Te Ara Poutama: An Evaluation of Te Poutama Tau 2007

Tony Trinick
The University of Auckland
Faculty of Education
<t.trinick@auckland.ac.nz>

Brendan Stevenson
Massey University
Māori Studies
<b.s.stevenson@massey.ac.nz>

The Te Poutama Tau project has evolved significantly over the last six years since the pilot in 2002. The project is seen as a means of supporting the overall development of Māori-medium mathematics education, with particular emphasis on raising student achievement. This paper reports on the analysis of the 2007 data from the project. In general, student performance improved throughout 2007, with improvements in a number of areas that were of concern in 2006. Analyses of patterns of performance and progress over time from 2004 to 2007 show that there have been positive longitudinal trends in most areas of the Number Framework.

Background

Te Poutama Tau (the Māori-medium numeracy project) evolved from a pilot that took place in 2002 (Christensen, 2003) and has evolved considerably over the last six years. The primary catalyst for the development of Te Poutama Tau was the opportunity to develop the teaching of mathematics in the medium of Māori generally. Māori-medium mathematics is a relatively new discipline, very small in comparison with English-medium mathematics, and relies heavily on the institutional support of the Ministry of Education. The Māori-medium mathematics community saw an opportunity in the Numeracy Development Projects (NDP) to address many of the challenges impacting on Māori-medium mathematics. These issues included a lack of effective te reo Māori teaching resources and a lack of research to inform practice. The NDP provided an opportunity to develop facilitators, curriculum developers, and researchers to support the teaching and learning of mathematics in the medium of Māori. The NDP also provided an opportunity to address some linguistic issues, including the continued development of the mathematics register and discourse in te reo Māori (Christensen, 2003, 2004).

There were concerns in earlier years about student achievement in pāngarau (Māori-medium mathematics), but before the NDP, there was no data available that showed student achievement nationally. Subsequently, the Te Poutama Tau project has provided a significant corpus of data for analysis and investigation. Analyses of student achievement data gathered every year from 2002 have provided a valuable source of information to teachers, schools, and numeracy facilitators supporting Te Poutama Tau. The information supports teachers to plan and implement their broader pāngarau programmes, to identify areas of concern and success, and to better understand the impact of individual teachers' practice on student outcomes. Te Poutama Tau evaluations and other research reports show that the issues confronting student achievement in English-medium mathematics are echoed in Māori-medium mathematics (Christensen, 2003, 2004; Trinick & Stevenson, 2005, 2006, 2007). Te Poutama Tau continues to focus on improving student performance in pāngarau by improving the professional capability of teachers. Te Poutama Tau is based on the Number Framework developed for New Zealand schools (Ministry of Education, 2007a) and provides a clear description of the key concepts and progressions of students' learning. This paper reports on the results of the 2007 Te Poutama Tau project and focuses on the following questions:

- What overall progress did students make on the Number Framework in 2007?
- In which areas of the Framework did students perform well and in which areas did they perform poorly in 2007? Why is this so?

- How do patterns of performance and progress of students involved in the 2007 Te Poutama Tau compare with patterns of performance and progress from 2004, 2005, and 2006?
- In what areas of the Framework have the students performed well or poorly over the four years? Why is this so?

Method

Thirty schools participating in Te Poutama Tau during 2007 provided data for this paper. In 2007, a significant number of wharekura students (years 9–10) participated as part of the Ministry of Education's strategy to extend the programme into secondary schools. All the Te Poutama Tau students were assessed individually at the beginning of the programme, using a diagnostic interview, and again at the end of the year (Ministry of Education, 2007a). The results for each student, class, and school were entered on the national database (see www.nzmaths.co.nz). The database shows the progress that the students made on the Number Framework between the initial and final diagnostic interviews. The time between the two interviews was about 20 weeks of teaching. Schools can access their own data in the national database to establish targets for planning and reporting purposes for the subsequent year(s). Teachers can use the data to group students according to ability, and they can use various activities supplied on the nzmaths website to support their students in both strategy and knowledge development.

Participants

Figure 1 shows the distribution across the year levels of the 2007 Te Poutama Tau students. The summaries of the data in the following section were restricted to only those students with both initial and final interview results. In 2006, 1153 students completed both the initial and final diagnostic interview, and in 2007, complete data was obtained for 1323 students.

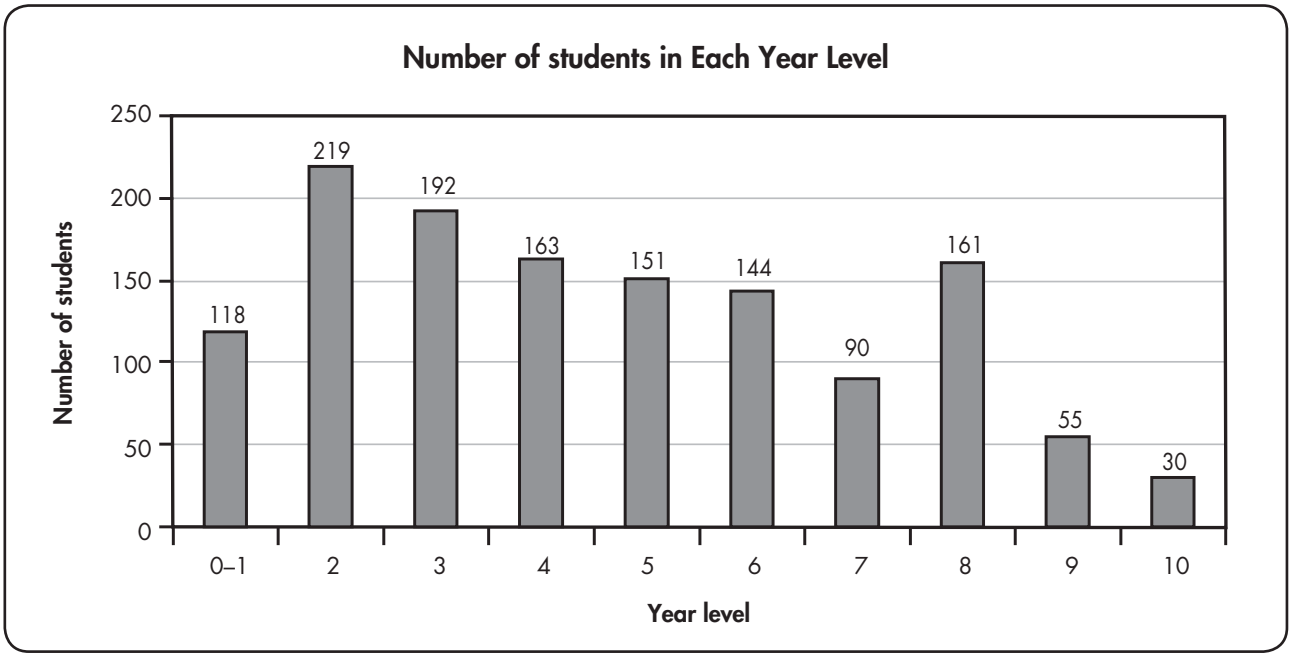

Figure 1. Distribution of 2007 Te Poutama Tau students across year levels

Overview of Student Progress, 2007

Student progress was very positive in most areas of the Number Framework. In 2006, the domains of numeral identification (NID), fractions, and grouping and place value were of concern (Trinick & Stevenson, 2007). The 2007 results show an improvement in the mean stage gain in these domains (see Figure 2). The mean stage gain for proportions and fractions does not look as positive, and these domains continue to be a challenge for students. They are conceptually complex areas, and it is expected that students will not make the same rate of progress through these two domains as perhaps they do through the addition/subtraction domain (Trinick & Stevenson, 2006). However, these are important areas in the learning of mathematics, so it is critical not to compromise expectations that students will eventually make sense of the complex concepts that relate to these domains.

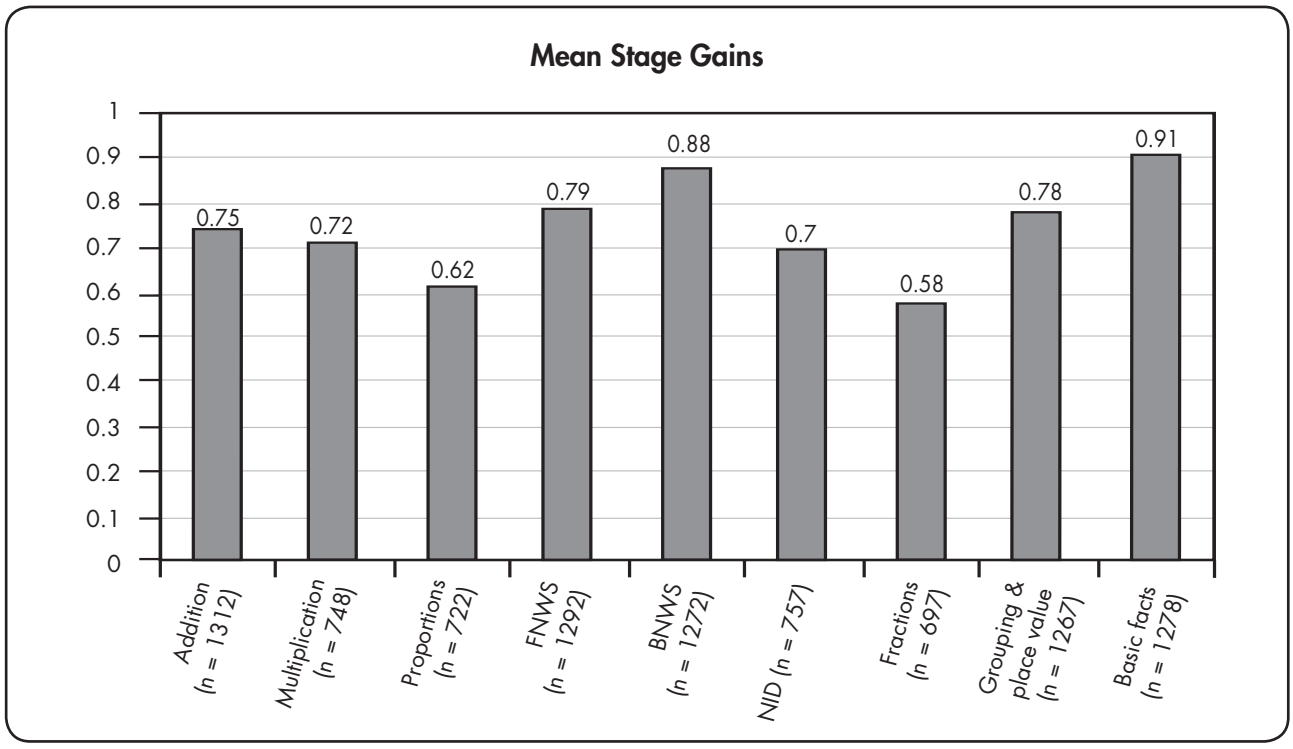

Figure 2. Mean stage gains across the Number Framework, 2007

Student Achievement and Year Level

The graphs in Figure 3 show variations in the mean gain for each domain of the Number Framework across the year levels. For example, students at years 0–1 made a mean stage gain of 1 for the addition/subtraction domain and at year 6, a mean gain of 0.4 (see Figure 3.1). A number of variables need to be considered when interpreting the results, including the increasing complexity of the stages (higher levels become more complex), the ceiling effect, and the number of years the students have been involved in Te Poutama Tau. The results show a consistent dipping of achievement at years 5 and 6 for all of the domains. It is not clear why this is so. It may be to do with these particular cohorts of students, the teaching, the schools, or it may be a result of a combination of factors.

Strategy domains

Although generally there have been improvements across the strategy domains of addition/subtraction, multiplication/division, and proportions (see Figures 3.1–3.3), there are differences in the results for each domain for the students in 2007. The results reflect the increasing complexity of each domain. It is expected that year 0–1 students will make more progress in the addition/subtraction

domain than in multiplication/division and proportions. The addition/subtraction domain is the only strategy domain included in Uiui A (Test A, the diagnostic interview test most commonly used for year 0–1 students). Similarly, it is unlikely that year 0–2 students will be tested on proportional thinking. It is not clear why there is an increase in the mean stage gains for year 7 and 8 students across these three domains in comparison to year 6 students in the same domains.

This is first time that the results for year 9 and 10 students have been included in the Te Poutama Tau evaluation. The results look very positive, but we must bear in mind that the results do not include details of the initial stages at which the students were tested. As noted in a number of other NDP reports, students are more likely to progress more quickly through the lower stages of any domain (Young-Loveridge, 2006).

Knowledge domains

Forward number word sequence (FNWS), backward number word sequence (BNWS), and numeral identification (NID) follow a similar pattern of regression in mean stage gain. This is not surprising, considering that students encounter these knowledge domains earlier, and the regression can be attributed to a number of key factors. A number of students in the older age groups may already have been at the upper stages in these domains when the initial testing took place. It is also important to note that the results for NID (Figure 3.6) have only been derived as part of the initial diagnostic interview and only show progress for students who were tested using Uiui A – the students who proceeded beyond Uiui A to E or U will not register mean stage progress in NID.

These particular three knowledge areas are closely related. In order for students to count forward or backward or to locate numbers in any way, they need to be able to identify numbers.

Fractions, place value, and basic facts also follow a similar pattern to the three strategy domain results – growth initially, then a regression around years 5 and 6, and then some growth again.

Note: Students tend to start learning fractions later than place value and basic facts, and it is highly likely that the year 0–2 students were tested with Uiui A only. There is no fractions component in Uiui A, hence the lack of data in these years.

Figures 3.1 to 3.3 show mean stage gains in the strategy domains, and figures 3.4 to 3.9 show mean stage gains in the knowledge domains.

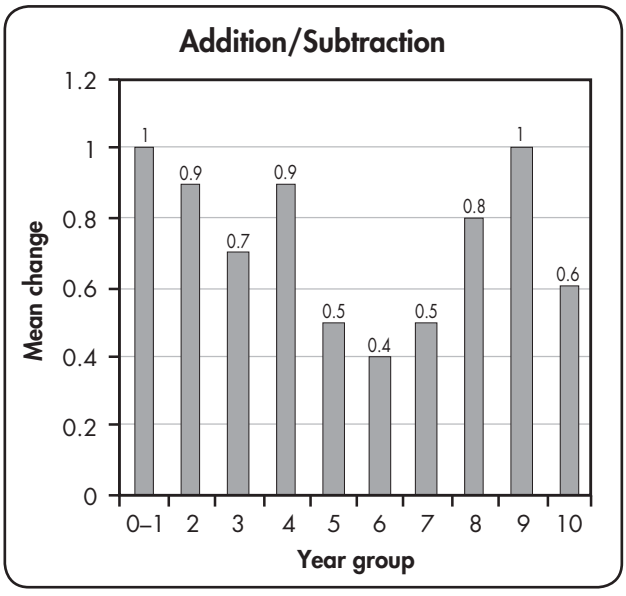

Figure 3.1. Mean stage gain for addition and subtraction

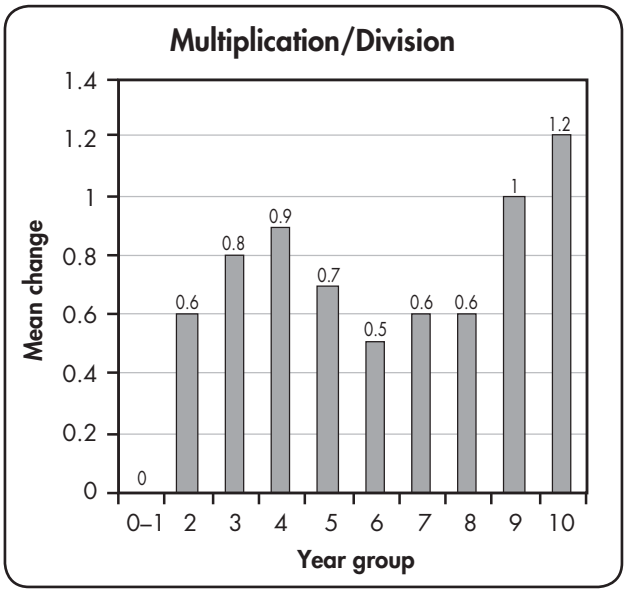

Figure 3.2. Mean stage gain for multiplication and division

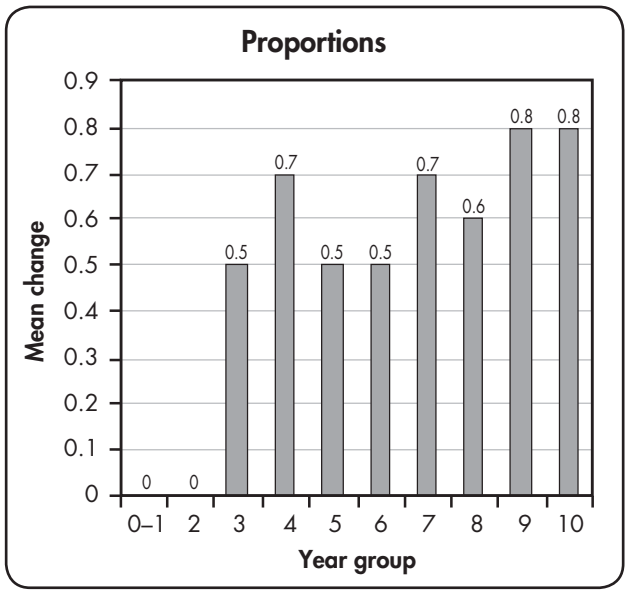

Figure 3.3. Mean stage gain for proportions

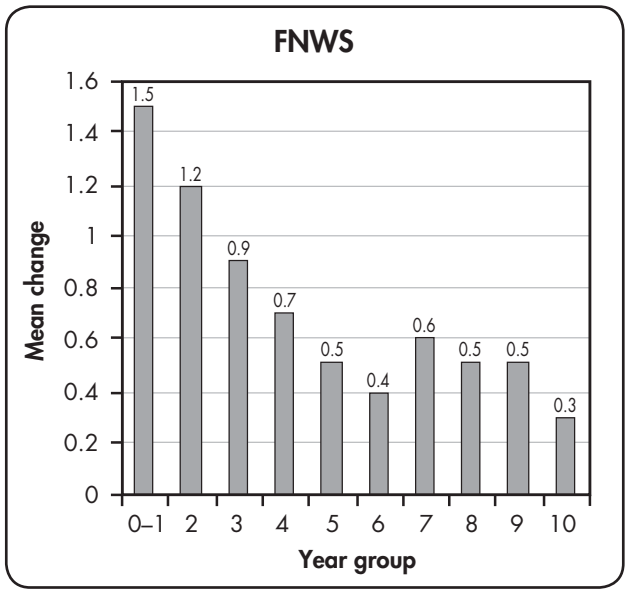

Figure 3.4. Mean stage gain for forward number word sequence

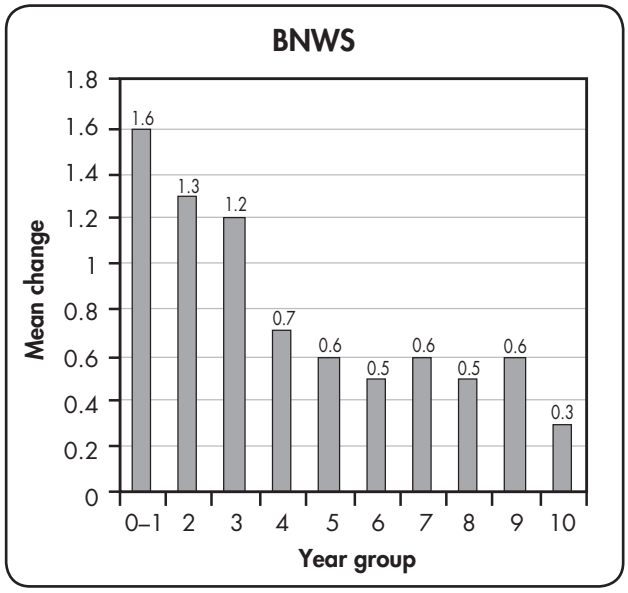

Figure 3.5. Mean stage gain for backward number word sequence

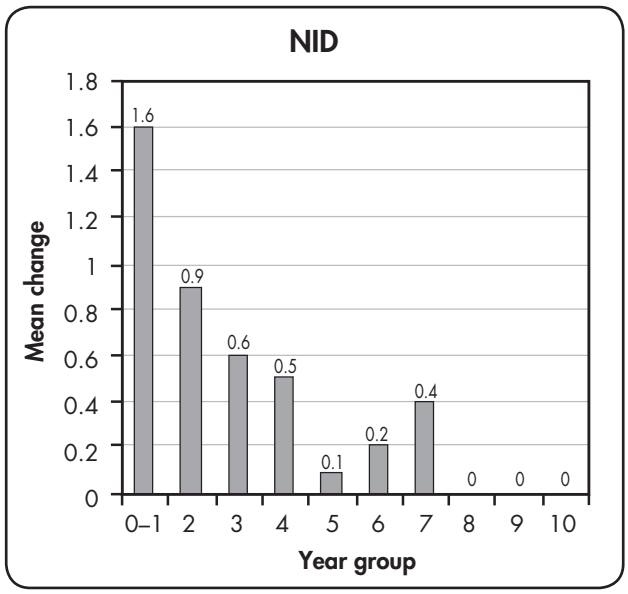

Figure 3.6. Mean stage gain for numeral identification

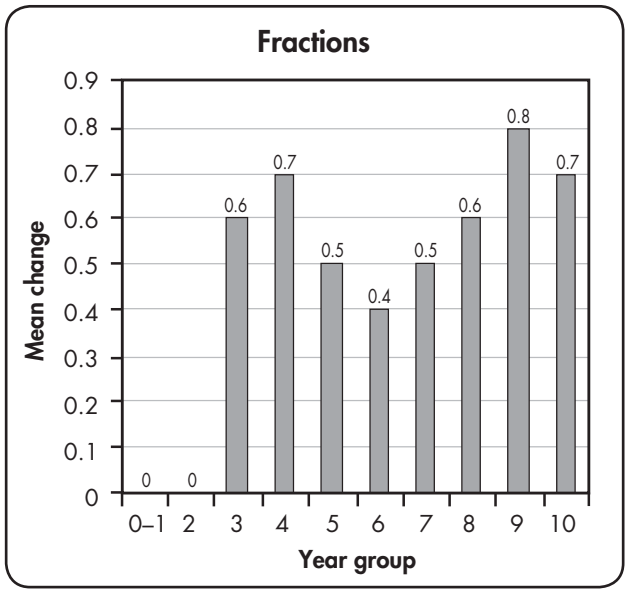

Figure 3.7. Mean stage gain for fractions

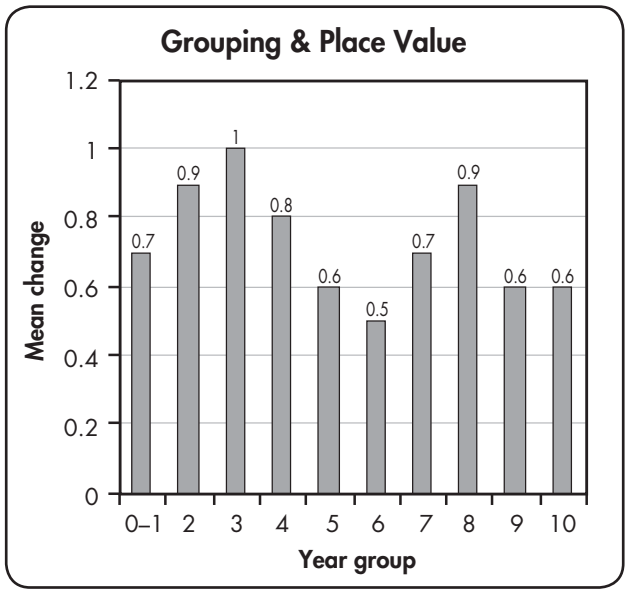

Figure 3.8. Mean stage gain for grouping and place value

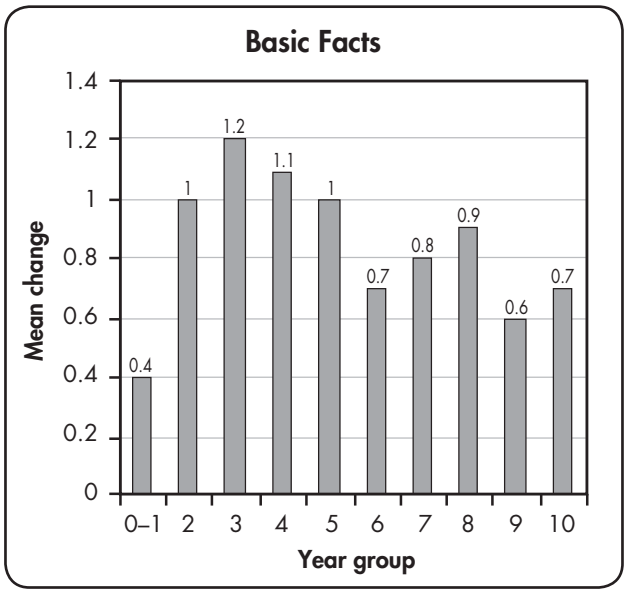

Figure 3.9. Mean stage gain for basic facts

Student Achievement and Initial Stage Assessment

The graphs in Figure 4 show the variation in the mean gain and initial stage level for each domain of the Number Framework. For example, the students who initially tested at stage 1 for addition/subtraction made a mean stage gain of 1.4. The students who initially tested at stage 5 made a mean 0.4 stage gain. The horizontal axis in each graph shows the stages in each domain.

Note: The final stage for each domain is not given in this data because there is no further stage for the students to progress to. For example, for the addition/subtraction domain, over the course of their schooling the students may progress from stage 0, Tatau Pitomata (Emergent), to stage 6, Te Puanga o te Wāwāhi Tau Tāpiriri (advanced additive–early multiplicative). If the students were at Te Puanga o te Wāwāhi Tau Tāpiriri for the addition/subtraction domain when they were initially tested for this analysis, they would not show any improvement because there is no further stage to progress to in this domain.

Most domains showed a "diminishing returns" pattern, which shows that advancement is more difficult for students at successively higher year levels. The gain in stage 7 of basic facts (Figure 4.9) may be well be attributed to the wharekura (year 9–10) students participating in the project.

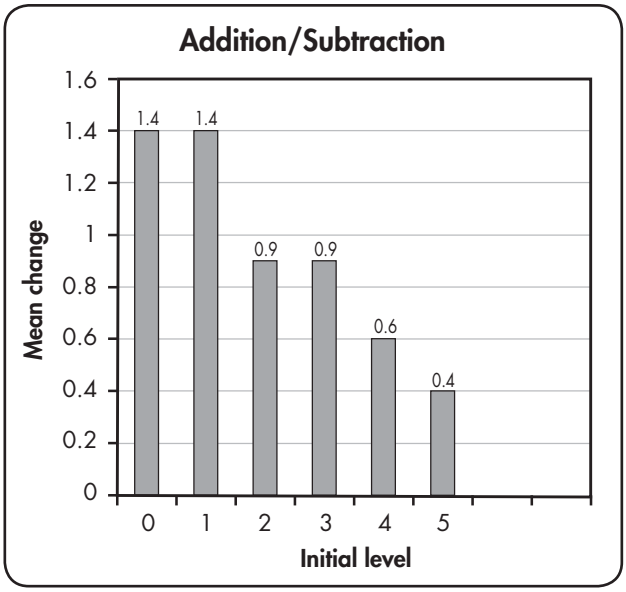

Figure 4.1 Mean stage gain for addition/subtraction, initial

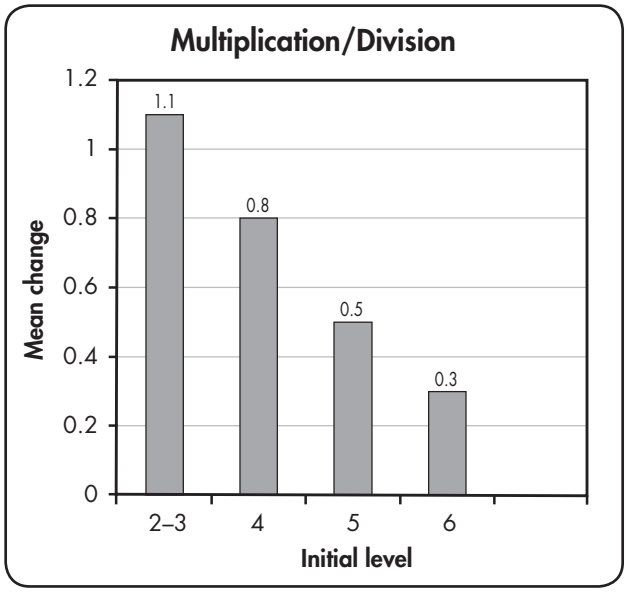

Figure 4.2. Mean stage gain for multiplication/division, initial

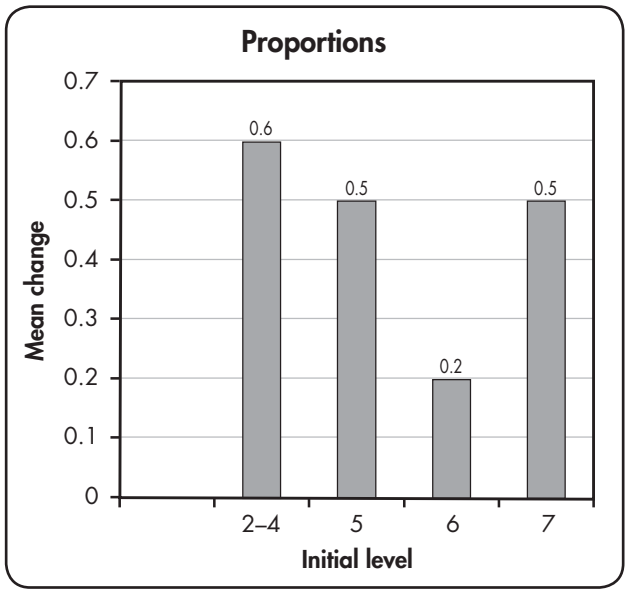

Figure 4.3. Mean stage gain for proportion, initial

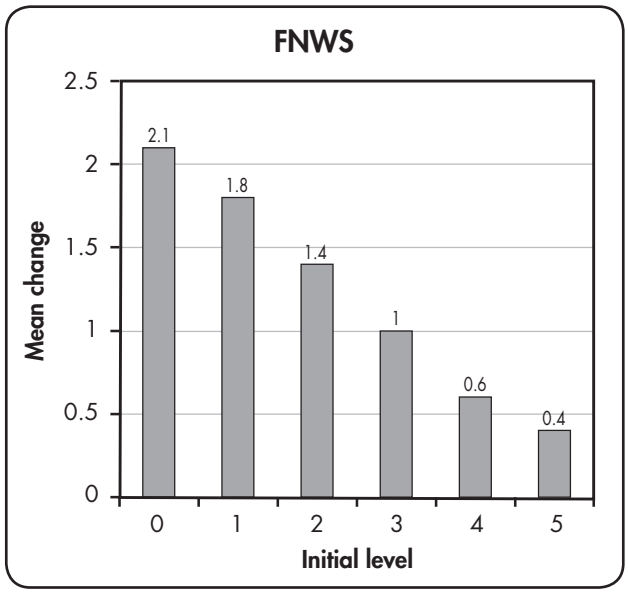

Figure 4.4. Mean stage gain for FNWS, initial

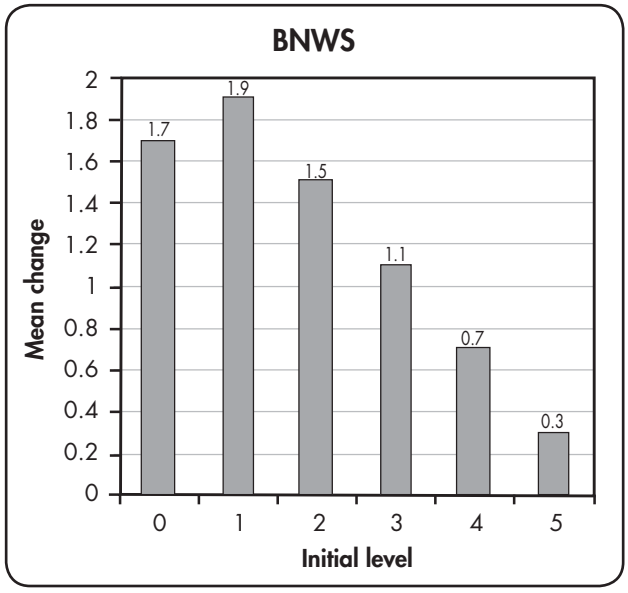

Figure 4.5. Mean stage gain for BNWS, initial

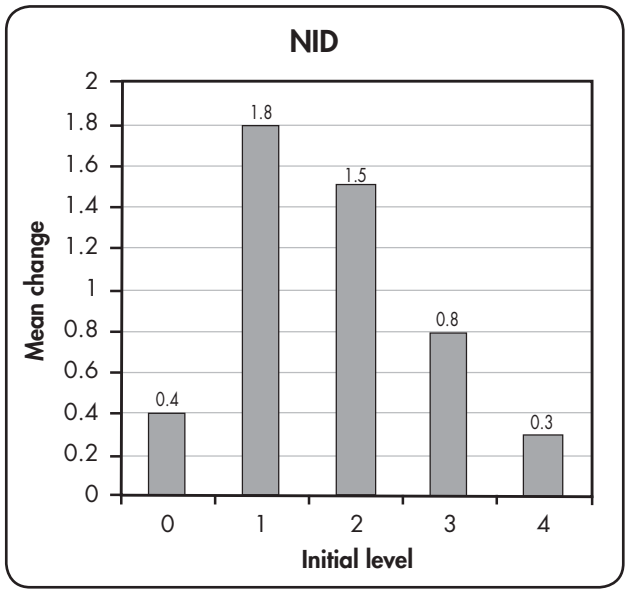

Figure 4.6. Mean stage gain for NID, initial

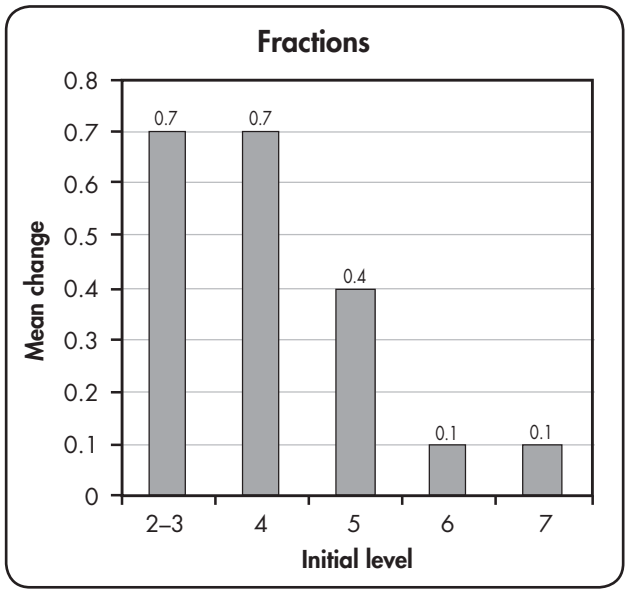

Figure 4.7. Mean stage gain for fraction, initial

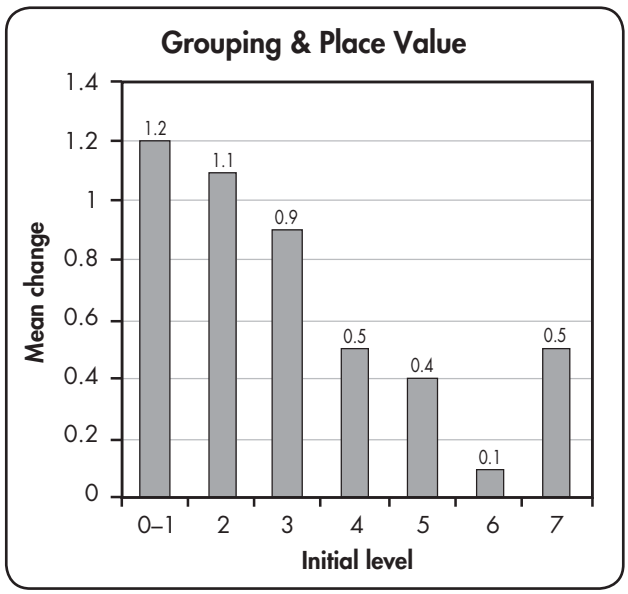

Figure 4.8. Mean stage gain for grouping and place value, initial

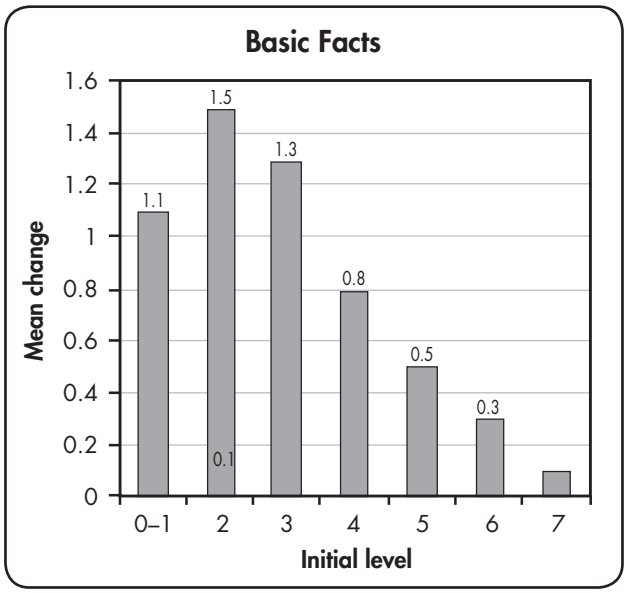

Figure 4.9. Mean stage gain for basic facts, initial

Reporting student achievement data

Individual schools and classes can use similar charts to analyse their own students' data. These charts can help teachers identify patterns and trends at an their own school, but the teachers need to be aware that for small samples of students, these charts can be very misleading. A useful addition to the NDP is the Ministry of Education (n.d.) curriculum expectations. These have been developed for English-medium settings but can be used as a guide for Māori-medium settings.

Longitudinal Patterns of Progress

This section examines patterns of performance over four years of implementation of Te Poutama Tau. As can be seen in Figure 5, with the exception of the fractions domain, the 2007 student cohort performed similarly to previous years, in terms of mean stage gains across most domains of the Number Framework.

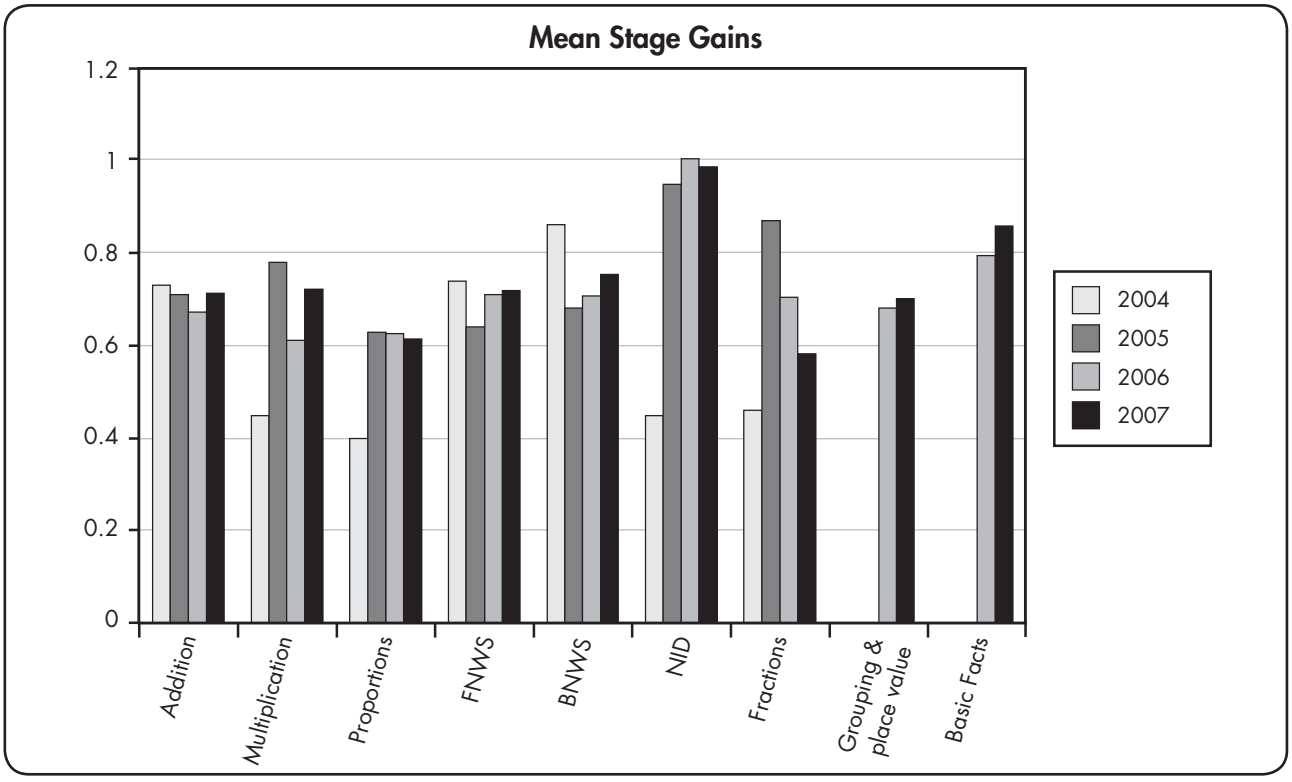

Figure 5. Mean stage gains across the Number Framework

A number of interesting trends show up in Table 1. If the 2006 results are compared with the 2007 results (larger data sample sizes), the change difference in most of the domains of the Framework can be seen to be greater in 2007. This is primarily because initial scores were lower than in 2006, and mean gains are higher at lower stages of the Framework.

Table 1
Comparison of Change between Initial and Final Test Results, 2006 and 2007

		2006			2007		
	Mean	Initial	Change	Final	Initial	Change	Final
Strategy	Addition/Subtraction	3.69	0.67	**4.36**	3.4	0.75	**4.09**
	Multiplication/Division	2.63	0.61	**3.25**	2.36	0.72	**2.97**
	Proportions	2.49	0.63	**3.12**	2.27	0.62	**2.80**
Knowledge	FNWS	4.04	0.71	**4.75**	3.69	0.79	**4.41**
	BNWS	4.11	0.71	**4.82**	3.42	0.88	**4.22**
	NID	3.24	1.00	**4.25**	2.27	0.70	**2.40**
	Fractions	2.04	0.70	**2.74**	1.96	0.58	**2.41**
	Decimals	2.87	0.68	**3.55**	2.06	0.78	**2.74**
	GPPV	3.41	0.79	**4.20**	2.10	0.91	**2.90**

Figure 6 shows how the average for the final results for all tests varies across the year levels for the years 2005 to 2007. From year 2 onwards, the trend is reasonably consistent for 2007 and 2005. Significant mean stage gains were made in the earlier year levels in 2006, with a drop off in years 7–9. There was not a significant number of students in years 8–10 prior to 2007. The Te Poutama Tau project was extended into wharekura in 2007. As noted earlier, it is important to interpret these results with caution because the stages do not constitute an interval scale. The figure shows a general trend of a dip at the year 5–6 age range.

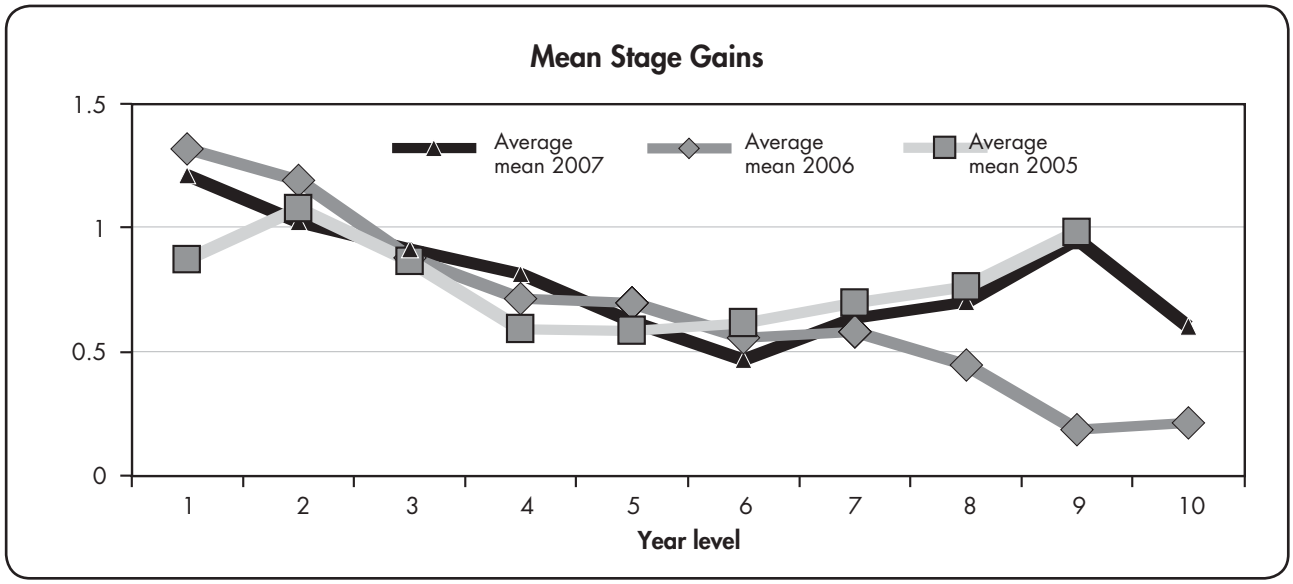

Figure 6. Comparison of students' average mean stage gain across years 2005, 2006, and 2007

Summary

The corpus of data collected for the Te Poutama Tau project over the last five years introduces an ever-increasing list of questions, for example, why there is a dip in students' progress around years 5 and 6. As noted earlier, as students progress through the stages, the stages become more complex, and it is not expected that the rate of student progress will be the same for all year groups. However, longitudinal trends show that the mean stage gain for year 7 and 8 students is slightly higher.

Also, it is not clear how language factors in Māori-medium teaching impinge on or support students' acquisition of the complex concepts, particularly multiplicative thinking. Multiplicative thinking is a significant component of algebra, fractions, and concepts such as proportions.

The following recommendations arise from the research that has been discussed in this report as well as from discussions with Te Poutama Tau facilitators for particular focus in 2008:

- Te Poutama Tau should focus more on older students who have made minimal stage gains, for example, 2007 year 4 students (who are year 5 in 2008) who have not progressed beyond the advanced counting stage for addition/subtraction.
- Investigate the possible reasons for the dip in progress for year 5 and 6 students.
- Continue to investigate the relationship between Māori language and mathematics.
- Continue to investigate the impact of Poutama Tau on Māori students' progress in other strands of the mathematics and statistics learning area of the new curriculum.

References

Christensen, I. (2003). *An evaluation of Te Poutama Tau 2002:* Exploring issues in mathematical education. Wellington: Ministry of Education.

Christensen, I. (2004). *An evaluation of Te Poutama Tau 2003:* Exploring issues in mathematical education. Wellington: Ministry of Education.

Ministry of Education (n.d.) Curriculum expectations: www.nzmaths.co.nz/Numeracy/Lead_Teacher/PLC/Expectations/index.aspx

Ministry of Education (2007a). *Te Poutama Tau, Pukapuka tuatahi: Te mahere tau.* Wellington: Ministry of Education.

Ministry of Education (2007b). *Te Poutama Tau, Pukapuka tuarua: Te uiui aromatawai.* Wellington: Ministry of Education.

nzmaths website (2007): www.nzmaths.co.nz

Trinick, T., & Stevenson, B. (2005). *An evaluation of Te Poutama Tau 2004.* Wellington: Ministry of Education.

Trinick, T., & Stevenson, B. (2006). *An evaluation of Te Poutama Tau 2005.* Wellington: Ministry of Education.

Trinick, T., & Stevenson, B. (2007). Te Poutama Tau: Trends and patterns. In *Findings from the New Zealand Numeracy Development Projects 2006* (pp. 44–53). Wellington: Learning Media.

Young-Loveridge, J. (2006). Patterns of Performance and Progress on the Numeracy Development Projects: Looking Back from 2005. In *Findings from the New Zealand Numeracy Development Projects 2005* (pp. 16–32). Wellington: Learning Media.