Acknowledgements

The Project directors acknowledge the vital support and contributions of many people to this report, including:

- the very dedicated staff of the Educational Assessment Research Unit
- Heleen Visser, Hadyn Green and other staff members of the Ministry of Education
- members of the Project's National Advisory Committee
- members of the Project's Mathematics Advisory Panel
- principals and children of the schools where tasks were trialled
- principals, staff and Board of Trustee members of the 228 schools included in the 2009 sample
- the 2638 children in the samples for the assessments, and their parents
- the 88 teachers who administered the assessments to the children
- the 44 senior tertiary students who assisted with the marking process
- the 160 teachers who assisted with the marking of tasks early in 2010
- the people and organisations who granted permission for the publication of their work in this report, to illustrate our assessment resources (acknowledged in full below).

Summary

Overview: This report addresses student knowledge, strategies and skills in four areas of mathematics: number, measurement, geometry and statistics. More than half of the assessment tasks were number tasks. Year 8 students, on average, performed at a substantially higher level than year 4 students, but on most tasks there was a substantial overlap in performance. Mathematics is a popular subject, second in popularity among year 4 subjects and third among year 8 subjects.

Performance in mathematics did not improve overall between 2005 and 2009, although there were marked differences from this pattern on some individual tasks. Taking a longer term view, there is evidence of a small improvement for year 4 students from 1997 to 2009, although this has been constrained by a drop in performance on tasks requiring quick recall or derivation of number facts. Over the same 12-year period there has been no meaningful performance change overall for year 8 students.

On average, year 4 boys perform a little better than girls, with no meaningful difference for year 8 boys and girls. At both year levels, Pakeha students averaged moderately to strongly higher than Māori students and strongly higher than Pasifika students, but there were exceptions on some tasks (for instance, Pasifika students performed similarly to Pakeha students on most addition tasks). There always was a substantial overlap in performance, with students of all ethnicities among the high and low performers on each task. Over the last 12 years there has been no clear downwards or upwards trend in performance differences among the ethnic subgroups, nor in the high proportion of mathematics tasks showing performance differences by school decile rating.

New Zealand's National Education Monitoring Project commenced in 1993, with the task of assessing and reporting on the achievement of New Zealand primary school children in all areas of the school curriculum. Children are assessed at two class levels: year 4 (halfway through primary education) and year 8 (at the end of primary education). Different curriculum areas and skills are assessed each year, over a four-year cycle. The main goal of national monitoring is to provide detailed information about what children know, think and can do, so that patterns of performance can be recognised, successes celebrated, and desirable changes to educational practices and resources identified and implemented.

Each year, random samples of children are selected nationally, then assessed in their own schools by teachers specially seconded and trained for this work. Task instructions are given orally by teachers, through video presentations, on laptop computers, or in writing. Many of the assessment tasks involve the children in the use of equipment and materials. Their responses are presented orally, by demonstration, in writing, in computer files, or through submission of other physical products. Many of the responses are recorded on videotape for subsequent analysis.

ASSESSING MATHEMATICS

In 2009, the third year of the fourth cycle of national monitoring, three areas were assessed: mathematics, social studies, and information skills. This report presents details of the mathematics assessments.

The use of many tasks with both year 4 and year 8 students allows comparisons of the performance of year 4 and 8 students in 2009. Because about 45% of the tasks have been used twice, in both 2005 and 2009, trends in performance across that four-year period can also be analysed. Four tasks allow direct consideration of longer-term trends: two with data from 1997 and 2009, and two with data from 2001 as well as from 2005 and 2009.

Chapter 2 explains the place of mathematics in the New Zealand curriculum and presents the mathematics framework. It identifies four areas of content (number and algebra, measurement, geometry, and statistics) linked to eight processes. The importance of attitudes and motivation is also highlighted.

NUMBER AND ALGEBRA

Chapter 3 presents the students' results on 56 number and algebra tasks. There was strong progress from year 4 to year 8. Averaged across 217 task components administered to year 4 and year 8 students in 2009, 30% more year 8 than year 4 students succeeded with these components.

Overall, performance at both year levels was unchanged between 2005 and 2009. Averaged across 137 task components attempted by year 4 students in both years, the same percentage of students succeeded in 2009 as in 2005. At year 8 level also, on average, across 172 task components, the same percentage succeeded in 2009 as in 2005. The most notable change in performance was a decline for year 8 students on multiplication problems (p36), where changes in computation strategy were clearly evident.

Three tasks allowed study of trends over periods longer than four years. One involved number patterns and sequences, with substantial improvement from 1997 to 2009 for year 4 students and smaller improvement for year 8 students. Two tasks involving knowledge of addition and multiplication facts had been used in the 2001 and 2005 assessments, when they showed substantial losses for year 4 students in both areas and a small loss for year 8 students on multiplication facts. There was negligible further change on these tasks between 2005 and 2009.

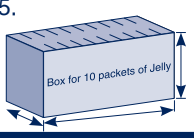
Students at both levels scored poorly in tasks involving estimation and tasks involving fractions (especially fractions other than halves and quarters). There was clear evidence that students have adopted changes in number strategy taught in recent years. This appears to have been advantageous in responses to some tasks and disadvantageous in responses to other tasks.

MEASUREMENT

Chapter 4 presents the results for 25 measurement tasks. There was strong progress from year 4 to year 8. Averaged across 95 task components administered to both year 4 and year 8 students, 28% more year 8 than year 4 students succeeded with these components.

Overall, there was no evidence of change between 2005 and 2009 for year 4 students, but a slight reduction in the performance of year 8 students. Averaged across 34 trend task components attempted by year 4 students in both years, the same percentage succeeded in 2009 as in 2005. At year 8 level, on average across 59 task components, 2.5% fewer students succeeded in 2009 than in 2005.

A good range of measurement systems, processes and applications was covered in the set of tasks attempted by students. At both levels students' skills of reading measurements were substantially stronger than those of making good estimations. Year 8 students were quite weak in the understanding of perimeter, area and volume.

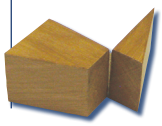


GEOMETRY

Chapter 5 presents the results for 13 geometry tasks. There was quite strong progress from year 4 to year 8. Averaged across 15 task components administered to both year 4 and year 8 students, 21% more year 8 than year 4 students succeeded with these components.

Overall, there was no meaningful change in performance for year 4 or year 8 students between 2005 and 2009. Averaged across 17 trend task components attempted by year 4 students in both years, 2% more students succeeded in 2009 than in 2005, but the small number of tasks and components mean that this change should not be regarded as meaningful. At year 8 level, the same percentage of students succeeded on 41 task components in 2009 as in 2005.

A small decline in capability to identify cross sections of three-dimensional objects was evident in one task previously used in the 1997 assessments.



Many students were able to identify the symmetry lines of two-dimensional shapes, and year 8 students had good success with drawing the nets of some three-dimensional objects. Students had less success with visualising the internal structure and cross sections of three-dimensional objects, and with following instructions involving angle measurements expressed in fractions of complete turns or in degrees.

STATISTICS

Chapter 6 presents the results of six statistics tasks. Readers should note that much of what is usually taught and assessed in this area is covered in separate NEMP reports on using *Graphs, Tables and Maps*: most recently Report 46 on the 2007 assessments. The one task administered at both year 4 and year 8 in 2009 showed moderate growth, with, on average, a 12% increase in performance from year 4 to year 8 on seven task components.

Year 4 students improved markedly on one trend task between 2005 and 2009, with little change on the other trend task. There was no meaningful change between 2005 and 2009 across three trend tasks for year 8 students.

Students generally performed well on tasks related to recording or directly interpreting data, but much less well in applying probability-related ideas to data.

SURVEY

Chapter 7 focuses on the results of a survey that sought information from students about their strategies for, involvement in, and enjoyment of mathematics. Mathematics was the second most popular of 14 subjects for year 4 students and the third most popular for year 8 students, the same result as in 2005 and one place higher at both levels than in 2001.

An open-ended question asked students, "What are some interesting maths things you do in your own time?" The emphasis on basic facts and tables among year 4 students had declined substantially between 2001 and 2005, from 56% to 36% of students, but increased in 2009 to 47% of year 4 students.

The student responses to 11 rating items showed that about 10% more year 8 than year 4 students have distinctly negative views about studying mathematics in school and about their own capabilities, while 32% more year 8 than year 4 students are negative about doing maths in their own time. These patterns have stayed quite consistent from the first survey in 1997 to the 2005 survey. Over the same period, there have been moderate reductions in the percentages of students who said that they didn't know how good their parents thought they were at maths, or how good their teacher thought that they were at maths.

PERFORMANCE OF SUBGROUPS

Chapter 8 details the results of analyses comparing the performance of different demographic subgroups. Community size, school size, school type (for year 8 students) and geographic zone did not seem to be important factors predicting achievement on the mathematics tasks. The same was true for the 2005, 2001 and 1997 assessments. However, there were statistically significant differences in the performance of students from low, medium and high decile schools on 85% of the tasks at year 4 level (compared to 63% in 2005, 87% in 2001 and 85% in 1997) and 83% of the tasks at year 8 level (compared to 65% in 2005, 76% in 2001 and 77% in 1997).

Effect sizes were used for the comparisons of boys with girls, Pakeha with Māori, Pakeha with Pasifika students, and students for whom the predominant language at home was English with those for whom it was not. Effect size is the difference in mean (average) performance of the two groups, divided by the pooled standard deviation of the scores on the particular task. For this summary, these effect sizes were averaged across all tasks.

Year 4 boys averaged slightly higher than girls, with a mean effect size of 0.14 (a little higher than the mean effect sizes of 0.08 in 2005 and 0.10 in 2001). Year 8 boys averaged very slightly higher than girls, with a mean effect size of 0.03 (in both 2005 and 2001, girls were ahead of boys by an identical margin).

Pakeha students averaged moderately to substantially higher than Māori students, with mean effect sizes of 0.42 for year 4 students (similar to 0.37 in 2005 and 0.46 in 2001) and 0.38 for year 8 students (similar to 0.35 in 2005 and 0.42 in 2001).

Year 4 Pakeha students averaged substantially higher than Pasifika students, with a mean effect size of 0.50 (compared with 0.35 in 2005 and 0.59 in 2001). Year 8 Pakeha students also averaged substantially higher than Pasifika students, with a mean effect size of 0.53 (essentially unchanged from 0.51 in 2005 and 0.53 in 2001). Responses to the Mathematics Survey showed a clear tendency for Pasifika students to be more enthusiastic about studying mathematics than their Pakeha counterparts.

Compared to students for whom the predominant language at home was English, students from homes where other languages predominated averaged moderately lower, with mean effect sizes of 0.20 for year 4 students and 0.24 for year 8 students (compared to 0.10 for both year levels in 2005). Comparative figures are not available for the assessments in 2001. Year 4 and year 8 students whose predominant language at home was not English tended to be more positive about studying mathematics than students whose predominant language at home was English.

OVERALL TRENDS

Considering the results on all of the trend tasks in this report, it is appropriate to conclude that there has been no change overall between 2005 and 2009 in the mathematics performance of year 4 or year 8 students. Between 2001 and 2005, averaged across about 200 trend task components included in the report on the 2005 assessments, the percentage of year 4 students succeeding with each component decreased by an average of just over 2%, while the performance of year 8 students was unchanged. The decrease for year 4 in 2005 came entirely from a decline in performance on basic number fact tasks: the result on other tasks showed a small increase. Between 1997 and 2001, in the report in the 2001 assessments, there had been an average increase of 4% on year 4 trend task components, and of 1% on year 8 trend task components. Putting these three trend periods together suggests that over the 12 years from 1997 to 2009 there has been a small net improvement in mathematics performance at year 4 level (held back from a larger improvement by the decline between 2001 and 2005 in basic fact knowledge), and essentially no net change in mathematics performance at year 8 level.