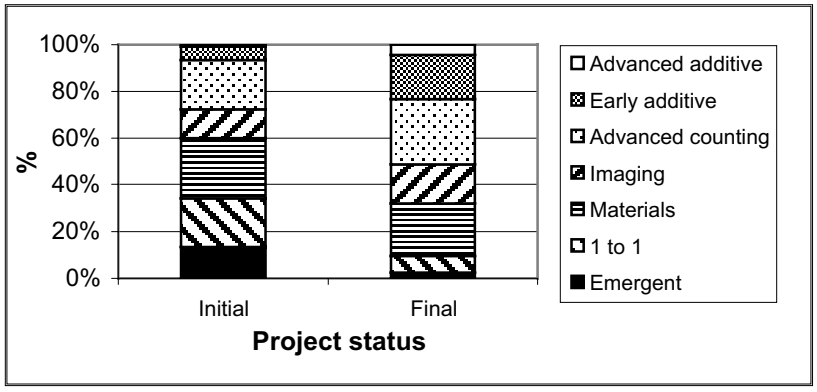
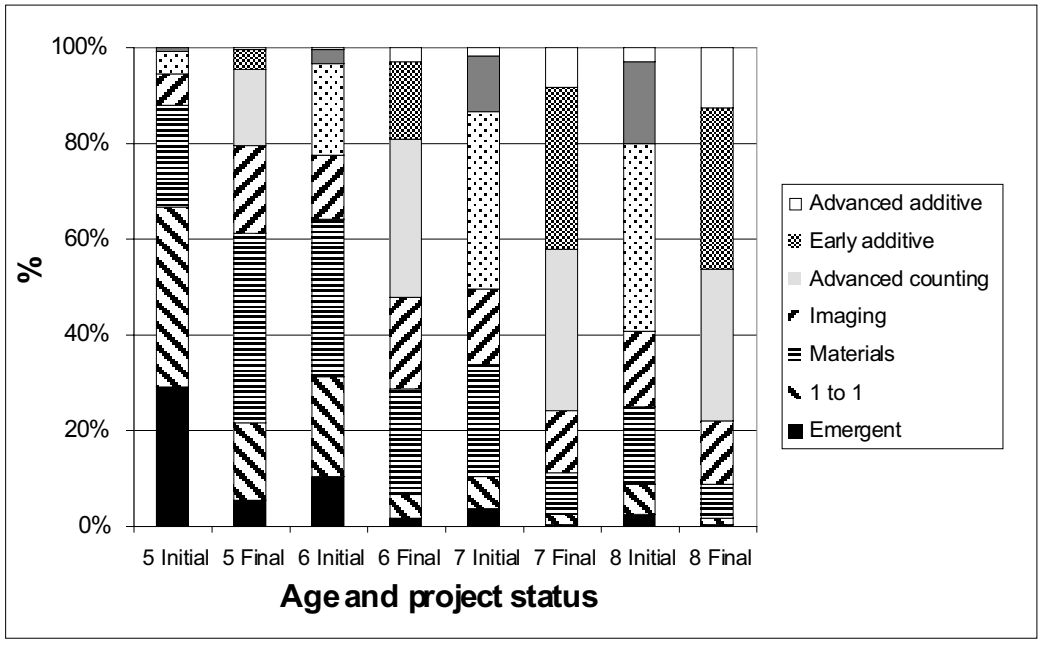


Figure 3.4 shows the distribution of students across the stages broken down by age. This graph shows how the pattern of change shifted from one age to another. For example, with five-year-olds, most of the change took place at the emergent and one-to-one levels, where student numbers decreased significantly (67%–22%), and at the materials, imaging and advanced counting stages, where there was a significant increase in student numbers (33%–74%). On the other hand, for eight-year-olds, there was relatively little change at the lower stages, the decreases being spread across the stages, with the major change in numbers being an increase in students at the part-whole stages (20%–46%). This figure also shows that *younger* students *after* participation in the ENP achieved higher SEAL scores than *older* students *before* participation. Hence "5 Final" can be compared with "6 Initial", "6 Final" with "7 Initial", and "7 Final" with "8 Initial". All of these comparisons show consistent advantages for students after participation in the project.

Figure 3.4: Percentage of students at each SEAL stage by age and project status



The percentage of students who made the transition from counting to part-whole is similar to that for the CMIT project for 2000. Table 3.8 compares the percentages of students in the two broad categories of counting and part-whole strategies. At the conclusion of the ENP project, 23% of the students were using part-whole strategies compared to 30% for the CMIT project.

Table 3.8: A comparison between ENP and CMIT 2000 – percentages of students using counting and part-whole strategies

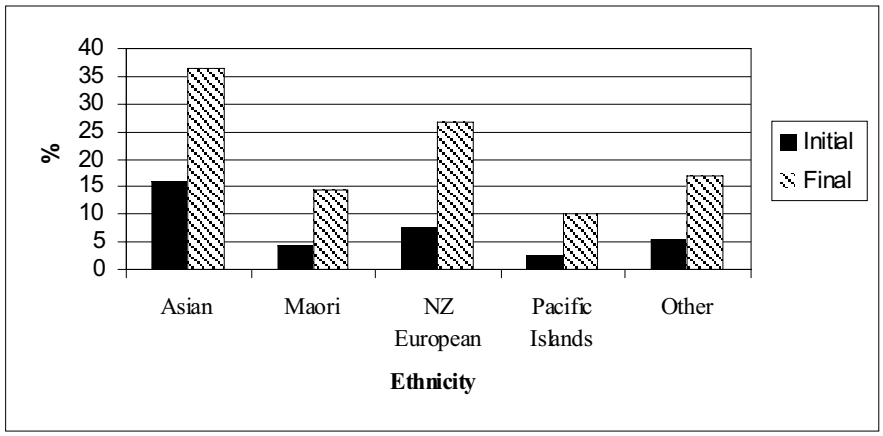
		SEAL Counting strategies	SEAL Part-whole strategies
CMIT 2000	Initial	90%	10%
	Final	70%	30%
ENP	Initial	93% (14055)	7% (982)
	Final	77% (11546)	23% (3491)

The previous section illustrated the similarities in gains made by the students regardless of their ethnicity and the school region and decile. Although the gains were similar, this does not mean that there were no differences in the profiles of the students in their subgroups.

Ethnicity

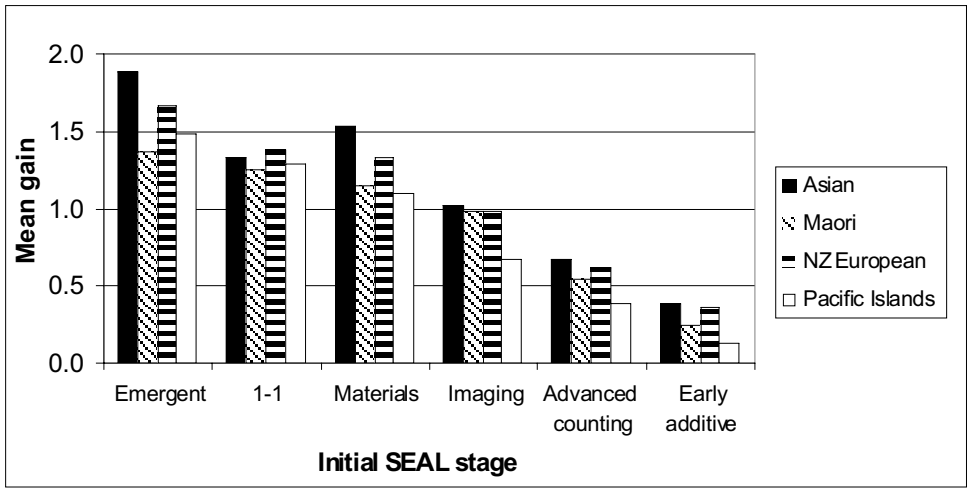
Figure 3.5 shows that fewer Māori (15%) and Pacific Islands (10%) students than Asian (36%) and New Zealand European students (27%) used part-whole number strategies by the end of the project.

Figure 3.5: Percentage of students using part-whole strategies by ethnicity



It is also interesting to examine the gains made on the SEAL when linked to ethnic group and initial SEAL stage. Figure 3.6 shows that the gains made by the Māori and Pacific Islands students were slightly but consistently lower than gains made by the other groups. That the total gains are almost identical (see Table 3.2) is explained by the larger percentages of Māori and Pacific Islands students at the lower stages where gains are greater overall.

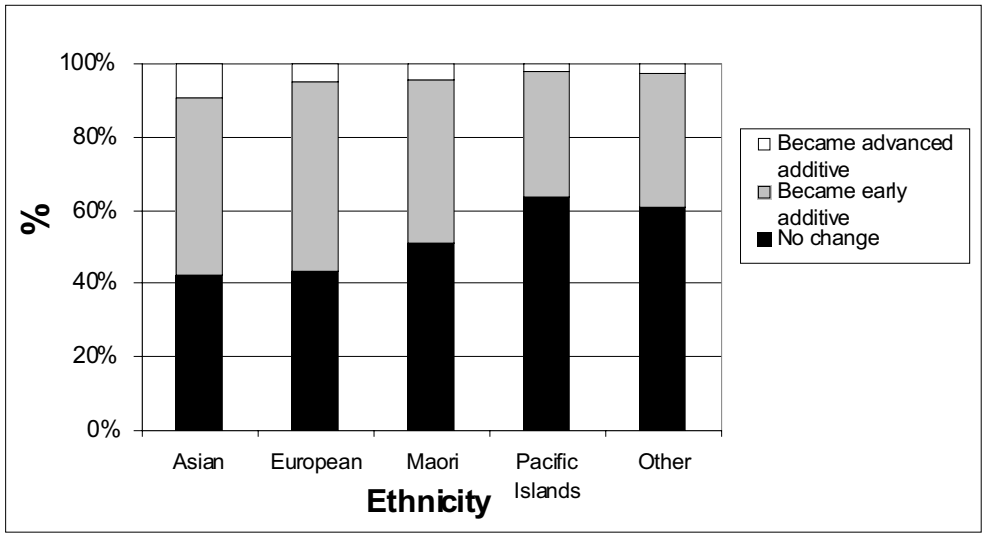
Figure 3.6: Mean gains on the SEAL linked to initial stage and ethnicity



The most concerning difference is in the proportions of students who made the transition from advanced counting to early additive or advanced additive strategies. Figure 3.7 illustrates the

final SEAL stage of students who had an initial SEAL assessment of advanced counting. Just 36% of the Pacific Islands students made the transition compared to 49% of the Māori students, 57% of the New Zealand European students and 58% of the Asian students. A higher proportion of Asian students (9%) moved the two stages from advanced counting to advanced additive than any other ethnicity. Pacific Islands students were again poorly represented with only 2% moving two stages.

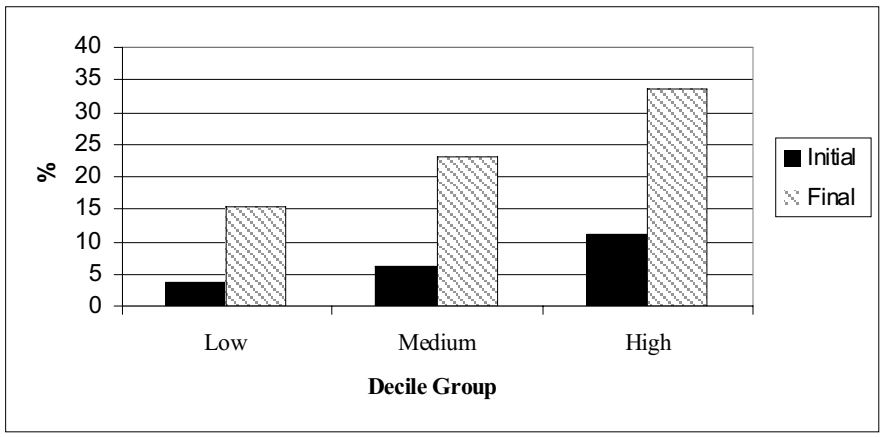
Figure 3.7: Final SEAL status of students who were initially advanced counters, by ethnicity



Decile level

Differences are also found in the percentages of students using part-whole strategies when the results are analysed according to decile group. As shown in Figure 3.8, a smaller percentage of students in the low-decile band (15%) used part-whole strategies compared to those in the medium (23%) and high-decile bands (33%) at the final assessment.

Figure 3.8: Percentage of students using part-whole strategies by decile group



When the gains are investigated according to the students' initial SEAL stages, there is a strong correlation between decile group and mean gains. As illustrated by Figure 3.9, students in the high decile group made slightly greater gains regardless of their initial SEAL stage. Once more,

the similarity in the total mean gains is explained by the larger percentages of low decile students at the lower stages where gains are overall greater.

Figure 3.9: Mean gains on the SEAL linked to initial stage and decile

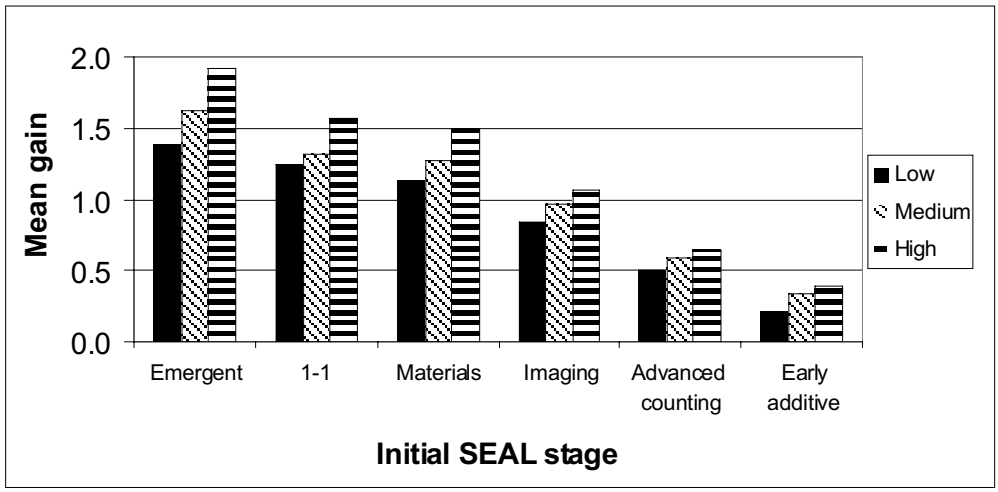
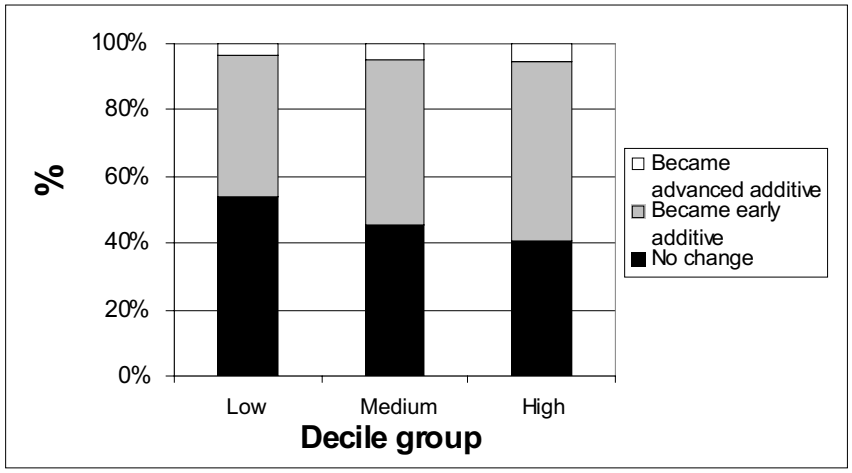


Figure 3.10 is based on the 3183 students who were assessed at the initial ENPA as using advanced counting strategies. Forty-seven percent of the students in the low decile group made the transition to part-whole strategies compared with 55% of the medium decile and 59% of the high decile group. The percentages of students (4%–5%) who moved the two stages from advanced counting to advanced additive are not differentiated by decile.

Figure 3.10: Final SEAL status of students who were initially advanced counters by decile group



BTS and SEAL compared

This section concludes with a comparison of students' SEAL and BTS stages. The BTS has two fewer stages as it does not include counting from one on materials or counting from one by imaging. As expected, the stages on the BTS are closely linked to the stages on the SEAL ($r = 0.743$, $p = 0.01$). Table 3.9 illustrates the consistency between the SEAL and the BTS stages.

Table 3.9: BTS and SEAL compared

Final SEAL	Final BTS				
	Emergent	One-to-one	Advanced counting	Early additive	Advanced additive
Emergent	79% (279)	20% (72)	1% (2)		
One-to-one	40% (435)	58% (624)	2% (22)		
Materials	13% (458)	72% (2456)	14% (479)	0% (7)	
Imaging	4% (106)	50% (1253)	44% (1098)	1% (26)	
Advanced counting	1% (48)	26% (1098)	66% (2781)	7% (294)	0% (8)
Early additive	0% (2)	4% (125)	36% (1009)	57% (1607)	3% (81)
Advanced additive		3% (17)	12% (82)	40% (266)	45% (302)

The Relationship between Number Strategy and Number Knowledge

As discussed in Chapter Two, The Number Framework has two main components: number strategy and number knowledge. This section looks at the relationship between the students' use of strategies and their number knowledge as assessed by the Early Numeracy Project Assessment (ENPA). The ENP resource material for teachers states that "this knowledge plays a critical role in students applying their available strategies with proficiency and fluency across all the numbers and problem types that they may encounter" (Ministry of Education, 2001d, Section A, page 8).

Tables 3.10 to 3.12 compare the percentages of students on the Final SEAL with their performance on the three assessed aspects of number knowledge. As anticipated, there appear to be strong links between strategy use and number knowledge.

Table 3.10 looks at the relationship between stages on the SEAL and stages of numeral identification. At least 97% of students who were part-whole in their use of strategies were able to identify numerals to 1000. The reverse doesn't apply as only 39% of those who were able to identify numerals to 1000 were early additive or advanced additive on the SEAL.

Table 3.10: Strategies and numeral identification compared

Final SEAL	Final NID				
	Emergent	To 10	To 20	To 100	To 1000
Emergent	32% (113)	37% (131)	15% (53)	14% (50)	2% (6)
One-to-one	6% (64)	37% (401)	21% (226)	31% (336)	5% (54)
Materials	1% (26)	15% (497)	15% (503)	49% (1655)	21% (719)
Imaging	0% (1)	4% (87)	5% (114)	40% (989)	52% (1292)
Advanced counting	0% (1)	1% (37)	1% (46)	22% (922)	76% (3223)
Early additive		0% (2)	0% (1)	3% (95)	97% (2726)
Advanced additive				0% (2)	100% (665)

Virtually all students who were part-whole (early or advanced) in their use of number strategies had number sequences to 100 (Tables 3.11 and 3.12). On the other hand, students could be at the highest stage in their number word sequences but at the lower stages of strategy use. For example, only 32% of the students who knew their forward number sequences to 100 were assessed as being at the early or advanced additive stages on the SEAL. This suggests that knowledge of the number system is necessary but not sufficient for the development of part-whole strategies.

Table 3.11: Strategies and forward number word sequence compared

Final SEAL	Final FNWS				
	Emergent	Initial	To 10	To 20	To 100
Emergent	11% (37)	31% (111)	35% (123)	20% (70)	3% (12)
One-to-one	0% (4)	16% (174)	36% (386)	33% (354)	15% (163)
Materials		2% (73)	17% (580)	40% (1359)	41% (1388)
Imaging		0% (10)	4% (98)	21% (515)	75% (1860)
Advanced counting		0% (4)	1% (46)	8% (334)	91% (3845)
Early additive		0% (1)	0% (3)	1% (26)	99% (2794)
Advanced additive				0% (2)	100% (665)

Table 3.12: Strategies and backward number word sequence compared

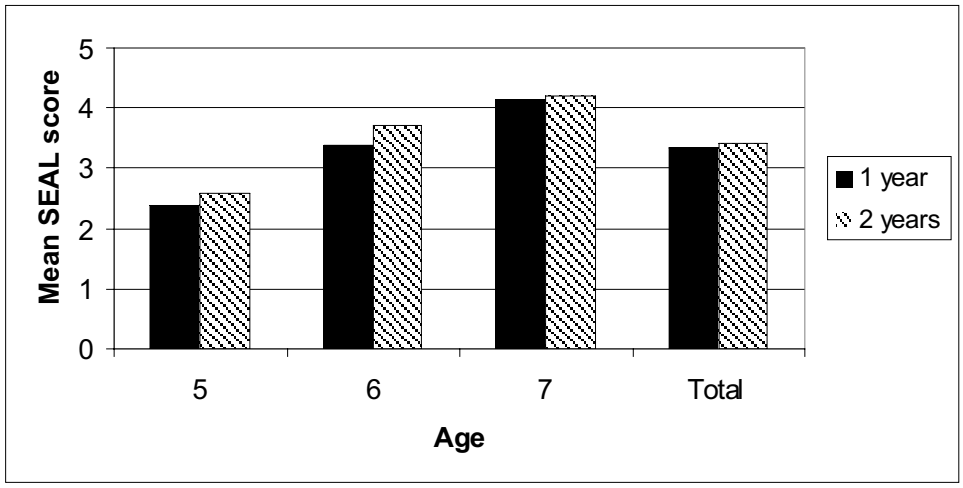
Final SEAL	Final BNWS				
	Emergent	Initial	To 10	To 20	To 100
Emergent	37% (131)	31% (109)	26% (91)	5% (17)	1% (5)
One-to-one	11% (119)	30% (325)	38% (414)	14% (151)	7% (72)
Materials	1% (49)	10% (337)	35% (1178)	32% (1072)	22% (764)
Imaging	0% (2)	2% (39)	13% (332)	29% (730)	56% (1380)
Advanced counting		0% (16)	5% (221)	16% (666)	79% (3326)
Early additive		0% (1)	0% (14)	2% (61)	97% (2748)
Advanced additive				1% (5)	99% (662)

The Longitudinal Impact of the Early Numeracy Project

In the final section of this chapter, comparisons are made between the final SEAL results of students in the ENP and those students in schools that participated in the CMIT pilot project. Twenty-two schools from the CMIT pilot project entered ENPA SEAL results in October 2001 for a total of 1741 students in their junior classes.

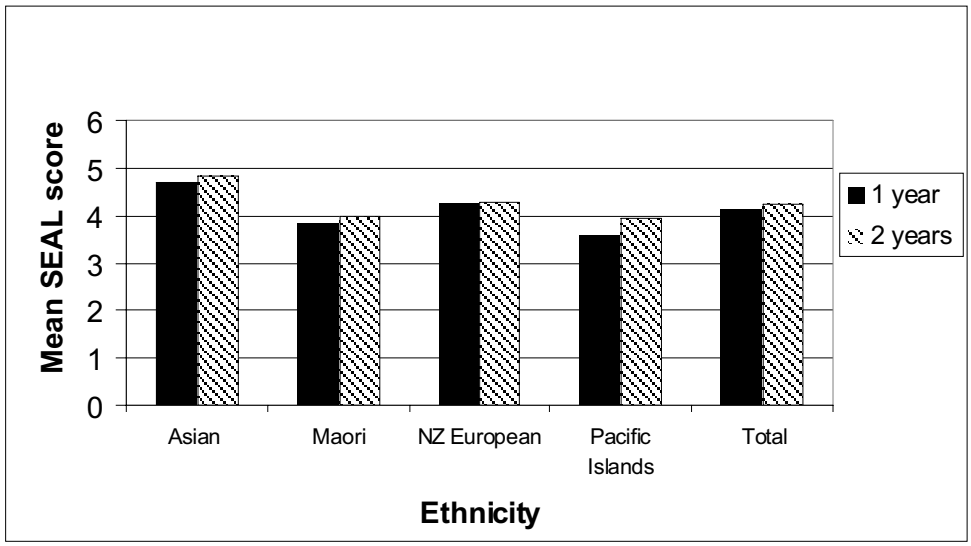
Figure 3.11 compares the mean SEAL scores of students by age. Schools that had been involved in the numeracy project for two years had slightly higher mean scores on the SEAL than those who had been involved for one year. The six-year-olds had the largest difference, with the students who had participated for two years having a mean score 0.33 of a stage higher than those who had participated for one year.

Figure 3.11: Mean SEAL score by age and years involved in the project



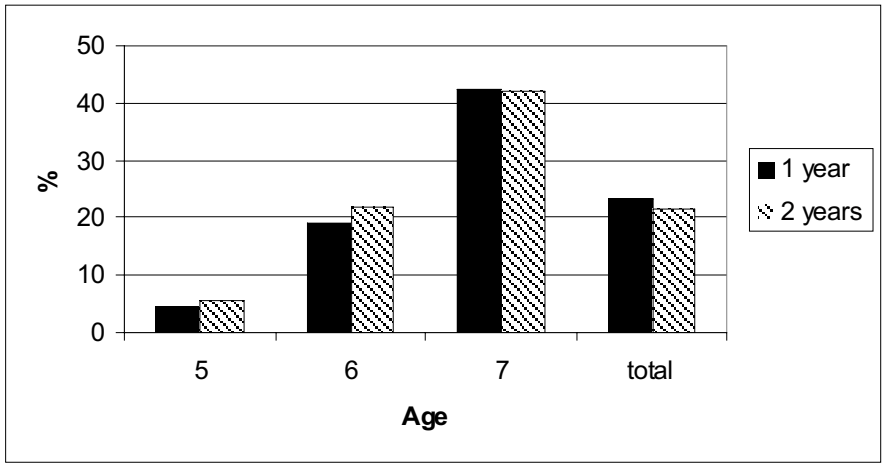
When the mean SEAL scores are compared by ethnicity, the students who are in schools that have participated for two years demonstrated slightly higher means across all ethnic groups (see Figure 3.12). The Pacific Islands students had the greatest difference, with a mean SEAL score 0.37 of a stage higher in the schools that had participated for two years.

Figure 3.12: Mean SEAL score by ethnicity and years involved in the project



The remainder of this section focuses on percentages of students at each stage of the SEAL, firstly examining those students who were part-whole in their use of number strategies. Figure 3.13 compares the percentage of students at each age who were using part-whole strategies. Schools that had been involved in the numeracy project for two years had a similar proportion of students using part-whole strategies to schools that had been involved for one year. This is a concerning finding as it was expected that six- and seven-year-old students, who had been in the project for two years, would build on the gains from the first year. As the CMIT schools were only asked to provide SEAL results in September 2001, it is not possible to examine their gains during 2000 or to compare the starting profiles of the CMIT students with the ENP students.

Figure 3.13: Percentage of students at part-whole stage by age and years involved in the project



It is of particular interest to compare the achievement of the six- and seven-year-olds as these were the students who had two years of teaching within the ENP. Figures 3.14 and 3.15 illustrate the SEAL profiles of students according to years of participation in the project. As you would hope, there were fewer six-year-old students in the early stages of the SEAL after two years of participation, which suggests that the gains from the first year were built on during the second year. However the profiles for seven-year-olds are very similar, which is contrary to the expectation that a greater proportion of those who had spent two years in the project would be at the higher stages of the framework.

Figure 3.14: Percentage of six-year-olds by SEAL stage and years involved in the project

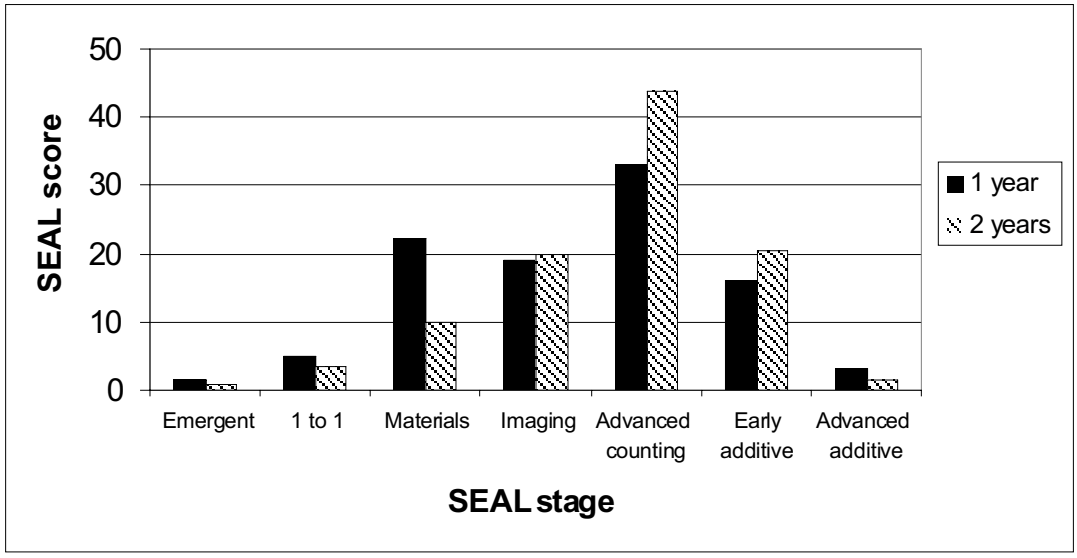
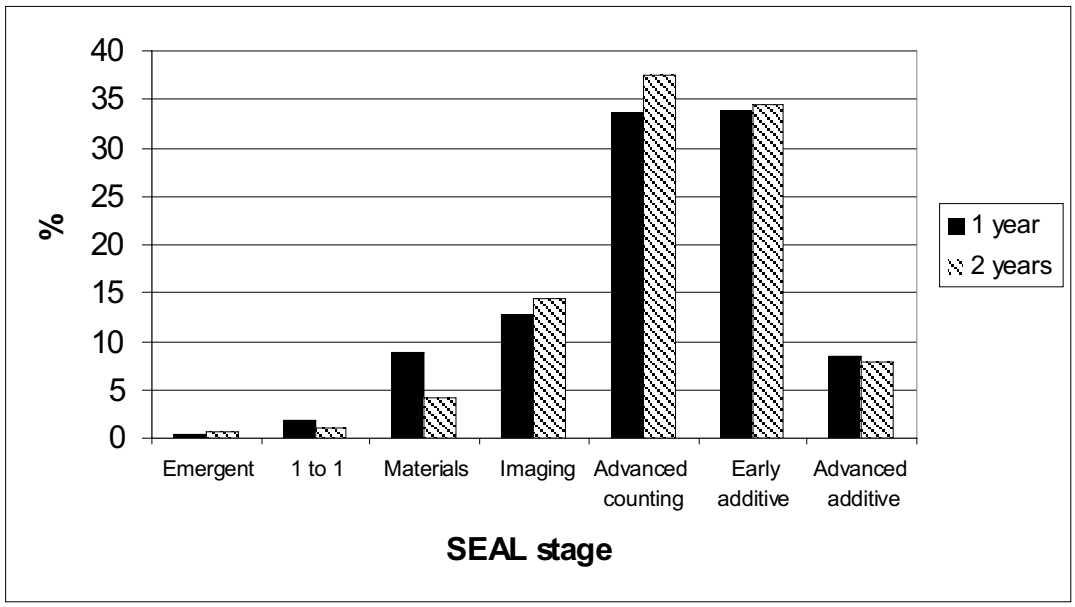


Figure 3.15: Percentage of seven-year-olds by SEAL stage and years involved in the project



A huge volume of data was gathered for the ENP, but because of the constraints of space, only some of the results have been reported and discussed in this chapter. Appendices E to I contain further result tables for the students in the Phase One schools.

Chapter Four: Participant Comment

This chapter examines the responses to the questionnaires completed in September 2001 by the teachers, principals and facilitators involved in the ENP and by the facilitators at the completion of the facilitator training (March 2001). It also considers responses to questionnaires completed in September 2001 by teachers and principals involved in the CMIT pilot project 2000. Throughout this chapter, comparisons are also made with comments from participants in the CMIT 2000 evaluation (Ministry of Education, 2001a).

The questionnaires had two components: one aimed at collecting demographic data and the other asking a series of open-ended questions. A summary of each questionnaire is included as Appendix C. Responses to the open-ended questions were analysed for key themes and patterns. In general, responses fell into three broad areas: attitudes to the project, perceived impacts of the project and issues with specific elements of the professional development programme.

Demographic Data of Respondents

One hundred and forty-eight questionnaires were returned from teachers involved in the ENP, representing 60% of the 246 distributed. Fifty of the 148 were randomly selected for analysis with the sample size determined by the similarity of themes that emerged within the first 25 questionnaires analysed. A summary of the results from part one of the questionnaire is presented in Table 4.1

Table 4.1: Demographic data of ENP teacher respondents

Category	Details	Percentage
Region	Otago/Southland	6
	Canterbury/Nelson	12
	Wellington Region	14
	Central North Island (Massey)	16
	Auckland Region	48
	Waikato	4
Size of school	< 50 students	4
	51–100 students	6
	101–200 students	18
	201+ students	72
Decile	1–3	30
	4–7	32
	8–10	38
Age*	20–30	24
	31–40	12
	41–50	34
	51+	26
Gender*	Female	96
	Male	2
Years of teaching experience*	1–5	22
	6–10	8
	11–15	22
	16–20	18
	21+	26
Level currently being taught	Year 1	34
	Year 2	10
	Year 3	14
	Composite	42
Years of teaching experience with juniors	1–3 years	30
	4–7 years	14
	7+ years	56
Length of time at current school*	1–3 years	36
	4–7 years	32
	7+ years	30

* Not all respondents completed this question.

Forty-two principals involved in the ENP returned questionnaires, a return rate of 85%. Forty-one of these were analysed, one arriving too late for inclusion. A summary of the demographic data of these principals is presented in Table 4.2.

Table 4.2: Demographic data of ENP principal respondents

Category	Details	Percentage
Region	Otago/Southland	14
	Canterbury/Nelson	10
	Wellington Region	7
	Central North Island (Massey)	20
	Auckland Region	37
	Waikato	12
Size of school	< 50 students	2
	51–100 students	10
	101–200 students	27
	201+ students	61
Decile	1–3	34
	4–7	34
	8–10	32

Facilitators in the ENP were presented with two questionnaires. One of these was issued at the completion of the facilitator training in February, and one in September. Fourteen responses to the earlier questionnaire were received and 21 to the latter question, each from a total of 23 facilitators. A summary of the demographic data of these respondents is presented in Table 4.3.

Table 4.3: Demographic data of ENP facilitator respondents

Category	Details	Percentage Feb. 2001	Percentage Sept. 2001
Age*	20–29	7	14
	30–39	14	19
	40–49	58	38
	50+	14	29
Gender*	Female	86	86
	Male	7	14
Years of teaching experience	1–5	0	14
	6–10	21	19
	11–15	21	14
	16–20	21	5
	21+	37	48
Facilitator in CMIT pilot project*	Yes		43
	No		52
Years of advisory experience	0	14	
	1–5	65	
	6–10	14	
	11–15	0	
	16–20	7	
	21+	0	

* Not all respondents completed this question.

Questionnaires were sent to junior class teachers and principals of schools involved in the CMIT pilot project. Twenty-two of the 25 schools randomly selected for this purpose accepted the invitation to participate. Responses were received from 77 (72%) teachers, with 50 of these randomly selected for analysis. Sixteen principals (73%) returned questionnaires, and 14 of these were analysed, two arriving too late for inclusion. A summary of the demographic data of these respondents appears in Tables 4.4 and 4.5.

Table 4.4: Demographic data of CMIT teacher respondents

Category	Details	Percentage
Region	Otago / Southland	12
	Canterbury / Nelson	24
	Wellington Region	20
	Central North Island (Massey)	4
	Auckland Region	22
	Waikato	18
Size of school*	< 50 students	0
	51–100 students	0
	101–200 students	10
	201+ students	88
Decile*	1–3	30
	4–7	38
	8–10	28
Age	20–30	6
	31–40	20
	41–50	48
	51+	26
Gender*	Female	98
	Male	0
Years of teaching experience*	1–5	6
	6–10	20
	11–15	22
	16–20	18
	21+	32
Level currently being taught	Year 1	38
	Year 2	8
	Year 3	4
	Composite	50
Years of teaching experience with juniors	1–3 years	16
	4–7 years	20
	7+ years	64
Length of time at current school	1–3 years	20
	4–7 years	44
	7+ years	36

* Not all respondents completed this question.

Table 4.5: Demographic data of CMIT principal respondents

Category	Details	Percentage
Region	Otago/Southland	21.5
	Canterbury/Nelson	21.5
	Wellington Region	7
	Central North Island (Massey)	7
	Auckland Region	21.5
	Waikato	21.5
Size of school	< 50 students	0
	51–100 students	0
	101–200 students	29
	201+ students	71
Decile	1–3	36
	4–7	36
	8–10	28

Analysis of the second section of the questionnaire involved responses to open-ended questions being examined for key themes and patterns. These key themes are presented below in three main sections: Attitudes towards the Project, Perceived Project Impacts and Project Issues. It should be noted that as questions were open-ended, interpretation of this data needs careful consideration. For instance, 24% of ENP teachers saying that they feel more positive about maths as a result of their participation in the project cannot be interpreted as 76% saying they are now more negative about maths. The views presented, and percentages given for these views, reflect the issues identified by a group of respondents. The omission of these views by other respondents does not necessarily indicate the presence of an opposite viewpoint.

Quotes used are typical of the comments given and are taken directly from the questionnaires.

Attitudes towards the Project

Attitudes towards maths

The majority of ENP teacher respondents (70%) believed their attitude towards maths had changed as a result of their participation in the project. The greatest change noted was an increase in enthusiasm for maths, which was identified by 24% of respondents. Teachers reported becoming more positive and gaining more enjoyment from their maths programmes:

> *Maths was previously not a favoured subject to teach (especially number), but I am now really enjoying it – it is hands on, fun and I can see results.*
>
> *Maths is now seen as something really enjoyable for the children and myself ... The results have been very positive, which builds a positive attitude.*
>
> *[I have] learnt that maths can be fun ... both teaching and learning.*

Thirty percent of teachers reported no change in attitude; however, 26% of that 30% believed they have "… always been positive about maths."

These results are consistent with the findings of the CMIT 2000 evaluation (Ministry of Education, 2001a), where 73% of teachers reported a more positive attitude towards maths, while 24% noted an increased enthusiasm. Twenty-seven percent reported no change in attitude, and 25% believed they already possessed a positive attitude.

The response from principals involved in CMIT indicates that this increased enthusiasm for maths has been sustained. One hundred percent of CMIT principal respondents believed that the attitudes of teachers towards mathematics programmes had changed since the completion of CMIT. Fifty-seven percent of these noted a more positive approach to maths, 43% commented on their staff's increased focus on knowledge, strategies and "the way children think" and 36% believed that the positive attitude change they observed could be attributed to the students' clear progress. Comments from these principals included:

> *Positive attitudes towards mathematics teaching generated during the project have continued ...*
>
> *Challenging the children and observing their achievement is very positive. The desire of the children to think outside the square generates excitement.*

Attitudes towards the project

In general, teachers responded very positively to the project. Eighty-eight percent of ENP principals and 81% of facilitators observed teachers to be positive, motivated and enthusiastic.

> *[There has been huge] enthusiasm and praise for the difference it has made to their children's attitude and achievement.*

The CMIT 2000 evaluation (Ministry of Education, 2001a) found that 42% of principals and 100% of facilitators described teachers as having a positive attitude towards the project.

In addition, 98% of ENP principals believed that the ENP had an impact on teachers as people, either inside or outside the classroom. This is in line with the CMIT 2000 evaluation, in which 97% of principals and 92% of facilitators observed the project to impact on teachers as people.

A variety of more specific responses were recorded, including the following points.

- Forty-nine percent of principals observed an increased confidence in teachers with regard to their numeracy teaching. Forty-eight percent of principals in the CMIT 2000 evaluation made the same observation.

- Twenty-four percent of facilitators attributed teachers' positive attitudes to the students' improved progress.

  This same observation was made by 20% of principals in the CMIT pilot project evaluation.

- Thirty-four percent of ENP principals recorded their staff as being diligent, hard working and committed.

  The majority of teachers have been extremely positive about the project and [have] worked hard making resources and readying the binder to get up and running.

  [Teachers are] determined to apply developing skills in their teaching.

- Thirty-two percent of ENP principals noted some concern amongst their teachers over workload and time issues.

  Time (or lack of it) is the biggest problem affecting those who were not positive.

In addition, 37% of principals found their staff to be experiencing increased stress and tiredness as a result of the project. This is almost twice the number of principals (20%) who made a similar observation in the CMIT 2000 evaluation (Ministry of Education, 2001a).

- Thirty-three percent of facilitators recorded teachers as being initially overwhelmed by the programme.

  Some [were] a little daunted by the overwhelming amount of ideas, reading, resources ...

This can be compared to 54% of facilitators making the same observation in the CMIT 2000 evaluation.

Impacts on other teaching staff were also noted. The majority of ENP principals (98%) and facilitators (95%) believed that the project had an impact on other teachers in the school who were not participating in the project. Impacts noted included the following points.

- A general interest in the programme from non-participating teachers was identified by 57% of facilitators.

- An enthusiasm to be involved in the ANP was noted by 49% of ENP principals and 29% of facilitators.

  After hearing bits and pieces about ENP, other teachers are keen to be involved in ANP.

- Increased informal professional discussion about maths was observed by 24% of ENP principals.

  There has been a great deal of professional discussion on an informal level.

- Concern over workload was noted by 29% of facilitators.

  A lot of the other teachers have noted the work and effort required from ENP teachers and are not looking forward to the extra workload next year.

  Other teachers have expressed a concern over the amount of time involved in making resources and training.

Parent response

Fifty-eight percent of ENP teachers and 63% of ENP principals noted a generally positive response to the project among parents and caregivers. Comments included observations that parents were "totally enthused" and "very positive". This is in line with the findings of the CMIT 2000 evaluation, in which 63% of teachers and 73% of principals made the same observation.

Thirty-four percent of the ENP principals commented that the only specific response identified among parents was a general pleasure with the progress that their children were making.

Parents have been amazed at what their children are achieving in number…

Thirty-four percent of ENP teachers recorded no response from parents.

Perceived Project Impacts

Content knowledge

The majority of ENP teacher respondents (80%) believed that their content knowledge of maths had been developed as a result of their participation in the project. This development of teacher content knowledge was also observed by 95% of facilitators and is in line with the results of the CMIT 2000 evaluation, in which 80% of teachers and 100% of facilitators observed development in teacher content knowledge.

Two main developments were noted. The first, an increased understanding of the knowledge and strategies students require and a greater knowledge of their progression through these strategies, was noted by 62% of ENP teachers and 57% of facilitators.

> *I am clearer about the progressions. [I know] what knowledge to focus on.*

> *The breakdown of numeracy into various stages of developmental progress is an aspect of knowledge [that] has been developed.*

In addition to this, 52% of facilitators observed teachers making developments in their own use of number strategies.

> *Many have indicated they are now thinking in a part-whole way. This was not the case previously.*

> *Many teachers say that they didn't know or use strategies themselves beyond advanced counting.*

Eighteen percent of ENP teachers believed that their content knowledge of maths had not developed as a result of their participation in the project.

Recent feedback from teachers involved in CMIT indicate that developments in teacher content knowledge have continued, with the majority of CMIT teachers (82%) believing their content knowledge of maths has developed since the completion of the project. Fifty-eight percent of these teachers cited an increased understanding of the progression of knowledge and strategy.

> *Another year (plus ANP) has refined my knowledge and given me a much clearer picture of stages – strategies and knowledge.*

Sixteen percent of CMIT teachers believed that their content knowledge had not developed since the completion of the project.

Pedagogy

Teachers and facilitators involved in ENP reported developments in teachers' pedagogical knowledge. Ninety-six percent of ENP teachers believed their understanding of how students learn number had changed as a result of their participation in the project, while 95% of facilitators observed ENP to have had an impact on the pedagogical knowledge of teachers. These findings can be compared with the same observations made by 89% of teachers and 100% of facilitators in the CMIT 2000 evaluation.

Three main developments in pedagogical knowledge were recorded. These were as follows.

- Teachers had a better understanding of the knowledge and strategies students require and a greater understanding of their progression through these – identified by 70% of ENP teachers and 57% of facilitators.

> *I now understand much better the depth of number knowledge children need before they can effectively use strategies. Also, [I understand much better] the huge*

number of strategies children use to solve problems mentally, rather than rote learning of a method.
Many [teachers] were unable initially to describe the progression of learning and now are able to confidently describe the way children progress.

- There was a greater awareness of the value of group work – identified by 33% of facilitators.

  [Group work] has refocused some teachers on the need for grouping in order to target individual needs.

  The value of small-group teaching / discussion / learning is now becoming evident.

- Teachers demonstrated a greater awareness of the value of hands-on activities – identified by 33% of facilitators.

  [There is] value in hands-on activities/games ... use of equipment to gain understanding ...

Four percent of ENP teachers reported no change in their understanding of how students learn number as a result of their participation in the project.

Feedback from teachers involved in CMIT indicates that developments in pedagogical knowledge have continued, with 86% of CMIT teachers believing that their understanding of how students learn number has developed since the completion of the project. Fifty-two percent of these teachers identified The Number Framework as being important in developing their knowledge.

I must have been very vague before, but now I know how to recognise, promote and teach to strategies. I feel I am much more focused in my teaching objectives.

Ten percent of CMIT teachers reported no change in their understanding of how students learn number since the completion of the project.

Classroom programmes

The majority of ENP principals (100%) and facilitators (95%) noted positive impacts on the mathematics programmes of participating teachers. Ninety-two percent of teachers on ENP felt that the way they taught number had changed as a result of their participation in the project. These views are in line with the findings of the CMIT 2000 evaluation, in which 98% of principals and 100% of facilitators noted positive impacts on maths programmes and 92% of teachers felt that the way they taught number had changed.

Positive developments noted included the following points.

- An increased focus on students' development of strategy and knowledge – noted by 34% of ENP teachers, 24% of ENP principals and 29% of facilitators.

  [Teachers have more] knowledge of stages children's thinking goes through [... and more] knowledge of maths concepts/content ...
  Teachers [are] teaching to strategic knowledge ...

More children are involved in thinking.

- Increased enjoyment and enthusiasm for maths – noted by 22% of ENP principals and 29% of facilitators.

  They are extremely enthused.

  The enthusiasm of both teachers and children has been greatly enhanced.

- Increased hands-on activities, with more effective use of equipment – noted by 33% of facilitators.

  Lots of hands on. ... Loads of challenges and reinforcing of skill – throughout the day, not just at maths time!

- More effective assessment practices – noted by 24% of ENP principals.

  [There is a greater understanding] of assessment and evaluation processes.

- An increased focus on students' individual needs – noted by 33% of facilitators.

  Small groups [are] developing number strategies at [the] children's own level.

  ... [Teachers have a] greater understanding of where the individual is at ...

- More effective grouping of children – noted by 20% of ENP teachers.

  Grouping of children is much more accurate and better able to cater for their needs.

- An increased collaboration among staff, with better teamwork – noted by 20% of ENP principals.

  [We have] better team work, with a cohesive planning approach ...

Teachers, principals and facilitators listed very similar changes in classroom programmes in the CMIT 2000 evaluation. Also listed in 2000, but not mentioned in the ENP evaluations, were a greater focus on number, higher expectations of students' abilities and a greater variety of classroom activities.

Feedback from teachers involved in CMIT indicates that these developments in classroom programmes have continued in 2001, with 94% of CMIT teachers and 100% of CMIT principals believing that the way number is taught has changed since the completion of the project. Developments noted included a greater focus on number (42% of teachers and 29% of principals), an increased focus on the development of students' knowledge and use of strategy (25% of teachers), an increased use of grouping (21% of principals) and more effective catering for individual learner's needs (21% of principals).

Thirty-two percent of ENP principals and 57% of facilitators noted negative impacts on the mathematics programmes of participating teachers. This is in line with the CMIT 2000 evaluation, in which 33% of principals and 69% of facilitators made the same observation. The

one outstanding negative impact noted was a concern over heavy workloads and the resultant lack of time. This was recorded by 20% of ENP principals and 24% of facilitators and compares with 10% of principals and 15% of facilitators from the CMIT 2000 evaluation making the same observation.

Sixty-eight percent of ENP principals and 43% of facilitators noted no negative impacts on the mathematics programmes of participating teachers.

Impacts on the students participating in the project were observed by 100% of facilitators – the same finding as in the CMIT 2000 evaluation. Impacts noted included the following points.

- An increased enjoyment of maths resulting in a more positive approach – noted by 56% of ENP principals and 86% of facilitators.

  Children now love maths. This is the biggest impact I've seen. I had one teacher who gave her year 3/4 class a choice (on a Friday afternoon) of art or maths. [One hundred percent] voted for maths.

- An increased understanding of mathematics – noted by 56% of ENP principals and 63% of facilitators.

  Understandings have improved as "rote" learning has not been emphasised as much.

- Increased confidence in their own number skills – noted by 17% of ENP principals and 38% of facilitators.

  Most [teachers] are far more confident and articulate.

- An increased ability to articulate their own mathematical thinking – noted by 43% facilitators.

  Children are able to verbalise how they solve problems. This demonstrates high skill levels and contributes to confidence.

Similar impacts on students were noted in the CMIT 2000 evaluation.

Sustaining impacts – CMIT schools

The majority of CMIT schools believed that they have been able to sustain the developments that occurred as a result of their involvement in the project in 2000. Ninety-three percent of principals and 88% of teachers made this observation, further noting reasons for this sustained development.

Forty-three percent of principals believed developments had been sustained as a result of teacher interest and enthusiasm, and 29% of principals observed that the ANP operating in the school has helped to give impetus to developments.

Staff have been keen to continue this. They have seen the advantages of the project.

The school is involved in ANP, so that also has maintained interest levels for other areas and continued the impetus.

Thirty-two percent of teachers recorded further developments in mathematics programmes as a result of ENP.

The ENP Individual Assessment has become the benchmark for grouping and tracking progress. New equipment making has continued.

Seven percent of principals and 8% of teachers believed that the developments that occurred as a result of their involvement in the project in 2000 have not been sustained.

Ninety-three percent of principals and 66% of teachers believed that there have been school-wide benefits from the implementation of the ANP in their schools in 2001. The two benefits noted were a more unified and consistent approach across the school, helping to ensure continuity (24% of teachers), and a more collaborative approach by teachers (21% of principals).

Everyone is on the same wavelength about number.

The involvement of all staff in either ENP or ANP has created wider opportunity for discussion, focus and sharing outcomes.

The whole staff understands what is involved and can discuss issues with shared knowledge.

Seven percent of principals and 8% of teachers believed that there have been no school-wide benefits from the implementation of the ANP in their schools.

Both teachers (86%) and principals (93%) noticed a change in students' ability in number now that the project has been operating in their schools for two years. Six percent of teachers noticed no change in the students' ability in number, with the remainder feeling unable to comment.

Two factors were noted in this increased ability, the first being an increased number knowledge, with more efficient use of strategy (noted by 56% of teachers), and the second being a general improvement in achievement in number (noted by 36% of principals).

Children can problem solve in a variety of ways, which I probably would never have noticed or encouraged before.

They have been challenged to operate with more efficient strategies; imaging is powerful. Students know more about the number system and patterns and are more empowered to estimate and use mental operations.

Project Issues

Reasons for participation

ENP principals identified a variety of factors that influenced their decision to participate in the project. These included the following points.

- Programme reputation – noted by 29% of principals.
- Concern over the level of students' understanding and skill in maths – noted by 29% of principals.
- Staff need for mathematics professional development – noted by 22% of principals.
- A desire for the school to focus on numeracy development – noted by 20% of principals.

Results of the CMIT 2000 evaluation also indicated a concern over the level of students' understanding and skill in maths and staff need for mathematics professional development as factors influencing participation. In addition, principals from the CMIT evaluation noted that a personal approach to being involved and the availability of the opportunity to be personally involved influenced their decision to participate.

Helpful/unhelpful programme elements

ENP teachers and facilitators were asked to identify aspects of the professional development programme that they found most helpful or effective. In-class modelling by the facilitator was the most likely to be mentioned, with 72% of teachers and 91% of facilitators believing it to be the most helpful element.

> *Modelling by the facilitator both at workshops and in class [was a helpful aspect of the programme]. I learn better from seeing things demonstrated. [It was good] to see how equipment can be used – it "brings it to life".*
>
> *In-class modelling by the facilitator [was the most effective aspect of the professional development] because teachers could see how children were managed, where to [go] next and the language to use.*
>
> *In-class modelling is very valuable – teachers really believe when they see ENP in action with their own kids ...*

Other aspects listed included in-class observations (33% of teachers), the support of the facilitator in general (28% of teachers) and co-operative support from within the school (20% of teachers).

> *In-class facilitation – hands on, ready, available to answer questions, good demonstration.*
>
> *Enthusiasm and competence of facilitator.*
>
> *Working together as a team – planning together – discussing [ideas] with other teachers – successes etc.*

These results are similar to the findings of the CMIT 2000 evaluation in which teachers identified in-class modelling (13%), support from the facilitator (28%) and support from within the school (17%) as helpful aspects of the programme. In addition, these CMIT teachers listed the framework of stages and strategies students use (25%) and the SENA assessment tool (23%) as being useful as well.

ENP teachers identified two aspects of the project as the least helpful or most confusing. These were the resource folder (36%) and making the resources required for activities and games (20%). The resource folder is discussed in more detail below.

The requirement for making resources and materials was also found to be an issue in the CMIT 2000 evaluation, with 44% of the teachers commenting on it.

Cluster meetings

Sixty-six percent of ENP teachers and 90% of facilitators attended cluster meetings as part of the development programme. Forty-four percent of teachers and 71% of facilitators found these to be effective, with 24% of teachers and 10% of facilitators identifying the reason for this as being the way they encouraged teacher interaction and sharing.

> *Comparing attitudes, feelings and ideas was helpful to all, and we all had similar problems/worries etc (which is reassuring!)*
>
> *... it was a good chance to share.*

Twenty-two percent of teachers and 19% of facilitators did not find cluster meetings helpful, with a wide variety of reasons given for this. Common themes included a lack of time spent talking to other teachers (listed by 12% of teachers), too many people at the meeting (listed by 10% of teachers) and the need for the meetings to be held in school time (also listed by 10% of teachers).

Resource folder

Eighty-six percent of ENP teachers found the resource folder useful, and 28% of facilitators observed a positive response to the folder from teachers. Twenty-four percent of facilitators did not receive a positive response to the folder, and 48% of facilitators recorded a mixed response.

In general, participants found the content of the activities useful, with 24% of facilitators commenting on this. However, large numbers of participants found the layout of the folder hard to follow (62% of teachers and 38% of facilitators) and the large size cumbersome and difficult to work from (30% of teachers and 33% of facilitators).

> *The actual games and activities are great. The setting out of sections needs improving.*
>
> *It is rather daunting – huge and hard to access what you need quickly. Sometimes [it's] difficult to find where activities fit in.*
>
> *[The folder is] not user friendly. It wouldn't last – some of the holes have ripped. It's too big to carry back and forth ([between] home and school). Some things are in the wrong place.*
>
> *The draft book contained LOADS of super info but [it's] too big to be practical.*

Similarly, 90% of CMIT teachers found the resource folder useful, with 56% adding, however, that the layout of the folder was difficult to follow.
A large number of improvements to the folder were suggested. These included breaking the folder into smaller handbooks, each one focusing on a different stage of The Number Framework and helping the reader find their way around the folder by re-numbering pages and including an index, cross-references and a table of contents. It was also suggested that using consistent terminology throughout would be helpful.

The Number Framework

Sixty-four percent of CMIT teachers found The Number Framework helpful. Twenty-six percent believed that it was more useful than the framework used in the CMIT project. These teachers found the narrower, more specific stages useful and were grateful for the inclusion of the more advanced stages.

> *[The Number Framework is] much more specific – there were some very large stages and now [The Number Framework] is broken down in a logical way.*
>
> *We needed the stages further up from counting on and early additive.*

Sixteen percent of CMIT teachers did not find The Number Framework helpful.

Results database

Fifty-four percent of ENP teachers felt that the website for results entry was user friendly, but 26% found themselves unable to comment as another member of staff was responsible for data input (secretary, teacher aide, teaching colleague or the principal).

> *Simple and didn't take much time.*
>
> *Clearly set out.*

Twelve percent of ENP teachers did not find the website for results entry user friendly.

> *The secretary had extreme difficulty with the wrong passwords.*
>
> *We're Apple not PC.*

Facilitator training

Facilitators recorded changes in attitude, content knowledge and pedagogy as a result of the training sessions they attended.

Eighty-six percent of facilitators believed their attitude to junior maths had changed as a result of their involvement in the facilitator training, while 14% believed that they already possessed a very positive attitude. The main reason given for the attitude change was The Number Framework, with 21% of facilitators noting an increased understanding of the knowledge and strategies students use.

Ninety-three percent of facilitators expressed the view that their content knowledge of maths had developed as a result of their involvement in the facilitator training. The Number Framework was a key to this developing knowledge, with 50% of facilitators commenting on their improved knowledge of students' strategies and the importance of these strategies and 36% finding the clear, detailed knowledge sequence helpful. Seven percent of facilitators noted that the training had affirmed the process of numerical development that they were already familiar with.

The majority of facilitators (93%) experienced a development in their understanding of how students learn number, with 21% expressing the view that they are now familiar with the stages of development students may be operating within. Fourteen percent of facilitators commented that The Number Framework helped to give structure to their existing knowledge. Seven percent of facilitators felt they did not develop their understanding of how students learn number as they had had prior experience with the CMIT programme as teachers in the pilot project.

A wide variety of views was expressed regarding the effectiveness of the facilitator training. Sixty-four percent of facilitators cited a facilitation skills session as the most effective element of their training. In addition to this, 43% of facilitators found the hands-on experiences with students valuable and 43% also listed the video illustrating different examples of strategy use as being an effective training tool.

Some elements of the training were listed by facilitators as being unhelpful or leaving them feeling confused. The only common theme in this case was the view that the February training session spent too much time going over issues previously discussed in the December session.

Suggestions for improving the training were also varied, with the only common theme being a request to include participants more and use more hands-on activities. This was noted as a possible improvement by 21% of facilitators.

Project improvements

Participants recorded three main improvements to the project. These were:

- Centralised resource production – noted by 44% of ENP teachers, 46% of ENP principals and 29% of facilitators. Forty-four percent of teachers, 30% of principals and 34% of facilitators in the CMIT 2000 evaluation made this same suggestion.

  Is it possible to have all the resources pre-made? The time taken to do this has been enormous.

  Centralised resource making of key equipment [would be useful].

- Improvement of the resource folder – noted by 38% of ENP teachers, 27% of ENP principals and 38% of facilitators.

  User-friendly teaching handbooks rather than bulky folder.

- Review of the sequence and amount of time spent in workshops – noted by 24% of facilitators.

A wider variety of project improvements were listed in the CMIT 2000 evaluation. Those that were omitted in the more recent evaluation include more time to support teachers (listed by 46% of facilitators), more transition activities (listed by 23% of facilitators) and increased teacher training (listed by 23% of facilitators).

Some of the principals of schools involved in their second year of the project expressed concern about resourcing, with 27% commenting on the need for ongoing funding.

> *The great difficulty in sustaining it will be in paying for it.*
>
> *I am very concerned about resourcing costs.*

In conclusion, participants expressed a variety of views on the ENP professional development programme and The Number Framework and resources. The majority of these comments were extremely positive. Participating teachers reported increases in their own knowledge of maths with corresponding increases in enthusiasm and enjoyment of the subject. They also reported improvement in their competence and confidence in teaching number. Participating facilitators and principals were similarly positive about the impacts of the programme on student achievement and teacher effectiveness. In general, the responses were very similar to those given in the CMIT 2000 evaluation.

The majority of CMIT schools believed that they had been able to sustain the developments that occurred as a result of their involvement in the pilot project in 2000, noting teacher interest and enthusiasm and the implementation of the ANP as keys to sustaining developments.

Chapter Five: Effective Teaching of Early Number

As described in chapter two, the teaching practices of 10 case-study teachers were assessed. These teachers were selected on the basis that they were effective in terms of students in their classes in the CMIT 2000 pilot project making the transition from counting to part-whole strategies.

Demographic and Biographical Data of Case-study Teachers

The 10 teachers selected had a wide range of teaching experience. At the lower end of the scale were two teachers in their second year of service, and at the other extreme was a one teacher with thirty years experience. Most of the teachers had spent the majority of their professional lives working in the junior area of the school.

Four of the teachers selected for the case study had received no maths professional development prior to CMIT. The more experienced teachers among the group had participated in some professional development, three receiving development opportunities associated with the release of the mathematics curriculum document and one having development experiences alongside the implementation of the Beginning School Mathematics (BSM) programme. Other professional development experienced by teachers in this group included a school-based development associated with rearranging school resources to accommodate a topic-based approach and two courses on the basics of junior maths (covering such topics as the use of task boards and classroom management).

The teachers also showed a wide variety of experiences in the level of maths studied prior to teacher training. This ranged from qualifications less than school certificate to 200 level university papers. Three of the teachers had majored in maths in their pre-service training.

Common Characteristics of Effective Teachers

After the first set of classroom-based observations, the videotapes and interview transcripts were reviewed by the researchers in an attempt to identify common teaching practices. The following list of practices was compiled.

(In no particular order)

1 A thorough knowledge of the students being taught: both their mathematical knowledge and the way they learn
2 Strong, positive relationships with students
3 Asking students to explain their thinking and waiting for them to do so (in teaching situations)
4 Using other students' questions and explanations to help students progress in their thinking

5 Clearly defined objective(s) for each teaching session, which helped teachers focus the learning (These objectives were made explicit to the students.)
6 Teachers clearly knowing where they were headed and why they asked the questions they did
7 Clear expectations that students would make progress.

It is interesting to note that these findings are in line with current research. A recent summary of the documented characteristics of effective teachers lists a depth of knowledge in the subject(s) area, clear learning goals and high expectations among the core pedagogical qualities of effective teachers (Fraser and Spiller, 2001).

This list of common characteristics was circulated to the teachers before the second set of classroom-based observations were conducted. The teachers verified the list, and it helped set the context for this second visit. The video recording of the second observed teaching session was viewed by the teachers and was used as a basis for a self-reflection interview. Teachers were questioned on their own practices, using the context of the teaching session as a basis for discussing the list of common characteristics. This interview was audiotaped and transcribed, and the transcription was then analysed.

This analysis resulted in the reworking of the list of common characteristics into three key themes: general characteristics, planning practices and classroom interactions. One extra point concerning teacher knowledge of The Number Framework was added. This re-worked list appears below along with teacher reflections on effective practice within each key theme.

Teacher Reflections on Effective Practice

General characteristics

Four general characteristics appeared to underpin teachers' planning and classroom interactions. These were:

- A thorough knowledge of the students they are teaching: both their mathematical knowledge and the way they learn
- Strong positive relationships with students
- Clear expectations that students would make progress
- A thorough understanding of The Number Framework and how to apply IT to their students.

Planning practices

The planning practices of the 10 teachers also exhibited some commonalities. These included:

- Clearly defined objective(s) for each teaching session, which helped the teachers focus the learning, select an appropriate learning activity and pose questions to students. The objectives were made explicit to the students.

In their planning, all teachers were aiming to enable their students to use part-whole thinking strategies in their solution of number problems. One teacher described this ultimate objective as being a sought-after prize.

Part-whole, that is the prize; if you can get them to advance to that, then they are going to make it. Helping them to realise that you can group and play around with them [numbers] is huge. That is the biggest change, the hardest change, and once you have got them there, they have arrived.

Several teachers expressed an awareness of this ultimate objective. Planning for each lesson included specific learning outcomes, but these were set within the broader context of a progression to part-whole thinking strategies.

You know how we talk about specific learning outcomes? I would like to have something that is a bigger picture ... I like to have objectives [that] are a wee bit more global. [I have] that concept in my mind, and that is where I want them to go ...

I think the planning I am doing is pretty tight, and I am thinking very hard about objectives. Sometimes there might be an objective that goes over two or three days, or it might be just a general objective for the week, such as to use this particular, more efficient strategy. That has been going on all year ... we are working on basically the same objective really.

The second teacher's reference to working on the same objective all year is a reference to the fact that that teacher is constantly focused on moving students towards part-whole thinking strategies.

Within the larger context of a progression to part-whole thinking, specific learning outcomes were selected for each lesson to focus learning.

I wanted them to apply Making to 10 with larger numbers. They can do it with numbers to about 30, so we were moving up.

They need more practice at the moment at this compensation idea, that was my focus ... compensation using the tens frames.

I need to know where the children are at, but I also need to know where [I'm hoping they will] go within that lesson. You always have to know where they are and where you want them to go ... otherwise, I could sit here and talk till the cows come home, but if they don't understand, it is a waste of my time and their time.

Once objectives were selected, these were made explicit to students.

I think children need to know why they are doing things ... If they can understand why we are doing it, perhaps they will see a meaning in why we are doing it.

In addition to selecting objectives, planning also involved selecting a learning activity, or a particular piece of equipment to support student's thinking. This selection process was evident, with all teachers having clear reasons for equipment choice.

One teacher chose to present students with a variety of equipment and let them choose what to use, stating:

... my reason for having all that different equipment out is that I have done quite a lot of it [strategy work], and I really just wanted to see if they were left to their own devices what they would do ... and they showed a real mixture. I just want to see how they are going to go about doing it – what strategy is their preferred strategy. After having done so much work on compensation, I am actually quite disappointed because they are not blinking-well using it.

Other teachers gave their students more direction, defining the equipment to be used and the appropriate procedures to be followed. They expressed clear reasons for this.

Researcher: *You said "What I want you to do is to take this counter and move it over there." Can you tell me why you are doing this?*
Teacher: *Just so they physically take one off there and physically move it. Before they can image it in their head, I use the process of "do with equipment", and then image, to help them develop the mental strategies.*

... to go from bundling them [popsticks] up to "OK, show me this number", that is a step in itself ... a small step, but it is still a step ... That was what I was trying to do ... go from me modelling it, to them doing it, and then take it a step further ... from a given set of equipment to a number, "Now show me this number."

In the following example, the equipment is being used in a step-like fashion to enable thinking progression, with each lesson developing on the next.

Researcher: *So where to next with them?*
Teacher: *With them, I would do the popsticks again, but this time, they would not be allowed to take any out of the pile.*
Researcher: *OK*
Teacher: *Just look at what they had, the 26 [put the 20 to one side and] say six and what would happen if they added on seven, and hopefully, they can visualise them going into the elastics bands, using four to make up to 30, then three left over. So they can see the 33 in their minds.*

It is interesting to note that, in all three specific examples, teachers were working to move students from the use of equipment, to imaging or visualising the strategy mentally. This process of moving from concrete to abstract thinking was emphasised more highly in the ENP professional development programme than in the CMIT programme undertaken by this group of teachers. It is interesting therefore to see this progression recognised and valued by these teachers.

All teachers demonstrated flexibility within their planning. This was enabled by the general characteristic of a thorough understanding of The Number Framework.

As long as the teacher knows where they are headed ... I think the other thing with that is that they know what to go back to. Like today, I know what to go back to if something doesn't work.

This knowledge of The Number Framework combined with a thorough knowledge of the students being taught enabled planning to meet the needs of individual students. This was

evident with two of the teachers who had struggling students. The planned pace of their lessons was consequently slower than the other observed lessons with one of these teachers reflecting:

> *These are the ones [who] find maths difficult and need lots and lots of reinforcement, and lots and lots of looking at it and doing it different ways.*

Classroom interactions

Two specific classroom interactions were identified as being central to effective teaching:

- Asking students to explain their thinking and **waiting** for them to do so (in teaching situations)
- Using other students' questions and explanations to help students progress in their thinking.

All the teachers observed placed a high priority on having students verbalise their thinking strategies.

> *... asking students to explain their thinking and waiting for them to do so. Sometimes I get a bit impatient and want to butt in. So you are trying. Sometimes you are trying to cover too much, it's best to just cover a little bit so that you do have time to do that.*
>
> *I think it is important that they can actually verbalise how they got there, and in most cases, I try to stress that as opposed to the other stuff.*

The lengths taken to find out about students' thought processes evidenced the high priority teachers placed on this. One teacher sought out the response of a particular student, questioning him again or seeking him out in a one-to-one situation as was appropriate.

> *He will put up his hand as he is really keen, and then he will forget what he is saying, or he won't know, so I will usually wait longer, or I say "Keep thinking and I will come back to you". Or I get to him one-to-one and find out what he is doing that way.*

Reflections from teachers on this practice of waiting for students' explanations of their thinking strategies revealed they had specific reasons for this. They were giving students a chance to learn from the explanations of their peers and were also confirming their own assessment of the strategies a particular student might have been using.

> *... I think I am hoping that the ones that aren't quite getting it are learning from the others. But some are just not mature enough to pick it up yet ... they are not ready to be there, and others are ready to move on. I don't think any of the kids in that group today are ready to go on. They need more practice at the moment at this compensation idea. I don't think they have quite got that.*
>
> *By waiting, the penny drops.*
>
> *... so that those ones that did it a slow way could actually hopefully listen and catch on a bit ... and also for me because I am still just double checking what sorts of things they are doing.*

Teachers displayed flexibility in classroom interactions, adapting lessons as they progressed in response to students' demonstrated needs. One teacher reflected:

Teacher: *[You need to be] flexible as the lesson goes so that your questioning can follow through and match the children's thinking. Sometimes you might have to go out on a tangent to clarify or sort out, like with Jack today. Perhaps it is not going to head down the path that you expect it to. Keep an open mind and be flexible, so that you can adapt what you are doing. Have questioning in your mind that matches what the children are saying to you to get them to the next level ... use the children's responses. Question further.*

Researcher: *What you did today, did you have questions that you were thinking you would use?*

Teacher: *Yes. Yes. And changes to those. Some of those I gave to Jack. I had to accommodate or go back a few steps from where I expected him to be.*

Demonstrating this flexibility, one teacher effectively split her group in two very early in the lesson, running two parallel sessions. Half her students solved the first problem very quickly so she got them to show her their answers (without revealing the answers to the rest of the group) before setting them some more challenging work. She reflected:

Teacher: *Poor wee things. That is where the group needed to be split in half.*

Researcher: *You have set them [the more able students] a problem very quietly. Why did you do that?*

Teacher: *I think I said to write it down [the answer to the first problem] so I could really see [what they were thinking], then I realized that they were going to get bored, so I had to do something about it.*

Researcher: *So you asked the fast ones to write it down so you could see where they were?*

Teacher: *I was conscious that some were going to struggle today, ... so I didn't want to put them too much on the spot.*

A Student Perspective on Effective Teachers

As described in chapter two, students were shown video recordings of the observed lessons and questioned to obtain their perspective on the teaching episode. They appeared distracted by the novelty of the situation, and limited responses were obtained using video footage. The interview process was found to be more effective at eliciting students views, and when asked about what made their teacher a "good teacher", several common themes emerged.

Teachers were seen as the providers of information.

She tells us lots of things to learn about ... tells us really good and important stuff ... she tells us things that are right.

In addition to the role of providing information, students also recognised the facilitation role their teachers played, helping them progress in their thinking but leaving the responsibility for learning in their hands. Several of the students commented that their teachers listened to their explanations.

She makes sure you understand because she sometimes writes it all on the board, and she just explains it a bit more, and she can give you lots of ideas of easy ways to do it.

She helps us work things out.

She doesn't know what our answers are and what we are thinking about. We have to tell her.

Students also recognised and appreciated the friendly and approachable nature of their teachers, making statements such as "she is nice" and "she helps you if you're hurt". It is interesting to note this is one of the four general characteristics identified in the initial analysis above.

Chapter Six: Summary

The results of the ENP show that students made significant progress on The Number Framework, with mean gains of about a stage shown at each area of the framework over the six months of the project. The expected gain with time alone is about one-fifth of a stage over the same six-month period. These gains are independent of the students' gender, age, ethnicity, region and decile.

The only factor that was shown to affect mean gains was students' starting points on the framework. Students who started at the lower stages of the framework tended to make greater gains, suggesting that the higher stages may represent bigger steps for students to make. Although all students made similar gains, there were marked differences between subgroups of students, when their number profiles, expressed as stages on The Number Framework, were compared. The decile of the school and the ethnicity of the student were strongly related to the number profiles. Students in high decile schools and students of Asian or New Zealand European descent had larger proportions at the higher stages of the framework.

In general, the response from participating teachers, principals and facilitators was very similar to that found in the CMIT 2000 evaluation (Ministry of Education, 2001a). A positive response to mathematics in general was noted, with teachers reporting an increase in their enthusiasm and enjoyment of the subject.

The content and pedagogical knowledge of participating teachers developed during the project, with the key development noted being an increased understanding of The Number Framework. Facilitators also noted an increased knowledge of The Number Framework as a key factor in the teachers' development. Teachers changed their classroom programmes to accommodate their new knowledge in a wide variety of ways, increasing their focus on students' development of number strategies and knowledge, utilising more effective grouping and using equipment more appropriately.

The professional development programme was generally well received, with the most helpful element found to be in-class modelling by the facilitator and the least helpful being the requirement to produce a large number of resources and the layout and size of the resource folder.

The majority of CMIT schools taking part in the ENP believed that they have been able to sustain the developments that occurred as a result of their involvement in the CMIT project in 2000, noting teacher interest and enthusiasm and the implementation of the ANP as keys to sustaining development. The ANP was seen as having school-wide benefits, namely, a more unified, consistent and collaborative approach, which helped to ensure continuity.

Principals and teachers in the CMIT schools believed that their students built on the gains from the first year of participation. This belief is supported by the results of the five- and six-year-olds. The results for the seven-year-olds appear to highlight the challenge posed by the transition from early to advanced additive strategies and suggest that a significant number of

these students, irrespective of length of participation in the project, are unable to make this transition. It will be important and interesting to examine the transition to advanced additive strategies with the ANP.

Two types of classroom interaction were identified as central to effectively teaching early number. These involved teachers asking students to explain their thinking and waiting for them to do so and the use of other students questions and explanations to help students' progress in their thinking. The common planning practices underlying the effective teaching of early number included clearly defining objective(s) for each teaching session, focusing learning, selecting an appropriate learning activity and posing questions to students. These objectives were made explicit to the students.

References

Askew, M., Brown, M., Rhodes, V., Johnson, D., and Wiliam, D. (1997). *Effective Teachers of Numeracy.* London: King's College.

Carpenter, T., Fennema, E., Loef Franke, M., Levi, L., and Empson, S. (1999). *Children's Mathematics: Cognitively Guided Instruction*. Portsmouth: Heinemann: NCTM.

Clarke, D. and Cheeseman, J. (2000). "Some Insights from the First Year of the Early Numeracy Research Project". *Improving Numeracy Learning: Proceedings of the ACER Research Conference 2000*, Australian Council for Educational Research, Brisbane, pp. 6–10.

Cobb, P., Gravemeijer, K., Yackel, E., McClain, K., and Whitemack, J. (1997). *Mathematizing and Symbolizing: The Emergence of Chains of Signification in One First-grade Classroom.* Mahwah, NJ: Lawrence Erlbaum.

Fraser, D. and Spiller, D. (2001). "Effective Teachers". In C. McGee and D. Fraser (eds.) *The Professional Practice of Teaching.* (pp. 67–84). Palmerston North: Dunmore Press.

Fullan, M. and Hargreaves, A. (1992). *Teacher Development and Educational Change*. London: The Falmer Press.

Fuson, K. C., Wearne, D., Hiebert, J., Human, P., Olivier, A., Carpenter, T., and Fenema, E. (1997). "Children's Conceptual Structure for Multidigit Numbers and Methods of Multidigit Addition and Subtraction". *Journal for Research in Mathematics Education, 28*, pp. 130–162.

Jones, G., Thornton, C., Putt, I., Hill, K., Mogill, A., Rich, B., and Van Zoest, L. (1996). "Multidigit Number Sense: A Framework for Instruction and Assessment". *Journal for Research in Mathematics Education, 27*(3), pp. 310–336.

Ministry of Education. (2001a). *An Evaluation of the Count Me In Too Pilot Project*. Wellington: Learning Media.

Ministry of Education. (2001b). *An Evaluation of the Year 4–6 Numeracy Exploratory Study*. Wellington: Learning Media.

Ministry of Education. (2001c). *Curriculum Update 45: The Numeracy Story*. Wellington: Learning Media.

Ministry of Education. (2001d). *Early Numeracy Project*. Wellington: Learning Media.

Parsons, R. (2001). *Professional Development: Improving Teaching Capability*. Paper presented at the Numeracy Project Conference, Auckland College of Education, 3–5 December.

Steffe, L. (1992). "Learning Stages in the Construction of the Number Sequence". In J. Bideaud, C. Meljac, and J. Fischer (eds.) *Pathways to Number*. Hillsdale, NJ: Lawrence Erlbaum, pp. 83–98.

Steffe, L. and Cobb, P. (1988). *Construction of Arithemetical Meanings and Strategies*. New York: Springer-Verlag.

Stephens, M. (2000). *Identification and Evaluation of Teaching Practices That Enhance Numeracy Achievement*. [http://www.aamt.edu.au/AAMT/ctxintro.html]. Paper commissioned by the Australian Association of Mathematics Teachers Inc.

Wright, R. (1998). *An Overview of a Research-based Framework for Assessing and Teaching Early Number.* Paper presented at the 21st Annual Conference of the Mathematics Education Group of Australasia, Brisbane: Griffiths University.

Wright, R. J., Stanger, G., Cowper, M., and Dyson, R. (1996). "First-graders' Progress in an Experimental Mathematics Recovery Program". In J. Mulligan and M. Mitchelmore (eds.), *Children's Number Learning: A Research Monograph of the Mathematics Education Research Group of Australasia*. Adelaide: AAMT, pp. 55–72.

Wright, R.J., Martland, J., and Stafford, A. (2000). *Early Numeracy: Assessment for Teaching and Intervention*. London: Paul Chapman Publications/Sage.

Young-Loveridge, J. (1999). "The Acquisition of Numeracy". *SET: Research Information for Teachers,* 1(12).

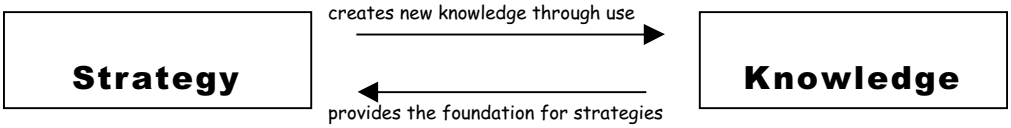
Appendix A: The Number Framework

Introduction

The Number Framework has been established to help teachers and children to understand the requirements of the Number strand from *Mathematics in the New Zealand Curriculum*. The framework relates to most of the achievement aims and objectives in levels 1 to 4.

There are two main sections to the framework; Strategy and Knowledge. The Strategy section is about how children solve number problems, in particular the mental processes they use. The Knowledge section considers the key items of knowledge that children need to acquire.

It is essential that children make progress in both sections of the framework as these parts are dependent on one another. Clearly it is impossible for a child to apply a clever strategy to solve a number problem if they have weak knowledge. For example, a child will not work out 8 + 6 as 10 + 4 if they do not know that 10 + 4 = 14. Similarly, using clever strategies helps to develop knowledge. For example, a child who uses doubling of the three times tables to work out the six times tables will soon learn their tables through appropriate repetition.



Underpinning the framework is a sequence of global strategy stages. The stacked layout of the stages represents increasingly sophisticated concepts about numbers.

Part-whole	Advanced Proportional Advanced Multiplicative Advanced Additive Early Additive
Counting	Advanced Counting One-to-one Counting Emergent

We have defined these stages in order to make it easier to identify and describe the kinds of mental strategies that children are using so that they can be lead to develop more sophisticated ones. Children appear to be very consistent in their view of numbers, and this consistency helps

us to anticipate what kinds of strategies they are likely to use and to plan appropriate learning activities and questions.

An Overview of the Strategy Section of the Framework

Below, we have described each strategy stage and linked it to the child's view of numbers as being units. Each stage assumes that the child has the ability to call up these unit structures and manipulate them mentally. Teachers need to have experience with using the *Early Numeracy Project Assessment (ENPA)* technique for interviewing children in order to understand these stages.

It is important to remember that children are often between stages. That is, they display characteristics of one stage given a certain problem but may use more or less advanced strategies given different problems. Consider this to be metaphorically like a children having one foot in both stages and "shifting weight" until they are confident in stepping to the more advanced stage.

Each stage contains the operational domains of addition and subtraction, place value, multiplication, and fractions. In the table below, information in the cells, reading across each stage, relates to the strategies that are consistent with the unit structure used by the child at that stage.

		Operational Domains			
Stages		Addition Subtraction	Place value	Multiplication	Fractions
Counting	Pre-Counting				
	Count All from One				
	Advanced Counting				
Part-Whole	Early Additive				
	Advanced Additive				
	Advanced Multiplicative				
	Advanced Proportional				

The most advanced stage demonstrated by children on any of the operational domains should be seen as their "zone of proximal development" and is indicative of the most advanced unit structure that they understand.

Strategy Stages

This section contains descriptions of the unit structures that children at each stage are using along with some examples of specific unit structures.

Stage One: Pre-Counting

Children at this stage have no counting unit. They are unable to count a given number of objects because they lack an understanding of counting sequences, one-to-one correspondence, or both.

Stage Two: Count All from One

Children at this stage have a counting unit of one. Given a joining or separating problem they represent all the objects in both sets, either with materials or later in their mind as an image. They count all the objects in both sets to find an answer.

Stage Three: Advanced Counting

This stage marks the point where the child realises that a number can represent a completed count that can be built on. For example, instead of counting all objects to solve 8 + 4, the child recognises that "8" represents the act of having counted 8 objects and counts on from there (8, 9, 10, 11, 12). Children at this stage also develop the ability to put together completed counts as in 10, 20, 30, 40, 50 to get $50 in $10 notes and increments in tens as in 14, 24, 34, 44, 54.

Stage Four: Early Additive Part-whole

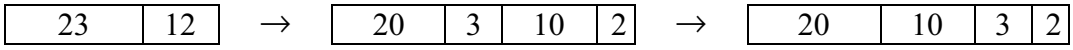
At this stage, the child has begun to recognise that numbers are abstract ideas (units) that can be treated as a whole or can be partitioned and recombined to solve addition and subtraction problems. A particular characteristic of this stage is the deriving of results from closely related known facts, such as finding addition answers by using doubles.

The unit structures that the children are using can be represented as:

(i) Compensation
Example: 7 + 8: 7 + 7 is 14 so 7 + 8 is 15

7	7	→	7	7	1	→	7	8

(ii) Standard place value partitioning,
Example: 23 + 12 is (20 + 10) + (3 + 2) = 30 + 5



The material covered in depth in this folder finishes at this stage.

Stage Five: Advanced Additive/Early Multiplicative Stage

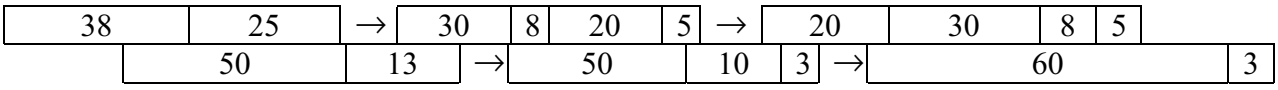
(Stages Five to Seven are covered in more detail in the Advanced Numeracy Project (ANP) folder.)

Children who are at the advanced additive part-whole stage are able to interpret a wide range of contextual problems that involve addition and subtraction, and they can choose appropriately from a rich repertoire of part-whole strategies to solve such problems. This view sees numbers as whole units in themselves, but also "nested" within these units are multiple possibilities for subdivision. Critically this stage includes the use of inverse operations, as in using addition to solve subtraction problems.

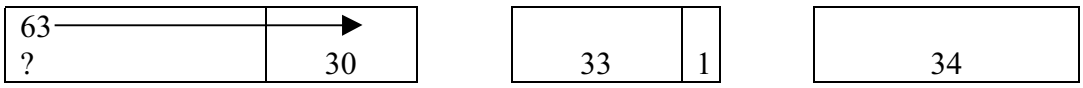
The key strategies used by children at this stage may be represented as:

(i) Standard place value partitioning

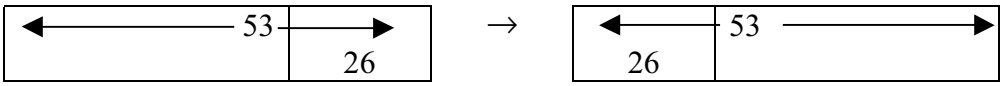
Example: 38 + 25 as 30 + 20 + 8 + 5 = 50 + 13

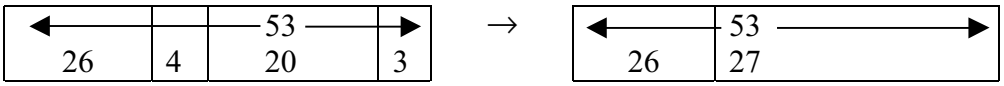


(ii) Compensation
Example: 63 – 29 as 63 – 30 + 1

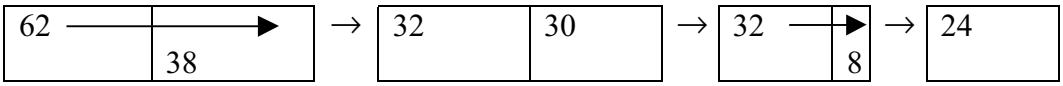


(iii) Inverse operation
Example: 53 – 26: 26 + ? = 53 and 26 + 4 + 20 + 3 = 53
so 53 – 26 = 27



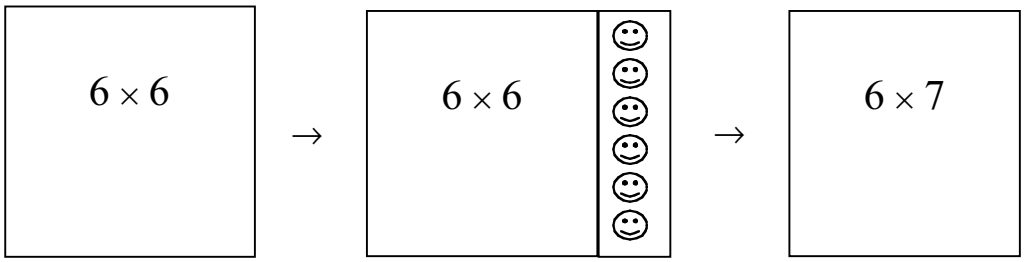


(iv) Decomposition with place value
Example: 62 – 38: 62 – 30 = 32, 32 – 8 = 24



Children at the advanced additive stage treat multiplicative units simultaneously as whole structures and units that can be partitioned and re-combined. A significant characteristic of children at this stage is their ability to derive multiplication and division facts from closely related known results. This is a direct result of their fluency with additive unit structures.

Example: $6 \times 6 = 36$ so 7×6 must be 6 more which is 42.

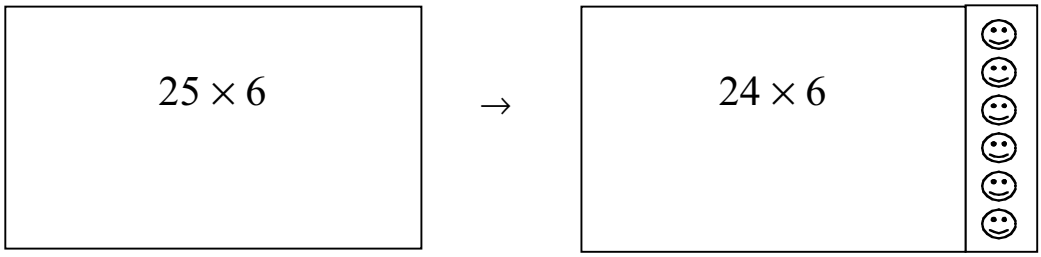


Stage Six: Advanced Multiplicative/Early Proportional Part-whole

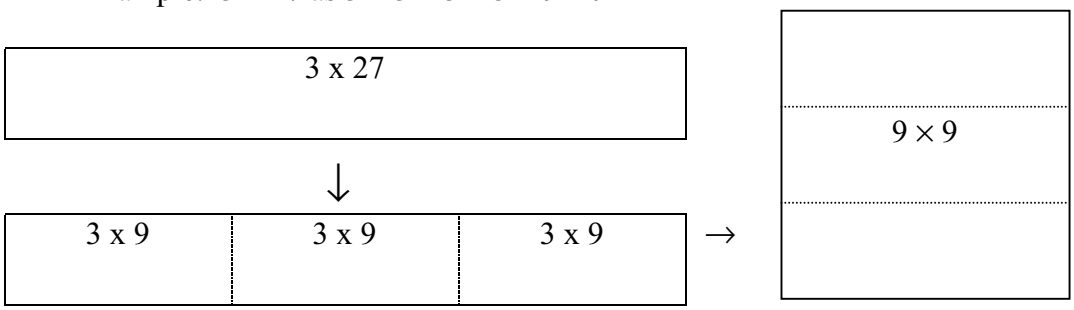
Children at the advanced multiplicative stage can solve contextual problems by choosing appropriately from a wide range of part-whole strategies that involve multiplication and division. This entails viewing multiplicative units as both complete and sub-dividable. A critical development at this stage is the use of inverse operations, for example, solving a division problem using multiplication.

Key strategies for advanced multiplicative children are summarised diagrammatically below:

(i) Compensation
Example: 24×6 as $25 \times 6 - 6$

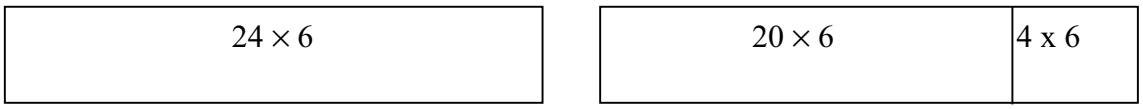


(ii) Associative property
Example: 3×27 as $3 \times 3 \times 3 \times 3 = 9 \times 9$



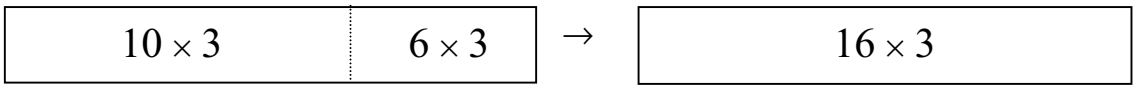
(iii) Distributive property

Example: 24×6 as $(20 \times 6) + (4 \times 6)$



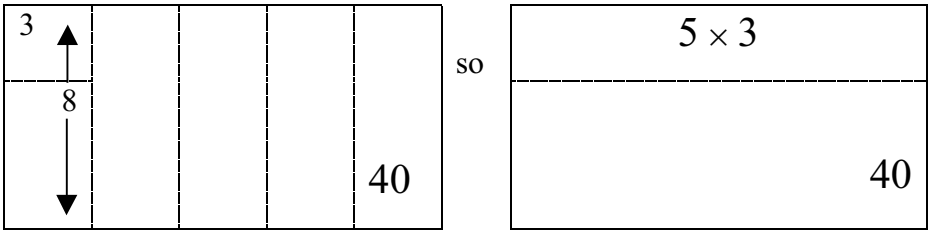
(iv) Proportion
Example: $80 \div 5$ as $(80 \div 10) \times 2$

(v) Inverse operation
Example: $48 \div 3$ as $? \times 3 = 48$, $10 \times 3 = 30$ and $6 \times 3 = 18$ so $48 \div 3 = 16$



Advanced multiplicative children develop the ability to apply multiplication and division unit structures to solve problems that involves fractions and proportions. This allows them to understand fractional and proportional equivalence, which is a foundation for the decimal system.

Example: Out of every 8 lollies in the jar 3 of them are raspberry. There are 40 lollies in the jar. How many of them are raspberry?
(3:8 as ?:40, $5 \times 8 = 40$ so $5 \times 3 = ?$)



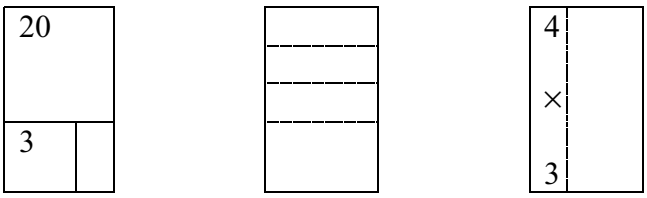
Stage Seven: Advanced Proportional Part-whole

Children who are at the advanced proportional stage are able to select from a wide range of part-whole strategies to solve problems that involve fractions and proportions. Critically this entails applying inverse operations, for example, solving a division problem by multiplication.

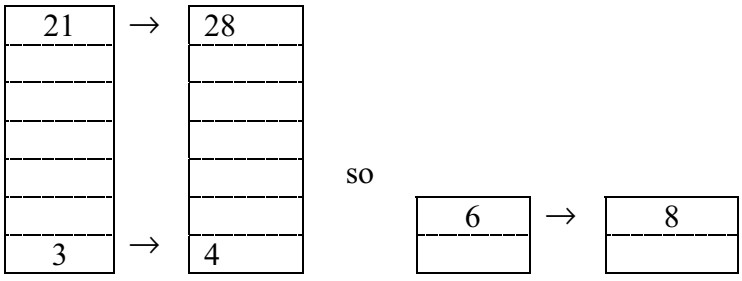
Key strategies for Advanced Multiplicative children are summarised diagrammatically below:

(i) Within strategies

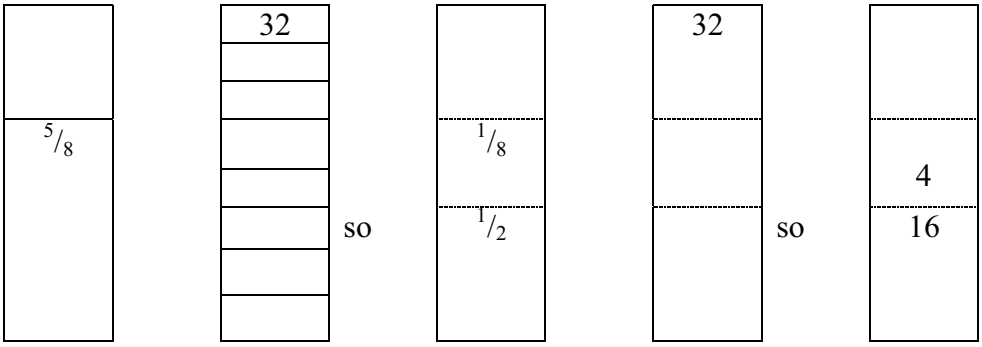
Example: Of every 5 children in the class, 3 are boys. There are 20 children in the class. How many of them are boys?
(3:5 as ?:20: $4 \times 5 = 20$ so $4 \times 3 = 12$)



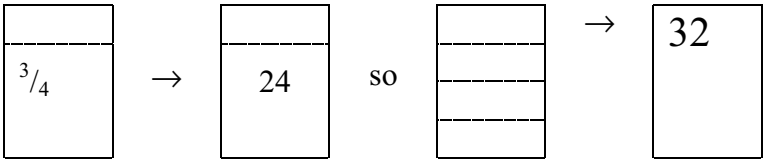
Between strategies
Example: You can make 21 glasses of lemonade from 28 lemons. How many glasses can you make using 8 lemons? (21:28 as ?:8, 21 is $^3/_4$ of 28 so $^3/_4$ of 8 is 6)



(iii) Distributive property
Example: Albert has 32 matchbox toys. Five-eighths of them are sports cars. How many of the matchbox toys are sports cars?
($^5/_8$ of 32 as $^1/_2$ of 32 is 16 and $^1/_8$ of 32 is 4, so $^5/_8$ of 32 is 16 + 4 = 20)



(iv) Inverse operation
Example: Marina has 24 metres of fabric to use to make T-shirts for the Kapahaka group. Each T-shirt takes three-quarters of a metre of fabric. How many T-shirts can Marina make?
($24 \div {}^{3}/_{4} = ?$ by ${}^{3}/_{4} \times ? = 24$)



An Overview of the Knowledge Section of the Framework

The intention of the Knowledge section of the framework is to outline the important items of knowledge that children should learn as they progress through the strategy stages. This knowledge plays a critical role in children applying their available strategies with proficiency and fluency across all the numbers and problem types that they may encounter.

The framework has knowledge categorised under four content domains: Numeral Identification, Number Sequence and Order, Grouping/Place Value and Basic Facts, and Written Recording. Items of knowledge can be taught to children across a range of strategy stages. This avoids limiting the children's exposure to important mathematical ideas. For example, children can come to read and write decimals long before their strategies are sufficiently developed for them to use decimals in operational problems.

It is important to recognise that the knowledge framework reflects some significant shifts in emphasis from previous interpretations as well as a restatement of the importance of some knowledge items. These shifts are in keeping with the trends observed across most overseas countries.

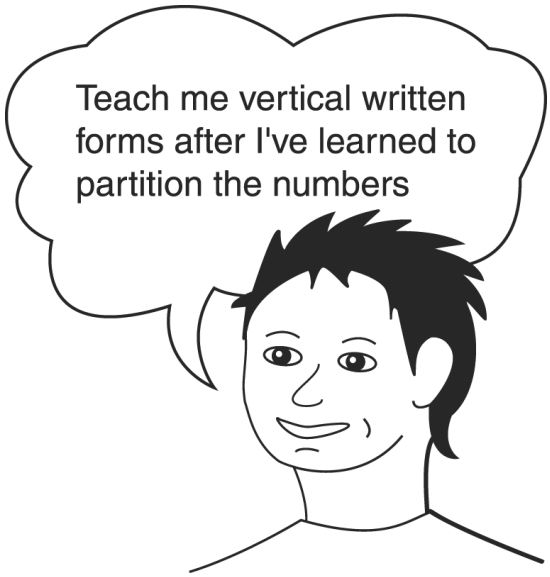
Written recording is seen primarily as a means to "think through" calculations **so that children are not exposed to standard vertical algorithms until mental strategies are sufficiently advanced**.

Counting needs to be developed with all primary-aged children. This counting should extend past counting by ones, twos, and other simple multiples into counting in powers of ten, in decimals, and in fractions. The framework also acknowledges the importance of backwards counting sequences, particularly in the early years of primary schooling.

The framework encourages greater use of children's natural inclination to use groupings of fives. There is significant emphasis on using finger patterns in the early years and in using multiples of five in later work, for example, 35 + 35 = 70, 500 + 500 = 1000.

The most significant model of fractions that needs to be developed is the partitioning of sets. Continuous models such as regions and lengths are useful spatial contexts for fractions, but sets models offer the more direct link to understanding the decimal system.

Basic fact knowledge is critical. *The Number Framework* emphasises that the process of coming to know and derive number facts is as important as knowing them. It also demands that children come to know a broader range of facts than previously, including groupings of "benchmark" numbers, knowledge of decimal, and fraction conversions. It is vital to the development of fluency and flexibility that children be able to automatically recall key number facts.



Appendix B: Early Numeracy Project Assessment

ENP Individual Assessment Script

Things that the teacher **says** to the child appear in ***bold*** and ***italic*** type.
Comments for the teacher's information appear in *italic*.

Stages of Early Arithmetic Learning (SEAL)

(1) ***Get me 8 counters.***
(The rest of the SEAL framework appears at tasks 47–50.)

	Stage and Behavioural Indicator
0	**Emergent** The child has no reliable strategy to count an unstructured collection of items.
1	**One-to-One Counting** The child has a reliable strategy to count an unstructured collection of items.

Forward Number Word Sequence (FNWS)

(2) ***"Start counting from 1. I will tell you when to stop."*** (*Stop the child at 32*.)

(3) ***"What's the next number after …?"***

(4) ***"What's the next number after 5?"*** *If the child does not understand the question, say,* "The next number after 2 is 3. Now what is the next number after …?"

(5) ***"… after 9?"*** *For questions (5) to (8) listen carefully for confusion between "-teen" (as in the numbers between twelve and twenty) and "-ty" (as in the numbers from twenty up). If the child is confused by this, you should assess them as being no higher than stage 2.*

(6) ***"What's the next number after 13?"***

(7) ***"… after 19?"***

(8) ***"… after 12?"***

(9) ***"… after 15?"*** *If the child confuses "-teen" and "-ty" in questions 5 to 8, it is still worth while to ask questions (9) to (11) to see if the confusion is only with the "-teen" numbers.*

(10) ***"What's the next number after 29?"***

(11) ***"… after 46?"***

(12) ***"… after 69?"***

(13) ***"… after 80?"***

	Stage and Behavioural Indicator
0	**Emergent FNWS** The child cannot produce the FNWS from 1 to 10.
1	**Initial FNWS up to 10** The child can produce the FNWS from 1 to 10 but *cannot* produce the number just after a given number in the range 1 to 10.
2	**FNWS up to 10** The child can give the number just after a given number in the range 1 to 10 *without dropping back.*
3	**FNWS up to 20** The child can produce the number just after a given number in the range 1 to 20 *without dropping back*.
4	**FNWS up to 100** The child can produce the number just after a given number in the range 1 to 100 *without dropping back.*

Backward Number Word Sequence (BNWS)

(13) ***"Count backwards from 10. I will tell you when to stop."*** *Stop the child at 0 or 1.*

(14) ***"Count backwards from 24. I will tell you when to stop."*** *Stop the child at 12.*

"What number comes before …?" *If the child does not understand question say,* ***"The number that comes before 4 is 3. Now what is the number that comes before …?"***

(15) ***"… before 3?"***

(16) ***"… before 5?"***

(17) ***"… before 9?"***

(18) ***"… before 8?"***

For questions 19 to 21, listen carefully for confusion between "-teen" and "-ty". If the child is confused by this, you should assess them as being no higher than stage 2.

(19) ***"What number comes before 16?"***

(20) ***"… before 20?"***

(21) ***"… before 17?"***

(22) ***"…before 11?"***

If the child confuses "-teen" and "-ty" in questions 5 to 8, it is still worth asking them questions (23) to (26) to see if the confusion is only with the "-teen" numbers.

(23) ***"What number comes before 47?"***

(24) ***"… before 13?"***

(25) ***"… before 70?"***

(26) ***"… before 31?"***

	Stage and Behavioural Indicator
0	**Emergent BNWS** The child cannot produce the BWNS from 1 to 10.
1	**Initial BNWS up to 10** The child can produce the BWNS from 1 to 10 but cannot produce the number just before a given number in the range 1 to 10.
2	**BNWS up to 10** The child can produce the number just before a given number in the range 1 to 10 *without dropping back*.
3	**BNWS up to 20** The child can produce the number just before a given number in the range 1 to 20 *without dropping back*.
4	**BNWS up to 100** The child can produce the number word just before a given number in the range 1 to 100 *without dropping back.*

Numeral Identification

"What is this number?"

Show cards with the number written on them.

(27)	3	(28)	2	(29)	7
(30)	9	(31)	8	(32)	6

For questions (33) to (37), listen carefully for confusion between "-teen" and "-ty" If the child is confused by this, you should assess them as being at stage 1.

"What is this number?"

(33)	13	(34)	19	(35)	11
(36)	16	(37)	12		

If the child confuses "-teen" and "-ty" in questions 33 to 37, it is still worth asking questions 37 to 44 to see if they are only confused with the "-teen" numbers.

"What is this number?"

(38)	66	(39)	43	(40)	80
(41)	38	(42)	97	(43)	309
(44)	431	(45)	470	(46)	800

Stage and Behavioural Indicator
0 Emergent Numeral Identification The child cannot identify most of the numerals in the range 1 to 10.
1 Numerals to 10 The child can identify the numerals in the range 1 to 10.
2 Numerals to 20 The child can identify the numerals in the range 1 to 20.
3 Numerals to 100 The child can identify 1- and 2-digit numbers.
4 Numerals to 1000 The child can identify 2- and 3-digit numbers.

Stages of Early Arithmetic Learning (SEAL)

Look back at the answer to question (1) about counting out items. If the child could not count 8 items, end the interview now; rate the child as stage 0 on the SEAL and stage 0 for the Base Ten Strategies.

(47) **"*I have 5 apples and I get another 3 apples. How many apples do I have altogether?*"**

(48) **"*Here are 9 counters.*** *(Briefly display and then screen).* ***Here are 4 counters.*** *(Briefly display and then screen.)* ***How many counters are there altogether?"*** *(Use a separate colour for each collection.)*

(49) ***"I have 14 sweets, and I eat 5 sweets. How many sweets do I have left?"***

(50) ***"I have 8 oranges and buy 7 more oranges. How many oranges do I have now?"***

Stage and Behavioural Indicator	
0	**Emergent** The child has no reliable strategy to count an unstructured collection of items.
1	**One-to-One Counting** The child has a reliable strategy to count an unstructured collection of items.
2	**Counting from One on Materials** The child's most advanced strategy is counting from one on materials to solve addition problems.
3	**Counting from One by Imaging** The child's most advanced strategy is counting from one without the use of materials to solve addition problems.
4	**Advanced Counting** The child's most advanced strategy is counting on, or counting back to solve addition or subtraction tasks.

5	**Early Additive Part-whole Thinking** The child shows *any* advanced strategy to solve addition or subtraction problems mentally by reasoning the answer from known basic facts. Examples from questions (48) to (50): 9 + 4: split the 4 into 1 and 3, add the 1 to the 9 to give 10 + 3 = 13. 12 – 3: 12 - 2 = 10, 10 – 1 = 9. 7 + ... = 11: 7 + 3 = 10, 3 + 1 = 4.
6	**Advanced Additive Part-whole Thinking** This is the *same* as the Base Ten Strategies stage 6. The child is able to use a full *range* of mental strategies to solve addition or subtraction and problems with 2 and 3 digits. The child is able to explain the method clearly. The child does not resort to imaging vertical written forms as a mental strategy. Examples from question (52): 39 + 28: 30 + 20 = 50, 50 + 9 = 59, 59 + 8 = 59 + 1 + 7 = 67 103 + 97: 103 – 3 = 100, 97 + 3 = 100, 100 + 100 = 200 65 – 38: 65 – 30 = 35, 35 – 8 = 27 107 – 98: 98 + 2 = 100, 100 + 7 = 107, 2 + 7 = 9 450 – 398: 450 – 400 = 50, 400 – 398 = 2, 50 + 2 = 52

Base Ten Strategies (BTS)

(51) *Place a Fours Strip horizontally on the table. Ask the child to count the dots. Place a Tens Strip horizontally on the table. Ask the child to count the dots. Now place a Tens Strip horizontally below the Fours Strip.*

"How many dots are there now?" *Continue adding Tens Strips to show 24 34 44 54 64 74.*

(52) *Ask these questions only of a child who is clearly at stage 5 on the SEAL.* ***"Work out in your mind 39 + 28 103 + 97 65 – 38 107 – 98 450 – 398."*** *If the child answers all the questions correctly, rate the child at stage 6 for Base Ten Strategies and also rate the child at stage 6 on the SEAL*

.

	Stage and Behavioural Indicator
0-1	**Emergent** The child has no reliable strategy to count an unstructured collection of items. (This is the *same* as stage 0 in the SEAL.)
2-3	**One-to-One Counting** The child can count items reliably but does not see 10 as a unit of any kind. The child's focus is on the individual items that make up 10.
4	**Counting by Tens** Ten is seen as a unit composed of 10 ones. The child can perform addition and subtraction tasks involving tens where these are presented with materials in units of tens and ones. The child *cannot* solve addition and subtraction tasks involving tens and ones when presented as written number sentences.

5	**Early Additive Part-whole Thinking** The child can solve *some,* but not all, addition and subtraction tasks involving tens and ones mentally when presented as written number sentences.
6	**Advanced Additive Part-whole Thinking** The child is able to use a full *range* of mental strategies to solve addition or subtraction with two and three digits. The child is able to explain the method clearly. The child does not resort to imaging vertical written forms as a mental strategy. (Note: Also rate this child at stage 6 in the SEAL.) Examples from question (52): 39 + 28: 30 + 20 = 50, 50 + 9 = 59, 59 + 8 = 57 103 + 97: 103 – 3 = 100, 97 + 3 = 100, 100 + 100 = 200 65 – 38: 65 – 30 = 35, 35 – 8 = 27 107 – 98: 98 + 2 = 100, 100 + 7 = 107, 2 + 7 = 9 450 – 398: 450 – 400 = 50, 400 – 398 = 2, 50 + 2 = 52

Based on: Wright, R. J., Martland, J., and Stafford, A. (2000). *Early Numeracy: Assessment for teaching and intervention*. London: Paul Chapman Publications/Sage.
Some of the ideas for questions were originally sourced from the New South Wales Department of Education and Training's *Count Me in Too* © programme.

Appendix C: Summary of Questionnaires

Facilitator Questionnaire

Training

1. Your age
2. Gender
3. Years of teaching experience (including this year)
4. Years of advisory experience
5. Do you think that your attitude to junior maths has changed as a result of your involvement in the facilitator training? Please explain.
6. Do you think your content knowledge of maths have been developed as a result of the facilitator training? Please elaborate on your response.
7. Has your understanding of how children learn maths changed as a result of your involvement in the facilitator training? Please elaborate on your response.
8. In your view, what aspect(s) of the ENP facilitator training were the most effective? Why?
9. In your view, what aspect(s) of the ENP facilitator training were least helpful or left you feeling confused? Why?
10. What suggestions can you offer for the improvement of the facilitator training?
11. Any other comments you would like to make concerning the facilitator training.

End of Project

1. Your age
2. Gender
3. Years of teaching experience (including this year)
4. Were you involved as a facilitator in the CMIT pilot project (2000)?
5. From your perspective, what has been the attitude towards the project of your participating teachers? Please specify.
6. In regard to the teachers that you worked with, do you think that the ENP had an impact on their maths content knowledge? If so, please give specific examples in relation to the teachers you were working with.
7. In regard to the teachers who you worked with, do you think that the ENP had an impact on their pedagogical knowledge? If so, how?
8. In your view, has the project had any positive impact on the mathematics programme of the participating teachers? Please elaborate on your response.
9. In your view, has the project has any negative impact on the mathematics programme of the participating teachers? Please elaborate on your response.
10. From your perspective, has the project had any impact on the other teachers in your school who were not participating in the project?
11. In your view, what impact has the project had on the children participating in the project? (consider attitudes, skills, understandings, etc)
12. Which aspects of the professional development (after school workshops, in-class modelling by the facilitator or in-class observation by the facilitator) have you found to be most effective when working with teachers? Why?

13. Have you received a positive response from teachers to the resource folder? Please comment.
14. Have you been involved in cluster meetings with schools? Did you find these to be effective? Please elaborate.
15. What aspects of this project could be improved? Why?
16. Are there any other comments you would like to make about the project?

ENP Principal Questionnaire

1. Region
2. Size of school
3. Decile
4. What factors most influenced your decision to apply to participate in the Early Numeracy Project?
5. From your perspective, what has been the attitude toward the project of your participating teachers? Please specify.
6. In your view, has the project had any positive impact on the mathematics programme of the participating teachers? Please elaborate on your response.
7. In your view, has the project has any negative impact on the mathematics programme of the participating teachers? Please elaborate on your response.
8. In your view, has the project had any impact on the teachers "as a person" either in or outside the classroom? (e.g., confidence, enthusiasm, tiredness)
9. From your perspective, has the project had any impact on the other teachers in your school who were not participating in the project?
10. In your view, what impact has the project had on the children participating in the project? (consider attitudes, skills, understandings, etc)
11. What has been the general reaction of parents on the Early Numeracy Project?
12. What aspects of this project could be improved? Why?
13. Are there any other comments you would like to make about the project?

ENP Teacher Questionnaire

1. Region
2. Size of school
3. Decile
4. Your age
5. Gender
6. Years of teaching experience (including this year)
7. What year level are you currently teaching? (tick all that apply)
8. How many years experience have you teaching in years 1–3?
9. How long have you taught at this school?
10. Do you think that your attitude towards maths has changed as a result of your participation in the project? Please explain your response.
11. Has your content knowledge of maths been developed in any way as a result of your participation in the project? Please elaborate on your response.
12. Has your understanding of how children learn number changed as result of your participation in the project? Please elaborate on your response.
13. Has the way you teach number changed as a result of your participation in the project? Please elaborate on your response.

14. What aspects of the professional development (after school workshops, in-class modelling by the facilitator or in-class observation by the facilitator) have you found most helpful? Why?
15. Do you find the resource folder useful? Please comment.
16. Have you been involved in cluster meetings with other schools? Did you find these useful? Why?
17. Do you find the data-base for results entry user friendly? Please comment.
18. In your opinion, what aspects of the project helped you most? How and why?
19. What aspects of the project were least helpful or confusing? Why?
20. What has been the general reaction of parents to the Early Numeracy Project?
21. What aspects of this project could be improved? Why?
22. Are there any other comments you would like to make about the project?

CMIT Teacher Questionnaire

1. Region
2. Size of school
3. Decile
4. Your age
5. Gender
6. Years of teaching experience (including this year)
7. What year level are you currently teaching? (tick all that apply)
8. How many years experience have you teaching in years 1–3?
9. How long have you taught at this school?
10. Have you been able to sustain the developments that occurred as a result of your involvement in the project in 2000? Please elaborate.
11. Has your content knowledge of maths developed since the completion of the project? Please elaborate.
12. Has your understanding of how children learn number changed since the completion of the project? Please elaborate on your response?
13. Has the way you teach number changed since the completion of the project? Please elaborate on your response?
14. Now that the project has been operating in your school for two years, have you noticed any change in the children's ability in number? Please elaborate.
15. Do you find the ENP resource folder useful? Please comment.
16. Do you find the revised number frameworks helpful? Please comment.
17. Have there been any school-wide benefits from the implementation of the Advanced Numeracy Project in your school this year? Please elaborate.
18. Are there any other comments you would like to make about the project?

CMIT Principal Questionnaire

1. Region
2. Size of school
3. Decile
4. From your perspective, has your school been able to sustain the developments that occurred as a result of your involvement in the project in 2000? Please elaborate.
5. In your view, has the attitude of the teachers towards mathematics programmes changed since the completion of Count Me In Too? Please explain your response.

6. In your view, have the classroom practices of the teachers changed since the completion of Count Me In Too? Please explain your response.
7. Have there been any school-wide benefits from the implementation of the Advanced Numeracy Project in your school this year? Please elaborate.
8. Now that the project has been operating in your school for two years, have you noticed any change in the children's ability in number? Please elaborate.
9. Are there any other comments you would like to make about the project?

Appendix D: Outline of Project Visits

Visit One

Interview with Teacher

Introduction

Reasons for teacher selection and participation

Biographical

Tell me about your teaching background.

How many years have you taught?

How many years have you taught at this level?

Do you have any experience in reading recovery?

Tell me about the mathematics based professional development you have participated in.

CMIT last year, and what else?

Tell me about your own background in mathematics before you became involved in teaching.

Do you have school certificate maths?

Do you have bursary maths?

Did you study maths at university?

Tell me about your teacher training in mathematics.

Did you major in maths at college?

Did you study maths at university? Why?

Expectations for involvement in case study:

Next two visits to involve video recording of a teaching group, with stimulated recall on teaching techniques observed.

Possible use of concept mapping

Selection of focus group children – the most able Counting On group.

Observation

In-class observation will enable familiarisation with children.

A focus group of children will be identified as appropriate.

The researcher will answer questions as required.

Visit Two

Interview with Teacher

Focus is on the reasoning behind teacher decisions.

Explain that we will watch the videotape – stopping to discuss points of interest (to either the researcher or the teacher).

Activity or task

Why did you select this task?

What were you trying to achieve? (for an individual student??)

What were your learning outcomes for this session?

Interactions with students

Why did you:

- ask that question?
- make that response?
- direct your question at that child?

What did you think about that response?

General

Did you learn anything new about the children's thinking (their strategies? /their knowledge?)

What were your feelings about the session?

Where to now?

What are your expectations for the children in this group?

Where do you think they will be by the end of the year?

By the third visit?

Interview with Children

Focus is on the children's thinking

Explain that we will watch the videotape – stopping to discuss points of interest. (identified earlier)

Activity or task

Why did you think [teacher's name] used this activity?

Did you enjoy it? Why?

Did it make you think? What?

Interactions with students

Why did [teacher's name]:

- ask that question?
- make that response?
- direct her question at you?

What were you thinking when [teacher's name] said that?/did that?

Visit Three

Interview with Teacher

View list of common characteristics with teacher (sent in pre-visit information). Discuss:

1. What is your response to this list?
2. Can you think of instances in your teaching (today or at other times) where you demonstrate these characteristics?
3. Can you add any other characteristics that you believe make you successful?

Together choose a five-minute portion of the video to view, either to illustrate one of the characteristics from the list or a new point that has come up in discussion.

Discuss the section in detail.

Why did you:

- ask that question?
- make that response?

- direct your question at that child?

What did you think about that response?

Semi-structured interview

1. Did you learn anything new about the children's thinking (their strategies? / their knowledge?)
2. What were your feelings about the session?
3. Where to now?
4. What are your expectations for the children in this group?
5. Where do you think they will be by the end of the year?
6. Have the children made the progress you expected to date? If not, why not?
7. Do you see the two number frameworks (knowledge and strategies) as related? How?
8. How do you see these frameworks linking to the mathematics curriculum?
9. Has your involvement in the project impacted on your teaching in the number strand? Other strands?

Interview with Students

Observation of video

Why did [teacher's name]:

- ask that question?
- make that response?
- direct her question at you?

What were you thinking when [teacher's name] said that?/did that?

What do you like about maths?

What don't you like doing in maths?

Why do you think that [teacher's name] is a good teacher?

Is there anything that you would like [teacher's name] to change?

Appendix E: Detailed SEAL results

Table E.1: Percentages of five-year-olds at each SEAL stage by ethnicity

	Final SEAL score						
Ethnicity	Emergent	One-to-one	Materials	Imaging	Advanced counting	Early additive	Advanced additive
Asian	4% (6)	17% (25)	33% (49)	15% (23)	24% (36)	6% (9)	1% (1)
European	4% (114)	13% (354)	40% (1129)	20% (568)	18% (507)	4% (116)	1% (16)
Māori	9% (88)	21% (204)	38% (377)	16% (155)	12% (118)	4% (35)	1% (5)
Other	5% (7)	19% (27)	42% (59)	15% (22)	15% (21)	3% (4)	1% (2)
Pacific Islands	7% (31)	28% (115)	42% (174)	10% (40)	10% (42)	3% (11)	0% (1)
Total	5% (246)	16% (725)	40% (1788)	18% (808)	16% (724)	4% (175)	1% (25)

Table E.2: Percentages of five-year-olds at each SEAL stage by decile

	Final SEAL score						
Decile	Emergent	One-to-one	Materials	Imaging	Advanced counting	Early additive	Advanced additive
Low	9% (135)	22% (330)	40% (583)	15% (214)	11% (160)	3% (47)	0% (5)
Medium	4% (85)	15% (301)	43% (841)	19% (365)	16% (308)	3% (57)	0% (9)
High	2% (26)	9% (94)	35% (364)	22% (229)	24% (256)	7% (71)	1% (11)
Total	5% (246)	16% (725)	40% (1788)	18% (808)	16% (724)	4% (175)	1% (25)

Table E.3: Percentages of five-year-olds at each SEAL stage by decile and ethnicity

		Final SEAL score						
Decile	Ethnicity	Emergent	One-to-one	Materials	Imaging	Advanced counting	Early additive	Advanced additive
Low	Asian	5% (2)	30% (13)	35% (15)	7% (3)	19% (8)	5% (2)	
	NZ European	7% (36)	18% (93)	41% (219)	19% (100)	13% (66)	2% (12)	0% (2)
	Māori	12% (63)	21% (108)	38% (196)	15% (76)	10% (50)	4% (23)	1% (3)
	Other	12% (6)	31% (15)	37% (18)	10% (5)	8% (4)	2% (1)	
	Pacific Islands	8% (28)	30% (101)	40% (135)	9% (30)	10% (32)	3% (9)	
	Total	9% (135)	22% (330)	40% (583)	15% (214)	11% (160)	3% (47)	0% (5)
Medium	Asian	6% (3)	12% (6)	40% (20)	20% (10)	18% (9)	4% (2)	
	NZ European	4% (58)	13% (188)	43% (621)	20% (282)	16% (236)	3% (45)	0% (6)
	Māori	6% (22)	23% (87)	40% (152)	16% (61)	13% (50)	2% (7)	1% (2)
	Other		20% (8)	56% (23)	12% (5)	10% (4)	2% (1)	
	Pacific Islands	3% (2)	21% (12)	43% (25)	12% (7)	16% (9)	3% (2)	2% (1)
	Total	4% (85)	15% (301)	43% (841)	19% (365)	16% (308)	3% (57)	0% (9)
High	Asian	2% (1)	11% (6)	25% (14)	18% (10)	34% (19)	9% (5)	2% (1)
	NZ European	2% (20)	9% (73)	34% (289)	22% (186)	24% (205)	7% (59)	1% (8)
	Māori	4% (3)	11% (9)	35% (29)	22% (18)	22% (18)	6% (5)	
	Other	2% (1)	8% (4)	35% (18)	23% (12)	25% (13)	4% (2)	4% (2)
	Pacific Islands	5% (1)	10% (2)	67% (14)	14% (3)	5% (1)		
	Total	2% (26)	9% (94)	35% (364)	22% (229)	24% (256)	7% (71)	1% (11)

Table E.4: Percentages of six-year-olds at each SEAL stage by ethnicity

	Final SEAL score						
Ethnicity	Emergent	One-to-one	Materials	Imaging	Advanced counting	Early additive	Advanced additive
Asian	1% (1)	1% (1)	11% (15)	20% (26)	34% (44)	24% (32)	9% (12)
NZ European	1% (31)	3% (113)	20% (683)	18% (614)	36% (1217)	18% (619)	4% (125)
Māori	3% (33)	9% (87)	27% (273)	19% (192)	28% (288)	12% (120)	2% (19)
Other	1% (1)	5% (7)	23% (36)	28% (43)	29% (45)	13% (20)	1% (2)
Pacific Islands	3% (15)	11% (53)	30% (141)	23% (106)	24% (114)	8% (37)	0% (1)
Total	2% (81)	5% (261)	22% (1148)	19% (981)	33% (1708)	16% (828)	3% (159)

Table E.5: Percentages of six-year-olds at each SEAL stage by decile

	Final SEAL score						
Decile	Emergent	One-to-one	Materials	Imaging	Advanced counting	Early additive	Advanced additive
Low	4% (57)	8% (138)	27% (440)	22% (361)	26% (417)	11% (186)	2% (27)
Medium	1% (20)	4% (98)	23% (529)	19% (425)	34% (770)	16% (357)	2% (53)
High	0% (4)	2% (25)	14% (179)	15% (195)	40% (521)	22% (285)	6% (79)
Total	2% (81)	5% (261)	22% (1148)	19% (981)	33% (1708)	16% (828)	3% (159)

Table E.6: Percentages of six-year-olds at each SEAL stage by decile and ethnicity

		Final SEAL score						
Decile	Ethnicity	Emergent	One-to-one	Materials	Imaging	Advanced counting	Early additive	Advanced additive
Low	Asian	2% (1)	2% (1)	17% (8)	36% (17)	21% (10)	17% (8)	4% (2)
	NZ European	3% (15)	6% (34)	24% (142)	21% (121)	29% (172)	15% (88)	3% (16)
	Māori	5% (26)	9% (50)	26% (141)	21% (112)	27% (143)	11% (57)	1% (8)
	Other	2% (1)	8% (5)	35% (23)	30% (20)	17% (11)	9% (6)	
	Pacific Islands	4% (14)	12% (48)	32% (126)	23% (91)	21% (81)	7% (27)	0% (1)
	Total	4% (57)	8% (138)	27% (440)	22% (361)	26% (417)	11% (186)	2% (27)
Medium	Asian			11% (5)	9% (4)	46% (21)	26% (12)	9% (4)
	NZ European	1% (12)	3% (59)	22% (382)	19% (326)	35% (598)	17% (286)	2% (37)
	Māori	2% (7)	8% (33)	30% (117)	18% (73)	27% (106)	12% (48)	3% (11)
	Other		2% (1)	24% (11)	22% (10)	39% (18)	11% (5)	2% (1)
	Pacific Islands	2% (1)	8% (5)	22% (14)	18% (12)	42% (27)	9% (6)	
	Total	1% (20)	4% (98)	23% (529)	19% (425)	34% (770)	16% (357)	2% (53)
High	Asian			5% (2)	13% (5)	34% (13)	32% (12)	16% (6)
	NZ European	0% (4)	2% (20)	14% (159)	15% (167)	40% (447)	22% (245)	6% (72)
	Māori		5% (4)	19% (15)	9% (7)	49% (39)	19% (15)	
	Other		2% (1)	5% (2)	31% (13)	38% (16)	21% (9)	2% (1)
	Pacific Islands			7% (1)	21% (3)	43% (6)	29% (4)	
	Total	0% (4)	2% (25)	14% (179)	15% (195)	40% (521)	22% (285)	6% (79)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table E.7: Percentages of seven-year-olds at each SEAL stage by ethnicity

	Final SEAL score						
Ethnicity	Emergent	One-to-one	Materials	Imaging	Advanced counting	Early additive	Advanced additive
Asian			4% (6)	7% (12)	24% (41)	45% (76)	20% (34)
European	0% (8)	2% (51)	7% (222)	11% (348)	33% (1029)	37% (1171)	9% (296)
Māori	1% (9)	3% (27)	14% (118)	15% (133)	35% (303)	27% (232)	5% (46)
Other		2% (2)	7% (7)	14% (14)	43% (43)	27% (27)	7% (7)
Pacific Islands	1% (5)	2% (6)	16% (61)	23% (89)	39% (149)	18% (69)	2% (8)
Total	0% (22)	2% (86)	9% (414)	13% (596)	34% (1565)	34% (1575)	8% (391)

Table E.8: Percentages of seven-year-olds at each SEAL stage by decile

	Final SEAL score						
Decile	Emergent	One-to-one	Materials	Imaging	Advanced counting	Early additive	Advanced additive
Low	1% (5)	3% (39)	15% (218)	18% (260)	34% (495)	25% (359)	4% (63)
Medium	0% (7)	2% (42)	8% (149)	12% (238)	35% (700)	35% (686)	8% (162)
High		0% (5)	4% (47)	8% (98)	30% (370)	44% (530)	14% (166)
Total	0% (12)	2% (86)	9% (414)	13% (596)	34% (1565)	34% (1575)	8% (391)

Table E.9: Percentages of seven-year-olds at each SEAL stage by decile and ethnicity

		Final SEAL score						
Decile	Ethnicity	Emergent	One-to-one	Materials	Imaging	Advanced counting	Early additive	Advanced additive
Low	Asian			4% (2)	14% (7)	36% (18)	34% (17)	12% (6)
	NZ European	1% (3)	2% (14)	14% (84)	16% (95)	33% (194)	28% (165)	5% (28)
	Māori	2% (8)	4% (19)	17% (78)	16% (74)	33% (154)	24% (112)	5% (23)
	Other		3% (1)	20% (7)	23% (8)	37% (13)	17% (6)	
	Pacific Islands	1% (4)	2% (5)	15% (47)	24% (76)	37% (116)	19% (59)	2% (6)
	Total	1% (15)	3% (39)	15% (218)	18% (260)	34% (495)	25% (359)	4% (63)
Medium	Asian			4% (2)	9% (4)	31% (14)	36% (16)	20% (9)
	NZ European	0% (5)	2% (33)	7% (99)	11% (166)	34% (517)	37% (555)	8% (127)
	Māori	0% (1)	2% (7)	10% (35)	15% (52)	37% (125)	29% (98)	6% (20)
	Other		3% (1)		11% (4)	50% (18)	22% (8)	14% (5)
	Pacific Islands	2% (1)	2% (1)	21% (13)	19% (12)	41% (26)	14% (9)	2% (1)
	Total	0% (7)	2% (42)	8% (149)	12% (238)	35% (700)	35% (686)	8% (162)
High	Asian			3% (2)	1% (1)	12% (9)	58% (43)	26% (19)
	NZ European		0% (4)	4% (39)	8% (87)	31% (318)	43% (451)	14% (141)
	Māori		2% (1)	8% (5)	11% (7)	39% (24)	35% (22)	5% (3)
	Other				7% (2)	41% (12)	45% (13)	7% (2)
	Pacific Islands			9% (1)	9% (1)	64% (7)	9% (1)	9% (1)
	Total		0% (5)	4% (47)	8% (98)	30% (370)	44% (530)	14% (166)

Appendix F: Detailed FNWS results

Table F.1: Percentages of five-year-olds at each FNWS stage by ethnicity

	Final FNWS score				
Ethnicity	Emergent	Initial	To 10	To 20	To 100
Asian	1% (2)	4% (6)	15% (22)	30% (45)	50% (74)
NZ European	1% (15)	4% (124)	17% (480)	30% (851)	48% (1334)
Māori	1% (13)	8% (79)	22% (213)	33% (324)	36% (353)
Other	2% (3)	8% (11)	15% (22)	27% (39)	48% (68)
Pacific Islands	0% (2)	10% (43)	21% (85)	31% (129)	37% (155)
Total	1% (35)	6% (263)	18% (822)	31% (1388)	44% (1984)

Table F.2: Percentages of five-year-olds at each FNWS stage by decile

	Final FNWS score				
Decile	Emergent	Initial	To 10	To 20	To 100
Low	1% (22)	9% (133)	21% (305)	31% (463)	37% (551)
Medium	0% (9)	5% (96)	19% (376)	32% (625)	44% (860)
High	0% (4)	3% (34)	13% (140)	29% (300)	55% (573)
Total	1% (35)	6% (263)	18% (821)	31% (1388)	44% (1984)

Table F.3: Percentages of five-year-olds at each FNWS stage by decile and ethnicity

		Final FNWS score				
Decile	Ethnicity	Emergent	Initial	To 10	To 20	To 100
Low	Asian			23% (10)	37% (16)	40% (17)
	NZ European	1% (5)	9% (45)	20% (104)	29% (153)	42% (221)
	Māori	2% (12)	8% (43)	22% (112)	33% (170)	35% (182)
	Other	6% (3)	12% (6)	20% (10)	35% (17)	27% (13)
	Pacific Islands	1% (2)	12% (39)	21% (69)	32% (107)	35% (118)
	Total	1% (22)	9% (133)	21% (305)	31% (463)	37% (551)
Medium	Asian	2% (1)	6% (3)	12% (6)	36% (18)	44% (22)
	NZ European	0% (7)	4% (57)	18% (265)	31% (448)	46% (659)
	Māori	0% (1)	9% (33)	23% (88)	35% (132)	33% (127)
	Other		5% (2)	10% (4)	32% (13)	54% (22)
	Pacific Islands		2% (1)	22% (13)	24% (14)	52% (30)
	Total	0% (9)	5% (96)	19% (376)	32% (625)	44% (860)
High	Asian	2% (1)	5% (3)	11% (6)	20% (11)	63% (35)
	NZ European	0% (3)	3% (22)	13% (111)	30% (250)	54% (454)
	Māori		4% (3)	16% (13)	27% (22)	54% (44)
	Other		6% (3)	13% (7)	17% (9)	63% (33)
	Pacific Islands		14% (3)	14% (3)	38% (8)	33% (7)
	Total	0% (4)	3% (34)	13% (140)	29% (300)	55% (573)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table F.4: Percentages of six-year-olds at each FNWS stage by ethnicity

	Final FNWS score				
Ethnicity	Emergent	Initial	To 10	To 20	To 100
Asian		2% (2)	2% (2)	11% (14)	86% (113)
NZ European	0% (4)	1% (35)	5% (172)	15% (517)	79% (2674)
Māori	0% (1)	3% (29)	8% (85)	21% (213)	68% (684)
Other		1% (2)	3% (4)	21% (32)	75% (116)
Pacific Islands		3% (15)	11% (52)	25% (119)	60% (281)
Total	0% (5)	2% (83)	6% (315)	17% (895)	75% (3868)

Table F.5: Percentages of six-year-olds at each FNWS stage by decile

	Final FNWS score				
Decile	Emergent	Initial	To 10	To 20	To 100
Low	0% (1)	3% (52)	8% (135)	20% (328)	68% (1110)
Medium	0% (4)	1% (23)	6% (131)	17% (392)	76% (1702)
High		1% (8)	4% (49)	14% (175)	82% (1056)
Total	0% (5)	2% (83)	6% (315)	17% (895)	75% (3868)

Table F.6: Percentages of six-year-olds at each FNWS stage by decile and ethnicity

		Final FNWS score				
Decile	Ethnicity	Emergent	Initial	To 10	To 20	To 100
Low	Asian		4% (2)	2% (1)	13% (6)	81% (38)
	NZ European	0% (1)	3% (17)	7% (39)	14% (85)	76% (446)
	Māori		3% (18)	9% (51)	23% (121)	65% (347)
	Other		2% (1)	3% (2)	26% (17)	70% (46)
	Pacific Islands		4% (14)	11% (42)	26% (99)	60% (233)
	Total	0% (1)	3% (52)	8% (135)	20% (328)	68% (1110)
Medium	Asian			2% (1)	15% (7)	83% (38)
	NZ European	0% (3)	1% (11)	5% (90)	16% (277)	78% (1319)
	Māori	0% (1)	3% (11)	7% (29)	20% (79)	70% (275)
	Other			4% (2)	24% (11)	72% (33)
	Pacific Islands		2% (1)	14% (9)	28% (18)	57% (37)
	Total	0% (4)	1% (23)	6% (131)	17% (392)	76% (1702)
High	Asian				3% (1)	97% (37)
	NZ European		1% (7)	4% (43)	14% (155)	82% (909)
	Māori			6% (5)	16% (13)	78% (62)
	Other		2% (1)		10% (4)	88% (37)
	Pacific Islands			7% (1)	14% (2)	79% (11)
	Total		1% (8)	4% (49)	14% (175)	82% (1056)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table F.7: Percentages of seven-year-olds at each FNWS stage by ethnicity

	Final FNWS score				
Ethnicity	Emergent	Initial	To 10	To 20	To 100
Asian			1% (2)	4% (6)	95% (161)
NZ European		0% (13)	2% (52)	6% (188)	92% (2872)
Māori		1% (9)	3% (24)	11% (94)	85% (741)
Other		1% (1)	3% (3)	6% (6)	90% (90)
Pacific Islands	0% (1)	0% (1)	3% (10)	13% (49)	84% (326)
Total	0% (1)	1% (24)	2% (91)	7% (343)	90% (4190)

Table F.8: Percentages of seven-year-olds at each FNWS stage by decile

	Final FNWS score				
Decile	Emergent	Initial	To 10	To 20	To 100
Low	0% (1)	1% (11)	3% (45)	11% (162)	85% (1230)
Medium		1% (10)	1% (28)	7% (134)	91% (1812)
High		0% (3)	1% (18)	4% (47)	94% (1148)
Total	0% (1)	1% (24)	2% (91)	7% (343)	90% (4190)

Table F.9: Percentages of seven-year-olds at each FNWS stage by decile and ethnicity

		Final FNWS score				
Decile	Ethnicity	Emergent	Initial	To 10	To 20	To 100
Low	Asian			2% (1)	8% (4)	90% (45)
	NZ European		1% (3)	3% (16)	10% (56)	87% (508)
	Māori		1% (7)	3% (16)	12% (56)	83% (389)
	Other			6% (2)	11% (4)	83% (29)
	Pacific Islands	0% (1)	0% (1)	3% (10)	13% (42)	83% (259)
	Total	0% (1)	1% (11)	3% (45)	11% (162)	85% (1230)
Medium	Asian			2% (1)	4% (2)	93% (42)
	NZ European		1% (8)	1% (21)	6% (91)	92% (1382)
	Māori		0% (1)	2% (6)	10% (33)	88% (298)
	Other		3% (1)		3% (1)	94% (34)
	Pacific Islands				11% (7)	89% (56)
	Total		1% (10)	1% (28)	7% (134)	91% (1812)
High	Asian					100% (74)
	NZ European		0% (2)	1% (15)	4% (41)	94% (982)
	Māori		2% (1)	3% (2)	8% (5)	87% (54)
	Other			3% (1)	3% (1)	93% (27)
	Pacific Islands					100% (11)
	Total		0% (3)	1% (18)	4% (47)	94% (1148)

Note: Percentages have been rounded to the nearest whole number where necessary.

Appendix G: Detailed BNWS results

Table G.1: Percentages of five-year-olds at each BNWS stage by ethnicity

	Final BNWS score				
Ethnicity	Emergent	Initial	To 10	To 20	To 100
Asian	3% (4)	18% (27)	22% (33)	27% (40)	30% (45)
NZ European	4% (109)	10% (283)	29% (800)	24% (667)	34% (945)
Māori	7% (71)	16% (155)	31% (308)	23% (229)	22% (219)
Other	6% (8)	15% (21)	23% (32)	28% (40)	29% (41)
Pacific Islands	7% (30)	16% (67)	30% (124)	26% (106)	21% (87)
Total	5% (222)	12% (553)	29% (1297)	24% (1082)	30% (1337)

Table G.2: Percentages of five-year-olds at each BNWS stage by decile

	Final BNWS score				
Decile	Emergent	Initial	To 10	To 20	To 100
Low	7% (99)	17% (245)	29% (429)	25% (363)	23% (338)
Medium	5% (100)	11% (221)	30% (597)	24% (467)	30% (581)
High	2% (23)	8% (87)	26% (271)	24% (252)	40% (418)
Total	5% (222)	12% (553)	29% (1297)	24% (1082)	30% (1337)

Table G.3: Percentages of five-year-olds at each BNWS stage by decile and ethnicity

		Final BNWS score				
Decile	Ethnicity	Emergent	Initial	To 10	To 20	To 100
Low	Asian	2% (1)	30% (13)	23% (10)	19% (8)	26% (11)
	NZ European	4% (23)	15% (81)	29% (151)	25% (130)	27% (143)
	Māori	8% (41)	17% (88)	30% (157)	24% (123)	21% (110)
	Other	12% (6)	22% (11)	18% (9)	31% (15)	16% (8)
	Pacific Islands	8% (28)	16% (52)	30% (102)	26% (87)	20% (66)
	Total	7% (99)	17% (245)	29% (429)	25% (363)	23% (338)
Medium	Asian	4% (2)	14% (7)	24% (12)	32% (16)	26% (13)
	NZ European	5% (69)	10% (142)	30% (429)	24% (338)	32% (458)
	Māori	7% (26)	16% (61)	33% (127)	23% (86)	21% (81)
	Other	2% (1)	5% (2)	34% (14)	32% (13)	27% (11)
	Pacific Islands	3% (2)	16% (9)	26% (15)	24% (14)	31% (18)
	Total	5% (100)	11% (221)	30% (597)	24% (467)	30% (581)
High	Asian	2% (1)	13% (7)	20% (11)	29% (16)	38% (21)
	NZ European	2% (17)	7% (60)	26% (220)	24% (199)	41% (344)
	Māori	5% (4)	7% (6)	29% (24)	24% (20)	34% (28)
	Other	2% (1)	15% (8)	17% (9)	23% (12)	42% (22)
	Pacific Islands		29% (6)	33% (7)	24% (5)	14% (3)
	Total	2% (23)	8% (87)	26% (271)	24% (252)	40% (418)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table G.4: Percentages of six-year-olds at each BNWS stage by ethnicity

	Final BNWS score				
Ethnicity	Emergent	Initial	To 10	To 20	To 100
Asian		2% (3)	3% (4)	16% (21)	79% (103)
NZ European	1% (32)	3% (93)	12% (396)	18% (624)	66% (2257)
Māori	2% (17)	7% (66)	16% (165)	24% (241)	52% (523)
Other	1% (1)	6% (9)	11% (17)	21% (33)	61% (94)
Pacific Islands	2% (11)	8% (36)	19% (90)	29% (137)	41% (193)
Total	1% (61)	4% (207)	13% (672)	20% (1056)	61% (3170)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table G.5: Percentages of six-year-olds at each BNWS stage by decile

	Final BNWS score				
Decile	Emergent	Initial	To 10	To 20	To 100
Low	2% (33)	6% (100)	16% (255)	24% (397)	52% (841)
Medium	1% (22)	4% (82)	13% (291)	20% (448)	63% (1409)
High	0% (6)	2% (25)	10% (126)	16% (211)	71% (920)
Total	1% (61)	4% (207)	13% (672)	20% (1056)	61% (3170)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table G.6: Percentages of six-year-olds at each BNWS stage by decile and ethnicity

		Final BNWS score				
Decile	Ethnicity	Emergent	Initial	To 10	To 20	To 100
Low	Asian		6% (3)	2% (1)	19% (9)	72% (34)
	NZ European	3% (15)	4% (24)	12% (73)	19% (110)	62% (366)
	Māori	1% (8)	7% (37)	19% (100)	25% (136)	48% (256)
	Other		11% (7)	11% (7)	30% (20)	48% (32)
	Pacific Islands	3% (10)	7% (29)	19% (74)	31% (122)	39% (153)
	Total	2% (33)	6% (100)	16% (255)	24% (397)	52% (841)
Medium	Asian			4% (2)	17% (8)	78% (36)
	NZ European	1% (11)	3% (50)	12% (209)	19% (326)	65% (1104)
	Māori	2% (9)	6% (24)	15% (58)	23% (92)	54% (212)
	Other	2% (1)	2% (1)	20% (9)	20% (9)	57% (26)
	Pacific Islands	2% (1)	11% (7)	20% (13)	20% (13)	48% (31)
	Total	1% (22)	4% (82)	13% (291)	20% (448)	63% (1409)
High	Asian			3% (1)	11% (4)	87% (33)
	NZ European	1% (6)	2% (19)	10% (114)	17% (188)	71% (787)
	Māori		6% (5)	9% (7)	16% (13)	69% (55)
	Other		2% (1)	2% (1)	10% (4)	86% (36)
	Pacific Islands			21% (3)	14% (2)	64% (9)
	Total	0% (6)	2% (25)	10% (126)	16% (211)	71% (920)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table G.7: Percentages of seven-year-olds at each BNWS stage by ethnicity

	Final BNWS score				
Ethnicity	Emergent	Initial	To 10	To 20	To 100
Asian			2% (4)	8% (13)	90% (152)
NZ European	0% (9)	1% (29)	5% (150)	9% (274)	85% (2663)
Māori	1% (5)	3% (22)	7% (60)	15% (129)	75% (652)
Other	1% (1)	1% (1)	5% (5)	16% (16)	77% (77)
Pacific Islands	0% (1)	2% (8)	10% (38)	18% (70)	70% (270)
Total	0% (16)	1% (60)	6% (257)	11% (502)	82% (3814)

Table G.8: Percentages of seven-year-olds at each BNWS stage by decile

	Final BNWS score				
Decile	Emergent	Initial	To 10	To 20	To 100
Low	0% (7)	2% (33)	9% (126)	15% (219)	73% (1064)
Medium	0% (7)	1% (20)	5% (97)	10% (203)	84% (1657)
High	0% (2)	1% (7)	3% (34)	7% (80)	90% (1093)
Total	0% (16)	1% (60)	6% (257)	11% (502)	82% (3814)

Table G.9: Percentages of seven-year-olds at each BNWS stage by decile and ethnicity

		Final BNWS score				
Decile	Ethnicity	Emergent	Initial	To 10	To 20	To 100
Low	Asian			6% (3)	10% (5)	84% (42)
	NZ European	1% (3)	2% (10)	8% (46)	13% (73)	77% (451)
	Māori	1% (3)	3% (16)	9% (40)	15% (71)	72% (338)
	Other		3% (1)	11% (4)	23% (8)	63% (22)
	Pacific Islands	0% (1)	2% (6)	11% (33)	20% (62)	67% (211)
	Total	0% (7)	2% (33)	9% (126)	15% (219)	73% (1064)
Medium	Asian			2% (1)	11% (5)	87% (39)
	NZ European	0% (4)	1% (13)	5% (75)	9% (134)	85% (1276)
	Māori	1% (2)	1% (5)	5% (17)	15% (51)	78% (263)
	Other	3% (1)			14% (5)	83% (30)
	Pacific Islands		3% (2)	6% (4)	13% (8)	78% (49)
	Total	0% (7)	1% (20)	5% (97)	10% (203)	84% (1657)
High	Asian				4% (3)	96% (71)
	NZ European	0% (2)	1% (6)	3% (29)	6% (67)	90% (936)
	Māori		2% (1)	5% (3)	11% (7)	82% (51)
	Other			3% (1)	10% (3)	86% (25)
	Pacific Islands			9% (1)		91% (10)
	Total	0% (2)	1% (7)	3% (34)	7% (80)	90% (1093)

Note: Percentages have been rounded to the nearest whole number where necessary.

Appendix H: Detailed NID results

Table H.1: Percentages of five-year-olds at each numeral identification stage by ethnicity

	Final numeral identification score				
Ethnicity	Emergent	To 10	To 20	To 100	To 1000
Asian	3% (5)	10% (15)	10% (15)	42% (63)	34% (51)
NZ European	3% (75)	18% (491)	13% (364)	42% (1184)	25% (690)
Māori	6% (58)	22% (220)	15% (150)	37% (362)	20% (192)
Other	4% (6)	11% (15)	11% (16)	51% (72)	23% (33)
Pacific Islands	3% (12)	21% (87)	16% (65)	43% (178)	17% (72)
Total	3% (156)	18% (828)	14% (610)	41% (1859)	23% (1038)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table H.2: Percentages of five-year-olds at each numeral identification stage by decile

	Final numeral identification score				
Decile	Emergent	To 10	To 20	To 100	To 1000
Low	5% (75)	20% (301)	15% (224)	40% (595)	19% (279)
Medium	3% (56)	18% (353)	14% (284)	43% (846)	22% (427)
High	2% (25)	17% (174)	10% (102)	40% (418)	32% (332)
Total	3% (156)	18% (828)	14% (610)	41% (1859)	23% (1038)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table H.3: Percentages of five-year-olds at each numeral identification stage by decile and ethnicity

		Final numeral identification score				
Decile	Ethnicity	Emergent	To 10	To 20	To 100	To 1000
Low	Asian	2% (1)	19% (8)	12% (5)	40% (17)	28% (12)
	NZ European	4% (22)	17% (90)	15% (79)	43% (226)	21% (111)
	Māori	7% (37)	23% (121)	16% (84)	35% (182)	18% (95)
	Other	8% (4)	20% (10)	8% (4)	53% (26)	10% (5)
	Pacific Islands	3% (11)	21% (71)	16% (52)	43% (144)	17% (56)
	Total	5% (75)	20% (300)	15% (224)	40% (595)	19% (279)
Medium	Asian	4% (2)	8% (4)	10% (5)	58% (29)	20% (10)
	NZ European	2% (35)	18% (253)	14% (204)	43% (618)	23% (326)
	Māori	5% (18)	22% (84)	15% (59)	40% (151)	18% (69)
	Other		10% (4)	17% (7)	54% (22)	20% (8)
	Pacific Islands	2% (1)	14% (8)	16% (9)	45% (26)	24% (14)
	Total	3% (56)	18% (353)	14% (284)	43% (846)	22% (427)
High	Asian	4% (2)	5% (3)	9% (5)	30% (17)	52% (29)
	NZ European	2% (18)	18% (148)	10% (81)	40% (340)	30% (253)
	Māori	4% (3)	18% (15)	9% (7)	35% (29)	34% (28)
	Other	4% (2)	2% (1)	10% (5)	46% (24)	38% (20)
	Pacific Islands		33% (7)	19% (4)	38% (8)	10% (2)
	Total	2% (25)	17% (174)	10% (102)	40% (418)	32% (332)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table H.4: Percentages of six-year-olds at each numeral identification stage by ethnicity

	Final numeral identification score				
Ethnicity	Emergent	To 10	To 20	To 100	To 1000
Asian		2% (3)	2% (2)	16% (21)	80% (105)
NZ European	1% (24)	4% (130)	4% (149)	29% (1000)	62% (2099)
Māori	1% (11)	8% (86)	7% (67)	31% (311)	53% (537)
Other		2% (3)	6% (10)	34% (52)	58% (89)
Pacific Islands	1% (3)	7% (34)	7% (34)	40% (187)	45% (209)
Total	1% (38)	5% (256)	5% (262)	30% (1571)	59% (3039)

Table H.5: Percentages of six-year-olds at each numeral identification stage by decile

	Final numeral identification score				
Decile	Emergent	To 10	To 20	To 100	To 1000
Low	1% (18)	7% (108)	7% (107)	33% (530)	53% (863)
Medium	1% (16)	5% (107)	5% (109)	31% (692)	59% (1328)
High	0% (4)	3% (41)	4% (46)	27% (349)	66% (848)
Total	1% (38)	5% (256)	5% (262)	30% (1571)	59% (3039)

Table H.6: Percentages of six-year-olds at each numeral identification stage by decile and ethnicity

		Final numeral identification score				
Decile	Ethnicity	Emergent	To 10	To 20	To 100	To 1000
Low	Asian		6% (3)	2% (1)	17% (8)	74% (35)
	NZ European	1% (8)	6% (33)	5% (32)	28% (164)	60% (351)
	Māori	1% (7)	8% (43)	8% (42)	31% (168)	52% (277)
	Other			6% (4)	47% (31)	47% (31)
	Pacific Islands	1% (3)	7% (29)	7% (28)	41% (159)	44% (169)
	Total	1% (18)	7% (108)	7% (107)	33% (530)	53% (863)
Medium	Asian				24% (11)	76% (35)
	NZ European	1% (12)	4% (64)	5% (78)	31% (526)	60% (1020)
	Māori	1% (4)	9% (36)	6% (22)	30% (120)	54% (213)
	Other		4% (2)	9% (4)	28% (13)	59% (27)
	Pacific Islands		8% (5)	8% (5)	34% (22)	51% (33)
	Total	1% (16)	5% (107)	5% (109)	31% (692)	59% (1328)
High	Asian			3% (1)	5% (2)	92% (35)
	NZ European	0% (4)	3% (33)	4% (39)	28% (310)	65% (728)
	Māori		9% (7)	4% (3)	29% (23)	59% (47)
	Other		2% (1)	5% (2)	19% (8)	74% (31)
	Pacific Islands			7% (1)	43% (6)	50% (7)
	Total	0% (4)	3% (41)	4% (46)	27% (349)	66% (848)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table H.7: Percentages of seven-year-olds at each numeral identification stage by ethnicity

	Final numeral identification score				
Ethnicity	Emergent	To 10	To 20	To 100	To 1000
Asian			1% (2)	7% (11)	92% (156)
European	0% (3)	1% (44)	1% (33)	11% (332)	87% (2713)
Māori	1% (5)	2% (15)	2% (21)	15% (130)	80% (697)
Other		1% (1)	2% (2)	13% (13)	84% (84)
Pacific Islands	0% (1)	1% (4)	2% (9)	9% (75)	77% (298)
Total	0% (9)	1% (64)	1% (67)	12% (561)	85% (3948)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table H.8: Percentages of seven-year-olds at each numeral identification stage by decile

	Final numeral identification score				
Decile	Emergent	To 10	To 20	To 100	To 1000
Low	0% (6)	2% (29)	2% (35)	15% (222)	80% (1157)
Medium	0% (3)	1% (21)	1% (25)	12% (244)	85% (1691)
High		1% (14)	1% (7)	8% (95)	90% (1100)
Total	0% (9)	1% (64)	1% (67)	12% (561)	85% (3948)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table H.9: Percentages of seven-year-olds at each numeral identification stage by decile and ethnicity

		Final numeral identification score				
Decile	Ethnicity	Emergent	To 10	To 20	To 100	To 1000
Low	Asian			2% (1)	12% (6)	86% (43)
	NZ European	0% (1)	2% (13)	2% (10)	13% (74)	83% (485)
	Māori	1% (4)	3% (12)	3% (15)	16% (75)	77% (362)
	Other			6% (2)	26% (9)	69% (24)
	Pacific Islands	0% (1)	1% (4)	2% (7)	19% (58)	78% (243)
	Total	0% (6)	2% (29)	2% (35)	15% (222)	80% (1157)
Medium	Asian			2% (1)	11% (5)	87% (39)
	NZ European	0% (2)	1% (18)	1% (17)	11% (171)	86% (1294)
	Māori	0% (1)	1% (2)	1% (5)	15% (50)	83% (280)
	Other		3% (1)		3% (1)	94% (34)
	Pacific Islands			3% (2)	27% (17)	70% (44)
	Total	0% (3)	1% (21)	1% (25)	12% (244)	85% (1691)
High	Asian					100% (74)
	NZ European		1% (13)	1% (6)	8% (87)	90% (934)
	Māori		2% (1)	2% (1)	8% (5)	89% (55)
	Other				10% (3)	90% (26)
	Pacific Islands					100% (11)
	Total		1% (14)	1% (7)	8% (95)	90% (1100)

Note: Percentages have been rounded to the nearest whole number where necessary.

Appendix I: Detailed BTS results

Table I.1: Percentages of five-year-olds at each base ten stage by ethnicity

	Final base ten score				
Ethnicity	Emergent	One-to-one	Advanced counting	Early additive	Advanced additive
Asian	15% (23)	53% (79)	28% (42)	3% (4)	1% (1)
NZ European	16% (436)	58% (1620)	24% (662)	3% (76)	0% (10)
Māori	23% (225)	57% (564)	17% (171)	2% (18)	0% (4)
Other	21% (30)	56% (79)	19% (27)	4% (5)	1% (1)
Pacific Islands	29% (122)	53% (221)	16% (68)	1% (3)	
Total	19% (836)	57% (2563)	22% (970)	2% (106)	0% (16)

Table I.2: Percentages of five-year-olds at each base ten stage by decile

	Final base ten score				
Decile	Emergent	One-to-one	Advanced counting	Early additive	Advanced additive
Low	26% (383)	55% (806)	17% (253)	2% (28)	0% (4)
Medium	18% (345)	59% (1162)	21% (416)	2% (38)	0% (5)
High	10% (108)	57% (595)	29% (301)	4% (40)	1% (7)
Total	19% (836)	57% (2563)	22% (970)	2% (106)	0% (16)

Table I.3: Percentages of five-year-olds at each base ten stage by decile and ethnicity

		Final base ten score				
Decile	Ethnicity	Emergent	One-to-one	Advanced counting	Early additive	Advanced additive
Low	Asian	30% (13)	53% (23)	12% (5)	5% (2)	
	NZ European	20% (107)	58% (305)	20% (103)	2% (12)	0% (1)
	Māori	28% (144)	53% (274)	17% (86)	2% (12)	1% (3)
	Other	37% (18)	51% (25)	10% (5)	2% (1)	
	Pacific Islands	30% (101)	53% (179)	16% (54)	0% (1)	
	Total	26% (383)	55% (806)	17% (253)	2% (28)	0 (4)
Medium	Asian	14% (7)	54% (27)	32% (16)		
	NZ European	17% (241)	59% (841)	22% (320)	2% (30)	0% (4)
	Māori	19% (74)	63% (239)	16% (62)	1% (5)	0% (1)
	Other	15% (6)	68% (28)	15% (6)	2% (1)	
	Pacific Islands	29% (17)	47% (27)	21% (12)	3% (2)	
	Total	18% (345)	59% (1162)	21% (416)	2% (38)	0% (5)
High	Asian	5% (3)	52% (29)	38% (21)	4% (2)	2% (1)
	NZ European	10% (88)	56% (474)	28% (239)	4% (34)	1% (5)
	Māori	9% (7)	62% (51)	28% (23)	1% (1)	
	Other	12% (6)	50% (26)	31% (16)	6% (3)	2% (1)
	Pacific Islands	19% (4)	71% (15)	10% (2)		
	Total	10% (108)	57% (595)	29% (301)	4% (40)	1% (7)

Note: Percentages have been rounded to the nearest whole number where necessary.

Table I.4: Percentages of six-year-olds at each base ten stage by ethnicity

	Final base ten score				
Ethnicity	Emergent	One-to-one	Advanced counting	Early additive	Advanced additive
Asian	2% (3)	23% (30)	50% (66)	21% (28)	3% (4)
NZ European	6% (195)	36% (1241)	43% (1479)	13% (427)	2% (60)
Māori	10% (100)	43% (440)	39% (390)	8% (76)	1% (6)
Other	5% (7)	45% (70)	43% (66)	7% (11)	
Pacific Islands	11% (50)	52% (241)	34% (161)	3% (14)	0% (1)
Total	7% (355)	39% (2022)	42% (2162)	11% (556)	1% (71)

Table I.5: Percentages of six-year-olds at each base ten stage by decile

	Final base ten score				
Decile	Emergent	One-to-one	Advanced counting	Early additive	Advanced additive
Low	10% (162)	45% (737)	37% (595)	8% (125)	0% (7)
Medium	6% (132)	38% (857)	44% (986)	11% (246)	1% (31)
High	5% (61)	33% (428)	45% (581)	14% (185)	3% (33)
Total	7% (355)	39% (2022)	42% (2162)	11% (556)	1% (71)

Table I.6: Percentages of six-year-olds at each base ten stage by decile and ethnicity

		Final base ten score				
Decile	Ethnicity	Emergent	One-to-one	Advanced counting	Early additive	Advanced additive
Low	Asian	6% (3)	28% (13)	51% (24)	15% (7)	
	NZ European	7% (43)	41% (242)	39% (231)	11% (67)	1% (5)
	Māori	12% (65)	44% (237)	36% (196)	7% (38)	0% (1)
	Other	8% (5)	59% (39)	30% (20)	3% (2)	
	Pacific Islands	12% (46)	53% (206)	32% (124)	3% (11)	0% (1)
	Total	10% (162)	45% (737)	37% (595)	8% (125)	0% (7)
Medium	Asian		26% (12)	46% (21)	26% (12)	2% (1)
	NZ European	6% (97)	37% (627)	44% (753)	12% (198)	1% (25)
	Māori	8% (30)	43% (170)	41% (160)	8% (30)	1% (5)
	Other	2% (1)	37% (17)	52% (24)	9% (4)	
	Pacific Islands	6% (4)	48% (31)	43% (28)	3% (2)	
	Total	6% (132)	38% (857)	44% (986)	11% (246)	1% (31)
High	Asian		13% (5)	55% (21)	24% (9)	8% (3)
	NZ European	5% (55)	33% (372)	44% (495)	15% (162)	3% (30)
	Māori	6% (5)	41% (33)	43% (34)	10% (8)	
	Other	2% (1)	33% (14)	52% (22)	12% (5)	
	Pacific Islands		29% (4)	64% (9)	7% (1)	
	Total	5% (61)	33% (428)	45% (581)	14% (185)	3% (33)

Table I.7: Percentages of seven-year-olds at each base ten stage by ethnicity

	Final base ten score				
Ethnicity	Emergent	One-to-one	Advanced counting	Early additive	Advanced additive
Asian	1% (1)	10% (17)	31% (53)	44% (74)	14% (24)
NZ European	2% (66)	17% (526)	44% (1373)	31% (967)	6% (193)
Māori	4% (31)	29% (252)	45% (387)	21% (182)	2% (16)
Other	2% (2)	17% (17)	58% (58)	19% (19)	4% (4)
Pacific Islands	6% (23)	35% (136)	45% (175)	12% (48)	1% (5)
Total	3% (123)	20% (948)	44% (2046)	28% (1290)	5% (242)

Table I.8: Percentages of seven-year-olds at each base ten stage by decile

	Final base ten score				
Decile	Emergent	One-to-one	Advanced counting	Early additive	Advanced additive
Low	4% (57)	29% (413)	46% (665)	19% (280)	2% (34)
Medium	3% (50)	19% (378)	46% (909)	27% (537)	6% (110)
High	1% (16)	13% (157)	39% (472)	39% (473)	8% (98)
Total	3% (123)	20% (948)	44% (2046)	28% (1290)	5% (242)

Table I.9: Percentages of seven-year-olds at each base ten stage by decile and ethnicity

		Final base ten score				
Decile	Ethnicity	Emergent	One-to-one	Advanced counting	Early additive	Advanced additive
Low	Asian		14% (7)	42% (21)	36% (18)	8% (4)
	NZ European	3% (19)	23% (134)	49% (285)	22% (126)	3% (19)
	Māori	4% (18)	33% (154)	42% (196)	20% (93)	1% (7)
	Other	6% (2)	20% (7)	69% (24)	6% (2)	
	Pacific Islands	6% (18)	35% (111)	44% (139)	13% (41)	1% (4)
	Total	4% (57)	29% (413)	46% (665)	19% (280)	2% (34)
Medium	Asian	2% (1)	13% (6)	33% (15)	29% (13)	22% (10)
	NZ European	2% (33)	17% (256)	46% (686)	29% (440)	6% (87)
	Māori	4% (12)	25% (83)	49% (166)	20% (68)	3% (9)
	Other		22% (8)	42% (15)	28% (10)	8% (3)
	Pacific Islands	6% (4)	40% (25)	43% (27)	10% (6)	2% (1)
	Total	3% (50)	19% (378)	46% (909)	27% (537)	6% (110)
High	Asian		5% (4)	23% (17)	58% (43)	14% (10)
	NZ European	1% (14)	13% (136)	39% (402)	39% (401)	8% (87)
	Māori	2% (1)	24% (15)	40% (25)	34% (21)	
	Other		7% (2)	66% (19)	24% (7)	3% (1)
	Pacific Islands	9% (1)		82% (9)	9% (1)	
	Total	1% (16)	13% (157)	39% (472)	39% (473)	8% (98)

Note: Percentages have been rounded to the nearest whole number where necessary.