Findings from the New Zealand Numeracy Development Projects 2005

Foreword

This is the second compendium of papers concerning research into various aspects of the New Zealand Numeracy Development Projects (NDP). The work has been undertaken by researchers who are all involved in some way or other in the local mathematics education scene. They are all either university academics or educational consultants. The 12 papers in this compendium span the areas of student achievement, professional practice, and sustainability as they relate to the NDP.

Student Achievement

Young-Loveridge's paper, "Patterns of Performance and Progress on the Numeracy Development Project: Looking Back from 2005" (p. 6), continues the work of assessing the overall performance of students by looking at the New Zealand-wide data reported by teachers (see also *Findings from the Numeracy Development Project 2004*).

Overall, students' results have improved steadily over the years of the NDP. For example, students are now progressing further relative to their initial performance than they did earlier in the life of the NDP. While there are still gaps between various ethnic groups, these appear to be reducing. In fact, if these differences are considered with respect to other studies, they are seen to be relatively small.

However, Young-Loveridge warns that the homogeneity of the data may be due to the fact that the average decile level of schools now is higher than it was at the start of the NDP. Further, students may be aided by the fact that the assessment is oral rather than written.

The paper by Thomas and Tagg ("Numeracy Development Project Longitudinal Study: Patterns of Achievement", p. 22) extends the work reported in *Findings from the New Zealand Numeracy Development Project 2004*. The study involves schools that first participated in the project at least two years ago.

In the first section of the study, 26 schools were involved. Students from four year levels were given especially designed tests: years 4 and 8 were given a balanced selection of questions from the Third International Mathematics and Science Study (TIMSS) 1995 and 2001 National Education Monitoring Project (NEMP) assessments; year 5 students were given items from the 2003 Trends in International Mathematics and Science Study (TIMSS) assessment; and year 6 students received items from Assessment Tools for Teaching and Learning (asTTle). In general, the students performed considerably better on NDP related questions, did less well on number problems not emphasised in the NDP, and did best of all on non-number questions. The authors expressed concerns about students' performance on calculations that were too hard to perform mentally.

In the second part of the study, 20 schools were involved. Students from years 1–8 continued to show the improving achievement reported in Thomas and Tagg's previous paper (ibid). This is confirmed by teachers, 70% of whom stated that at least 70% of their students were attaining their school's numeracy targets.

Te Poutama Tau, which is based on the Number Framework developed for the NDP, is a professional development programme for teachers involved in the teaching of numeracy in Māori-medium settings. In "An Evaluation of Te Poutama Tau 2005" (p. 34), Trinick and Stevenson look at the progress that was made in 2005. This follows on from similar pieces of research that were undertaken in 2003 and 2004 and uses the national database on which teachers record the stage levels of students at the start and end of the year. The purpose of the research was to determine the overall progress of students and to identify areas where students had performed well or poorly over the three years of the project.

There was a small general improvement over the three years for most of the numerical knowledge, but there were large gains in the areas of multiplication, proportions, number identification, and fractions, with a smaller improvement in grouping and place value knowledge. One of the positive aspects of the results from 2005 is that the number of students making no stage gain is declining. In particular, there was a very large drop in the number of students making no stage gain in multiplication and fractions, from 70% to 40%.

The aims for subsequent years are:

- to improve the outcomes for students who currently are making no stage gains
- to maintain an emphasis on grouping and place value
- to maintain a focus on the important areas of multiplication, fractions, decimals, and proportions – essential skills in higher mathematics as well as in everyday life
- to determine how te reo Māori linguistic structures help or hinder the development of the various areas of pāngarau (Māori-medium mathematics).

Irwin and Britt's paper ("Algebraic Thinking in the Numeracy Project: Year Two of a Three-year Study", p. 46) continues work that was started in 2004 and reported in *Findings from the New Zealand Numeracy Development Project 2004*. The same test that was given to students in 2004 was given to those who took part in 2005. The questions on these tests all involved increasingly difficult compensation problems in each of the four arithmetic operations. Each of the four test sections contained (in this order) whole numbers, decimal fractions, whole numbers and a literal symbol, decimals and a literal symbol, and just literal symbols in an algebraic identity.

At the middle stage of this study, the results show that the year 9 students who had been involved in the NDP in intermediate school were significantly better at algebraic thinking than they were in year 8. The students from the intermediate school that had the best performances in the 2004 study were also the top performers in year 9 and had the highest correlation between successes at these two levels. Students from other schools did not show equivalent progress or correlation. There were significant differences between schools.

"What do you think that maths is all about?" is the question that Young-Loveridge, Taylor, Sharma, and Hāwera asked a number of children in "Students' Perspectives on the Nature of Mathematics" (p. 55). There seems to be a reasonable amount of literature on the topic from an adult viewpoint, but few children's opinions have been sought. Young-Loveridge et al. interviewed 459 year 2–6 students from schools that had taken part in the NDP and from schools that hadn't and gathered a large number of interesting responses.

Nearly half of the students' responses covered items of mathematical content, mainly on number; the learning process was mentioned by over 30% (though the percentage seemed to decline as

the students got older); well over 20% thought it would be useful at some later stage in their lives; and a small percentage each talked about the value of maths for thinking, solving problems, enjoyment, and current usefulness. Perhaps surprisingly, just under 25% could not think of anything to say on the subject at all. There seemed to be little consistent difference between students who had been involved in the NDP and those who had not.

Professional Practice

"Modelling Books and Student Discussion in Mathematics" (p. 65), the paper by Higgins with Wakefield and Isaacson, takes the using of manipulatives a stage further. Instead of simply letting the students work with some material to introduce or solidify a mathematical idea, Higgins et al. propose the use of a modelling book (also know as a recording book) to be used in tandem with the activity. In this large book that is used by a teacher with a group of students, the teacher and students write down mathematical ideas that have been stimulated by the equipment. This written work reinforces the concepts of the model and provides a stepping stone between the activity and the imaging of the mathematics. In addition, it provides a record of the work that enables the group to look back on what they have achieved. Teacher and student quotes reinforce the value and enjoyment of the modelling book. Although this work was undertaken with a single Māori class, there is no obvious reason why the modelling book shouldn't be of value in all classrooms.

"Contextually Responsive Facilitation" (p. 72), a paper by Higgins and Tait-McCutcheon with Carman and Yates, explores a contextually responsive model of facilitation. This model focuses on the concepts and strategies of the programme rather than attending to the minutiae of the guidelines. Higgins et al.'s research investigated how the use of co-teaching and co-generative dialogue produced facilitation that was responsive to a teacher's context. Data included classroom observations and interviews with students and teachers in schools in two different regions of the country.

The research suggests that this approach produces both a collective capacity and commitment among the teachers and a feeling that they can make a difference for their professional teaching community. But perhaps most importantly, an environment is developed in which the individual builds new teaching habits and transforms their professional practice. In this way, it is hoped the effect will be sustained well after the facilitator withdraws from the school.

The work of Irwin and Woodward (reported in "Advancing Pasifika Students' Mathematical Thinking" p. 80) follows on from initial research undertaken in 2004 and reported on in *Findings from the Numeracy Development Project 2004.* In that previous study, the class was observed only once and the aim of the 2004 research was to see how the students' mathematical language developed over time, especially when the teacher was not involved in the conversation. Again in 2005, the year 5 and 6 class consisted mainly of students from a Pasifika background. The class was in a decile 1 school, and its membership varied over the time of the five observations.

The teacher, a New Zealand European, continued to help her students make progress that was greater than the average for Pasifika students nationwide. She used language that is known to facilitate children's thinking and encouraged them to use similar language. Although the students used similar language when the teacher was present, they used only selected aspects of this language when the teacher was not working with their group. They continued to emphasise

method rather than answers but did not solve problems co-operatively. The literature suggests that solving mathematical problems co-operatively enhances mathematical success. The authors recommend that it would be useful to ensure that this takes place whenever students are working together to solve problems.

Thomas, Tagg, and Ward have taken a different and equally important approach in "Numeracy Assessment: How Reliable are Teachers' Judgments?" (p. 91). At least two aspects of the NDP rely heavily on teachers' diagnostic assessments of students. One of these is that the Numeracy Project Assessment diagnostic tool (NumPA) and the Global Strategy Stage (GloSS) assessment, along with a teacher's own diagnostic questions, are the basis of a teacher's knowledge of their students' mathematical ability and provide the starting point for their classroom programme. The other is that the initial and final assessments for the year are used as evidence for the success of the NDP. However, the quality of the teachers' assessment decisions on which the data is based had never been examined. It is of vital importance, therefore, to know how reliable teachers' judgments are.

Thomas et al. compared teachers' judgments against those of educators experienced in strategy stage assessments. This comparison was made by both "live" assessments of actual students and by assessing scripted situations. There was a high level of agreement between teachers and experts in the work with students. Where there were differences, the teachers' ratings were lower in two-thirds of the cases. One reason for this may be that teachers are grouping their children for instructional, rather than reporting, purposes. In the scripted situations, reliability was good but not quite as high. This may be due in part to the limited information available in the written scenarios. Another possible reason is that the scenarios represented all stages of the Framework, whereas the teachers involved teach at specific year levels that focus on specific stages of the Framework. However, the results of this work are encouraging in that teachers' reliability appears to be very good.

In "Te Poutama Tau: A Case Study of Two Schools" (p. 103), Trinick studied two kura kaupapa Māori that had achieved significant gains during 2004 to try to determine the factors that foster student performance. In interviews and through a questionnaire, principals and teachers were asked socio/cultural questions about the school and its community and the links between the two, what experience and qualifications staff had, especially regarding pāngarau, and staff reflections on Te Poutama Tau. This research is similar to that reported last year.

Trinick found that both schools had in common the desire of their communities to revitalise Māori language, knowledge, and culture. It was also suggested that the positive relationship between all the professionals in the schools was critical in producing student outcomes. Further, teachers in both kura collaborated regularly and built up an environment where they could share ideas and gain support. These had all enabled positive changes to be made by both staff and students in their attitude towards pāngarau.

Sustainability

The study on the sustainability of the NDP commissioned by the Ministry of Education in 2005 concentrated on the 2005 lead teacher initiative. The questionnaire used for this study by Thomas and Ward ("Sustaining the Numeracy Project: The Lead Teacher Initiative 2005", p. 115) was sent to lead teachers, teachers, and principals of the schools involved in the initiative as well as to the facilitators of those schools.

The researchers found that the participants believed that the lead teacher initiative had been effective in providing lead teachers with both increased confidence to guide the development of numeracy in their schools and increased knowledge of mathematics.

It was found that nearly all teachers continued to use NDP practices within their teaching programmes. The most common of these were strategy stage grouping of students and the employment of resources and activities. Fundamental to sustaining numeracy in schools appears to be ongoing facilitator support, leadership by lead teachers, and the support of the principal. Barriers to sustainability identified by participants included the challenge of new staff that lack numeracy training and a lack of time to plan, teach, and assess numeracy. A view expressed by some facilitators was that schools need to take increased responsibility for teachers' ongoing professional learning if numeracy is to be successfully sustained.

Five teachers from two schools (including the two lead teachers) took part in Ell and Irwin's study of sustainability of the NDP ("Sustained Numeracy Project Practices in Two Schools", p. 129). The data was obtained through audiotaped interviews and collected documentation.

The literature suggests that internalisation by teachers is the basis for innovation and change and that this leads ultimately to sustainability through school-wide change. Ell and Irwin's study found that all but one of their teachers showed evidence of this internalisation in both their interviews and their practice. The remaining teacher was still holding change at arm's length by her vocabulary in the interviews and by her noting that the project does not align with her practice. However, the authors point out that sustainability involves more than maintaining the system aspects of the NDP; sustained depth of insight into students' progress is also involved, and determining whether this exists requires a deeper study than was possible in the time available to them.

Conclusion

Some aspects of the research reported in this compendium gave cause for concern. Specifically, the performance on arithmetical tasks that cannot be performed mentally and the differences that exist between the performances of ethnic groups were highlighted by researchers. In the former case, teachers may have felt that such calculations were not as important as other aspects of the NDP. Consequently, more emphasis will need to be placed on this in future years. And although there are continuing differences between ethnic groups' results, the magnitude of these differences appears to be declining and seems to be smaller than in comparable studies elsewhere.

However, there is much reported here about the NDP that is positive and shows that the NDP is raising the standard of New Zealand children's mathematical performance. Consequently, it would appear that the NDP continues to play a major role in the education of the nation's youth.

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