

Summary

This report, the first of two, presents a descriptive summary of the mathematics and science achievement results from New Zealand's participation in the repeat of the Third International Mathematics and Science Study (TIMSS-98/99). The repeat study provides the first opportunity to build a comprehensive picture of trends in achievement for New Zealand Year 9 students in mathematics and science. In addition, trend information on the context of students' mathematics and science learning was generated. TIMSS studies assess the cumulative learning of students. That is, most Year 9 students have had eight years of previous formal mathematical and scientific experience before beginning their secondary education. However, the classroom and school level data gathered through TIMSS does permit a one year "snap-shot" of the year of schooling in which the student is studying that assists in describing the environment in which the student is currently operating. This first report focuses on students' achievement and on students' beliefs and attitudes towards mathematics and science within both the national and international contexts.

New Zealand's commitment to TIMSS-98/99 began at the end of 1997. The key reason for taking part in the study was the opportunity it afforded to gather comprehensive trend information in an international context. In part, the impetus to collect this information arose from the release of the TIMSS-94/95 middle primary level results (in June 1997) which showed that New Zealand students were weak in mathematics and to a lesser extent in science, relative to their international counterparts. TIMSS 98/99 was thus able to investigate any relative gains this cohort may have made four years on when they were in lower secondary school.

As a result of recommendations of the Mathematics and Science Taskforce, established after the release of the TIMSS-94/95 middle primary results in 1997, there has been a considerable amount of emphasis in developing resources for use in primary schools, and several schemes have been initiated to assist teachers. However, due to the short timeframe, it is unlikely that any of these developments would have had a substantial impact on the results for Year 9 students in 1998.

YEAR 9 STUDENT ACHIEVEMENT IN AN INTERNATIONAL CONTEXT

Chapter 2 of this report provided an overview of the achievement of New Zealand Year 9 students in both mathematics and science relative to their international counterparts in 1998/99. In brief, it showed that New Zealand Year 9 students achieved a mean mathematics score that was about the same as the international mean, and a mean science score that was significantly higher than the international mean.

In terms of trends, New Zealand Year 9 students, on average, achieved scores marginally lower than their Year 9 counterparts did in 1994. Furthermore, New Zealand's performance in mathematics from middle primary to lower secondary remained unchanged relative to other countries in the study. In

science, while there was virtually no change in achievement at the lower secondary level, New Zealand's standing relative to other countries decreased slightly from the middle primary to lower secondary level. This apparent decrease was, however, largely attributed to the relative improvement in performance for countries such as Hungary, Singapore, Canada, and to a lesser extent Australia, in the intervening years.

The results presented in Chapter 2 did not attempt to offer any explanation for New Zealand's performance. Nor was there an attempt to provide any contextual information that may provide insights into, or offer explanations for, student performance. However, it did present an opportunity to identify areas for further examination in order to gain insights into students' understanding and knowledge. For example, the benchmark information can be used to identify lower achieving students in order to develop a 'profile' of their understanding in each learning area. Examining student performance on individual items, or sets of items, to ascertain misconceptions students might hold about particular phenomena, would also be important in gauging areas of weaknesses or strengths for New Zealand students.

YEAR 9 STUDENT ACHIEVEMENT IN A NATIONAL CONTEXT

Chapters 3 and 4 provided an overview of the mathematics and science achievement of Year 9 students in 1998 relative to that of their Year 9 counterparts in 1994 for a variety of New Zealand sub-populations.

The overall small (non-significant) decrease in overall mean achievement in mathematics, from 1994 to 1998, was also reflected in the mathematics achievement of students in the Pakeha/European and Maori groupings while the mean achievement of Pacific and Asian students stayed virtually the same. The slight declines for the former two groupings were largely attributed to the small decreases in both Pakeha/European and Maori boys' mean achievement.

Overall, science achievement within the various sub-group population examined was shown to be reasonably stable since 1994. In science, only students in the Asian grouping showed some movement but this increase was not large enough to be of statistical significance. The corollary of this is that the relativity in achievement among the population sub-groups was more or less maintained. With regard to achievement in science, the most noteworthy difference between the 1994 and 1998 was that, in the latter year, New Zealand girls and boys no longer exhibited a statistically significant difference in their overall scores.

As part of describing the national context of achievement, some school level factors were incorporated into the analyses. In particular, school types (ie, single sex and coeducational schools) were compared on the basis of the achievement of the students attending them. Also, schools within communities that have different socio-economic characteristics were compared on the basis of achievement of the students attending them. While there are some slight changes in one or two areas, in general, the trend in mathematics and science achievement over the four-year period reflected the overall trend in achievement.

In mathematics, *Geometry* was area of apparent relative weakness for Year 9 students compared to their performance in other content areas. However this may, in part, reflect a change in curricular emphasis since 1994 rather than being a weakness in student ability per se. In science, *Scientific*

Inquiry and the Nature of Science was identified as an area of strength for New Zealand students, both relative to their performance in other science content areas and relative to their international counterparts.

YEAR 9 STUDENTS' BACKGROUND CHARACTERISTICS, ATTITUDES AND BELIEFS

Chapter 5 described some of the contextual elements of Year 9 students' mathematics and science achievement in New Zealand. Students' home language environment, the educational resources present in their homes, their attitudes towards mathematics and science, and their self-concept in these subjects were among the factors described and related to mathematics and science achievement.

Students' home language environment, the educational resources present in their homes were found to be strongly associated with achievement. So too were Year 9 students' attitudes towards mathematics and science and their self-concept in their abilities in mathematics and science.

Gender and ethnic identity were found to be associated with how students viewed mathematics and science, and their self-concept in their abilities. Boys typically held very positive views towards mathematics and science — more so than girls; Asian and Pacific typically held more positive views than their Pakeha/European and Maori counterparts. Boys also tended to have a higher self-concept of their ability in science than girls. Pakeha/European students tended to have a relatively high self-concept of their abilities in science while Asian students had a relatively high self-concept in mathematics.

Year 9 students in 1998 reported higher educational aspirations than their Year 9 student counterparts four years previously in 1994; Asian students were more likely to aspire to complete university than students in the other three groupings, while Maori were more likely to report that they did not know what their future educational plans were.

It was also interesting to note some contextual changes which may be interpreted as symptomatic of the ongoing shift towards the 'knowledge society' — for example, an increase in the proportion of homes with computers, and the increasing proportions of students aspiring to higher academic destinations. On the other hand, students indicated a continuing preference for television watching compared to reading books for leisure.

FUTURE WORK

It is acknowledged that while this report provides a broad overview of student achievement, there are other ways in which this rich achievement database can be analysed to gain further insight as to why there has been little change in New Zealand's performance relative to other countries in four years. Contextual information collected from students' teachers as well as school principals will also provide insight to enable a greater understanding Year 9 student achievement and this will be the subject of a second report.

