CHAPTER 5: The Context for New Zealand Year 9 Students' Achievement

KEY POINTS

- The demographics of New Zealand Year 9 students in 1998 were similar to that of their Year 9 counterparts in 1994.
- There was a strong positive relationship between mean achievement (particularly in science) and frequency of English usage in the home; the relationship was particularly strong in the case of Pacific students.
- There was a strong positive relationship between mean achievement and the presence of educational resources in the home. An index of home educational resources revealed that of 33 countries, New Zealand had the sixth highest proportion of students categorised as having 'high' levels of educational resources in the home.
- New Zealand Year 9 students in 1998 reported considerably higher educational aspirations than their Year 9 counterparts in 1994. In particular, the proportion of students aspiring to eventually 'finish university' increased from 37 to 52 percent.
- Positive attitudes were found to be associated with higher mean achievement in both mathematics and science. Slightly higher proportions of boys than girls conveyed strong positive attitudes toward mathematics and science.
- A strong self-concept in mathematics was found to be associated with higher mean achievement in that subject; the same was true for a self-concept in science.
- There were no gender differences found in achievement in either mathematics or science for students with similar levels of self-concept in the relevant subject.
- About two-thirds of students reported that they undertook some homework (but, in most cases, less than an hour) in both mathematics and science on a typical school day.
- As was the case in 1994, TV watching continues to be one of the more popular out-of-school activities on school days, with almost half of the Year 9 students in 1998 reporting that they watched television for at least three hours each school day.
- Only 20 percent of New Zealand's Year 9 students reported reading for leisure for an hour or more for leisure each school day.

INTRODUCTION

The background characteristics of students play an important part in understanding student achievement. Student attitudes to learning, their perceptions of their own ability and of their parents views of success in education, and their socio-economic milieu are all factors that provide some insight into student performance.

Both TIMSS-94 and TIMSS-98 recognised this relationship. In addition to the student achievement tests, students were asked to complete a questionnaire designed to obtain measures of cultural and economic capital, attitudes to learning, use of English in the home, the types of activities in which they were involved outside of school, and their educational aspirations. The questionnaire also asked for demographic information.

The purpose of this chapter is to provide a context for the achievement of New Zealand Year 9 students[1]. Trend information is also presented — that is, comparisons are made with the TIMSS-94 findings for Year 9 students. Where pertinent, the information for New Zealand Year 9 students is compared with that for their international counterparts. As well, some links are made with the TIMSS-94 data on the Year 5 student population since they are the same cohort examined as Year 9 students in TIMSS-98.

HOW DO THE DEMOGRAPHIC CHARACTERISTICS OF YEAR 9 STUDENTS IN TIMSS-98 COMPARE WITH THE STUDENTS IN TIMSS-94?

Age

Table 5.1 presents a breakdown of the age statistics for the New Zealand Year 9 student groups in the two TIMSS studies (1998 & 1994). Although there was a wider range of ages in 1998 than in 1994, the key statistics (ie, mean and median) are the same. Bearing in mind that both assessments are age-grade studies (ie, they focus on the upper 'grade' or class where most 13 year olds are found), it is not necessary to make any adjustments to account for differences in age distribution for valid comparative analysis.

TABLE 5.1: THE AGE OF NEW ZEALAND YEAR 9 STUDENTS IN TIMSS-94 AND TIMSS-98

Student age	TIMSS-94	TIMSS-98
Mean	14.0	14.0
Median	14.0	14.0
Range (5^{th} – 95^{th} percentile)	13 years 5 months – 14 years 6 months	13 years 6 months – 14 years 7 months

Gender

Table 5.2 presents a breakdown of the student groups in the two TIMSS studies, by gender. The proportion of New Zealand Year 9 girls and boys was about the same in each study.

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[1] *For the remainder of this chapter, reference to 'Year 9' means New Zealand Year 9 students. Year 9 students are found in classes sometimes known as form 3 (in many countries this class level is referred to as grade 8).*

TABLE 5.2: THE PROPORTIONS OF NEW ZEALAND YEAR 9 GIRLS AND BOYS IN TIMSS-94 AND TIMSS-98

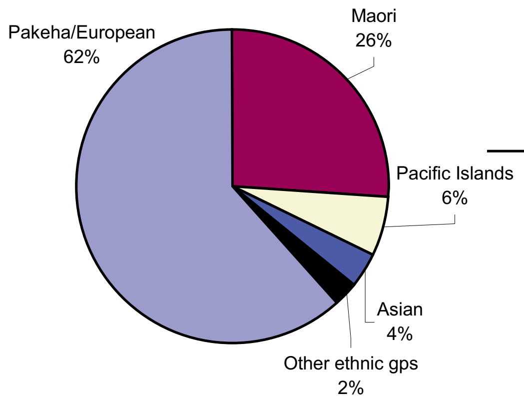
Students	TIMSS-94		TIMSS-98	
	Proportion of girls (%)	Proportion of boys (%)	Proportion of girls (%)	Proportion of boys (%)
Year 9	48	52	49	51

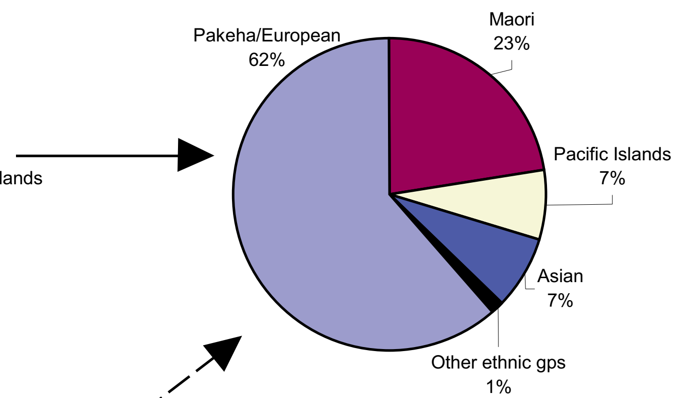
Ethnic identity

Students were asked with which ethnic group or groups they identified. Their responses were collapsed into five main groupings[2]. These were Pakeha/European, Maori, Pacific, Asian, and Other ethnic groups. Figure 5.1 presents a comparison of the proportions of Year 9 students in each of the ethnic groupings in TIMSS-94 and TIMSS-98, alongside the ethnic proportions of the Year 5 students examined in TIMSS-94. (See TN.7 in Technical Notes for an explanation of the levels of missing students.)

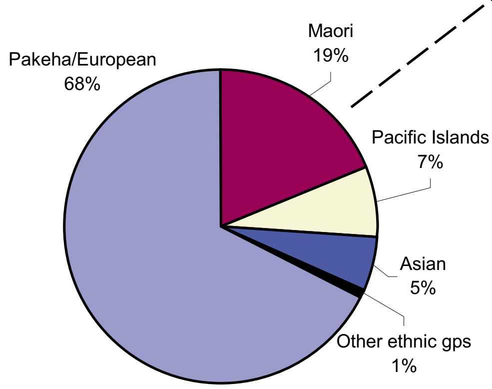
FIGURE 5.1: THE PROPORTIONS OF NEW ZEALAND STUDENTS IN EACH MAIN ETHNIC GROUPING IN TIMSS-94 AND TIMSS-98

Year 5 (Standard 3) in 1994 **Year 9 (Form 3) in 1998**





Year 9 (Form 3) in 1994



Since the Year 9 students in TIMSS-98 were mostly Year 5 students in standard 3 in 1994 a breakdown of the TIMSS-94 Year 5 (standard 3) student group is also shown for comparative purposes.

[2] *The New Zealand Department of Statistics* Standard Classification of Ethnicity *(1992, 1996), a hierarchical classification, was used to group student responses.*

There were lower proportions of Year 9 students in the Pakeha/European grouping and a higher proportion of these students in the Maori grouping in 1998 than in 1994. The 1998 proportions also differed from the national proportion of 13- and 14-year-old students in these ethnic groupings (67% and 19%) reported in *Education Statistics of New Zealand for 1998*, (Ministry of Education, 1999). However, a likely explanation for the difference between these sets of figures is the way they were derived. The TIMSS-98 figures are self-reported, from an adjusted (or weighted) sample of students. The Education Statistics figures come from school-level reporting (based on either student self-identification or parent/guardian identification). Note that the proportions in each ethnic grouping for TIMSS-98 Year 9 students are consistent with how the TIMSS-94 Year 5 students identified themselves four years previously. When the ethnic proportions participating in the study were adjusted to reflect the proportions reported at the school-level, there was very little change in the overall mean achievement scores for mathematics and science.

Note: Since the proportion of students in "Other ethnic groups" was very small, the remaining discussion focuses only on students in the four main ethnic groupings.

Country of origin

Table 5.3 presents the proportions of New Zealand Year 9 students in 1998 who indicated that they were born in New Zealand or in another country, along with their mean mathematics and science scores. A slightly higher proportion (2%) of students in 1998 indicated that they were born in a country other than New Zealand compared with their Year 9 counterparts in 1994 (see Table D.1 in Appendix D for 1994 data).

It is interesting to note that Year 9 students who reported that they were born in New Zealand, on average, achieved nominally higher scores in science than those who reported they were not born in New Zealand. By way of contrast, those reporting that they were born in New Zealand, on average, achieved slightly lower mathematics scores than those reporting their birthplace as outside of New Zealand. This was also the case in 1994. However, only the difference between the mean mathematics scores were of statistical significance[3].

TABLE 5.3: MEAN MATHEMATICS AND SCIENCE SCORES FOR YEAR 9 STUDENTS IN 1998, BY PLACE OF BIRTH

Country of birth	Mean achievement scores in 1998		
	% of students	mathematics score (se)	science score (se)
Born in NZ	86	489 (5.1)	512 (4.9)
Not born in NZ	14	508 (7.7)	500 (8.8)

(se) Standard errors appear in parentheses.

The students who indicated that their birth country was not New Zealand were asked to indicate the age at which they came to New Zealand. The mean age was 7 years 8 months, with the most common age being 11 years.

[3] *Throughout this chapter, differences are described as 'significant', or 'statistically significant' where significance tests meet $\alpha = 0.05$ (ie, the 5% level); see also TN.4 in Technical Notes*

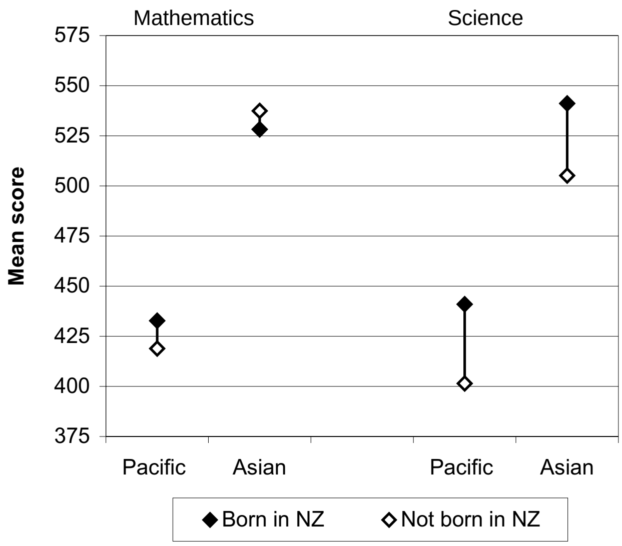
Not surprisingly, the proportions of Pacific and Asian students reporting that they were not born in New Zealand were greater (27% and 71% respectively) than the proportions of students in the Pakeha/ European and Maori groupings (8% and 3% respectively). Pacific students were most often in their pre-school years when arriving in New Zealand (typically, 3 years of age) while Asian students were considerably older (typically, 11 years of age).

On average, students in the Pakeha/European, and Asian ethnic groupings who reported that they were born in New Zealand achieved lower mathematics scores than their counterparts born outside New Zealand (the scores for Maori students were about the same). On the other hand, Pacific students born in New Zealand had nominally higher mean mathematics scores than their non-New Zealand-born counterparts (see also Table D.2, Appendix D). However, none of the differences for each of the groupings were of statistical significance.

In science the converse was apparent — that is, students in three of the four ethnic groupings who reported being born in New Zealand achieved higher mean scores than students born outside of New Zealand. This was particularly evident among students in the Asian grouping where the difference in mean science achievement was statistically significant. Students in the Pakeha/European grouping were the exception this time, with those born outside of New Zealand having the higher mean science scores.

Figure 5.2 illustrates the relationship between birthplace (ie, born in New Zealand or not) of students in the Pacific and Asian ethnic groupings (being those with a high proportion of students born outside of New Zealand) and their mathematics and science achievement.

FIGURE 5.2: MEAN MATHEMATICS AND SCIENCE SCORES FOR YEAR 9 STUDENTS IN THE PACIFIC AND ASIAN ETHNIC GROUPINGS IN 1998, BY PLACE OF BIRTH



LANGUAGE OF THE HOME

In New Zealand, both TIMSS-94 and TIMSS-98 were administered in English. Findings from TIMSS-94 and other studies have shown that there is a strong association between lower achievement and not speaking the language of the test in the home (eg, Wagemaker, 1993; Beaton et al, 1996a & 1996b; Chamberlain, 1996b). However, it is important to remember that there are often other confounding factors that interact with 'home language', for example, the degree to which students are bilingual or multilingual, as well as socio-economic variables (see Bradby et al, 1992). In New Zealand, this association is more apparent in reading and in science, where a greater facility with language is required in these subjects than for mathematics.

The question asked of Year 9 students in TIMSS-98 was '*how often do you speak English at home*'. Students were asked to respond on a three point scale. Ninety percent of students responded that they 'always or almost always' spoke English in the home, while a further nine percent said they spoke English only 'sometimes'. Only one percent reported that they 'never' spoke English in the home.

Table 5.4 presents the mean 1998 mathematics and science scores for students in two categories: those who spoke English at home at least most of the time and who reported that they never or only sometimes spoke English (see Table D.3 in Appendix D for 1994 data).

TABLE 5.4: YEAR 9 STUDENTS' MEAN MATHEMATICS AND SCIENCE SCORES IN 1998, BY THE EXTENT TO WHICH ENGLISH WAS SPOKEN IN THE HOME

Speaking English in the home	Mean achievement scores in 1998		
	% of students	mathematics score (se)	science score (se)
Always/almost always	90	495 (5.1)	517 (4.6)
Sometimes/never	10	469 (9.2)	452 (10.1)

(se) Standard errors appear in parentheses.

The proportion of New Zealand Year 9 students reporting that they almost always spoke the language of the test (in New Zealand's case, English) in the home was similar to proportions of their counterparts in Australia (89%), Canada (91%), and the United States (90%) who said this was the case. In sharp contrast were countries such as Indonesia (28%), the Philippines (11%), Singapore (27%), and South Africa (23%) where relatively small proportions of students reported speaking the test language at home.[4]

In general, across all 38 countries, the pattern of achievement was very similar — students who almost always spoke the language of the test at home, on average, achieved higher scores than those who reported that they never spoke the language of the test at home.

Language of the home and ethnicity

In 1998, more than half of New Zealand Year 9 Asian students and two-fifths of Pacific students reported that they only 'sometimes' or 'never' spoke English in their homes. These students alone accounted for an estimated seven percent of the entire Year 9 population in TIMSS-98. This compares with much smaller proportions of Pakeha/European (only 2%) and Maori (8%) students. The proportions were generally not dissimilar to the Year 9 (form 3) proportions observed in TIMSS-94, although the figure for Pacific students is slightly higher for 1998 (40%) than it was for 1994 (34%) (for further details see Table D.4 in Appendix D). Because of the small proportions of Maori and Pakeha/European students who reported speaking English at home only 'sometimes' or 'never', the achievement scores should

[4] *Many countries, including Canada, South Africa, and the Philippines, offered the test in more than one language.*

only be considered as indicative for these two groups. Figures 5.3 and 5.4 provide a graphical representation of the differences in mean achievement between students who reported that they either 'sometimes' or 'never' spoke English at home and those students who indicated that they 'always or almost always' spoke English in their homes, by ethnic grouping (see Table D.5 in Appendix D for details).

It is important to remember that if students had very limited English they were excluded from the testing (the guideline was to exclude those who had received less than one year of instruction in English). Bearing this in mind, a home language other than English (or more importantly, fluency in the language of instruction) is clearly a factor that is associated with lower mean achievement in both mathematics and science for students in three out of the four ethnic groupings, particularly Pacific students, where the differences in both mathematics and science were of statistical significance. The difference for Asian students in science was also of statistical difference.

FIGURE 5.3: YEAR 9 STUDENTS' MEAN MATHEMATICS SCORES IN 1998, BY ETHNIC GROUPING AND FREQUENCY OF ENGLISH USE IN THE HOME

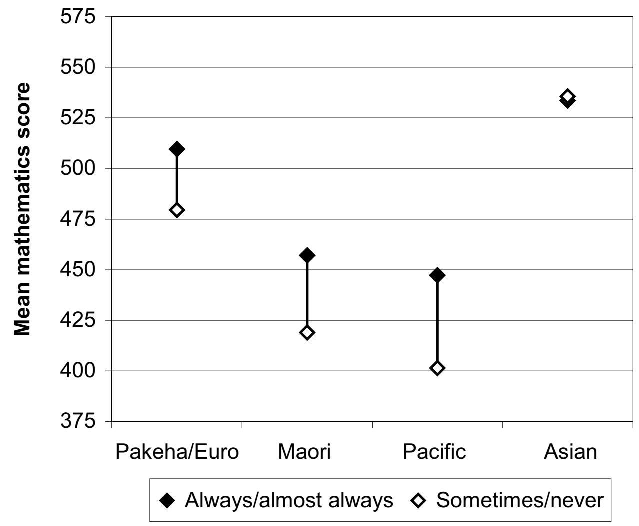
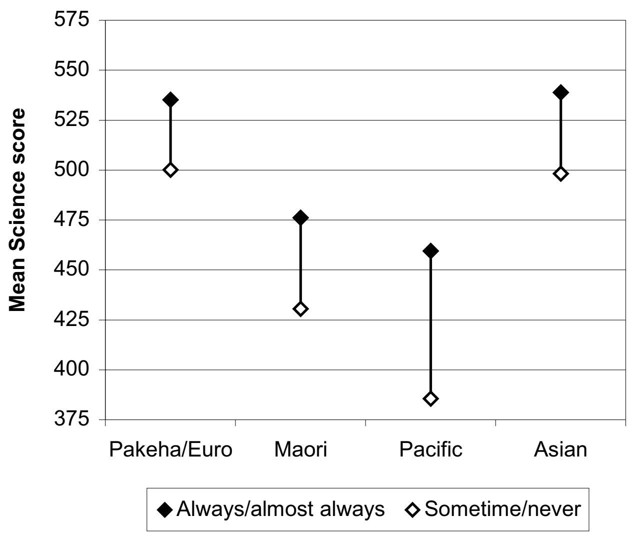


FIGURE 5.4: YEAR 9 STUDENTS' MEAN SCIENCE SCORES IN 1998, BY ETHNIC GROUPING AND FREQUENCY OF ENGLISH USE IN THE HOME



HOME EDUCATION RESOURCES

New Zealand findings from TIMSS-94 showed that availability and frequent use of books were associated with higher achievement in mathematics (eg, Martin, 1996a). Students were asked to estimate the number of books in their homes, choosing from the following categories: 0-10; 11-25; 26-100; 101-200; and >200. Generally, the proportions of students in 1998 who selected each category were comparable to those in TIMSS-94 — although the proportion of students who estimated that they have more than 200 books in the home was only 33 percent in 1998 compared with 41 percent of Year 9 students in 1994. Table 5.5 provides a summary of these data.

TABLE 5.5: YEAR 9 STUDENTS' ESTIMATES OF NUMBER OF BOOKS IN THE HOME IN 1994 AND 1998

Books in the home	Proportion (%) of students in 1994	Proportion (%) of students in 1998	Significance of change
25 or less	10	16	▲
26-100	24	27	●
More than 100	66	56	▼

▲ Mean achievement was statistically significantly higher
● No difference in mean achievement
▼ Mean achievement was statistically significantly lower

Students were further asked whether or not the home in which they normally lived contained possessions such as a computer, musical instruments, a television, a CD player, etc. For most of the items, there were approximately the same proportions of students reporting possession in 1998 as in 1994. However, in five out of the 16 items asked about, there was a difference of more than five percent between the proportions reporting possession in each of 1998 and 1994. Not surprisingly, these items reflect the ongoing diffusion of modern technology into society in the 1990s, with CD players, cell phones, computers, video cameras, and dishwashers all becoming considerably more prevalent — see Table 5.6.

TABLE 5.6: THE PROPORTIONS OF YEAR 9 STUDENTS WHO REPORTED SELECTED POSSESSIONS IN THE HOME IN 1994 AND 1998

Item	Proportion (%) of students reporting possession	
	1994	1998
CD Player	66	93
Cell phone	37	62
Computer	60	72
Video Camera	29	41
Dishwasher	52	61

Among the items in the home listed in the student questionnaire, were three 'core study aids': computer, study desk and dictionary. Sixty-seven percent of New Zealand Year 9 students reported that they had all three core study aids in their home, up 11 percent from the proportion of Year 9 students who reported having all three in 1994. Nearly every other country that participated in both assessments also experienced a significant increase in the proportion of students with all three core study aids. In most cases, these increases were attributable to the proliferation of home computers.

TABLE 5.7: THE PROPORTIONS OF YEAR 9 STUDENTS HAVING THREE CORE STUDY AIDS IN THE HOME IN 1994 AND 1998

Educational aid	Proportion (%) of students in 1994	Proportion (%) of students in 1998	Significance of change
Computer	60	72	▲
Study desk	91	90	●
Dictionary	99	97	▼

▲ Mean achievement was statistically significantly higher
● No difference in mean achievement
▼ Mean achievement was statistically significantly lower

The presence of computers in the home was also interesting because of the wide variation of responses between countries. In five countries, 85 percent or more of students reported having a computer at home (the highest proportion, 96%, was in the Netherlands). In marked contrast, there were ten countries with 15 percent or less of students having a computer at home (the lowest proportions being Indonesia, Iran and Moldova — each with 7%; see Martin et al, 2000 or Mullis et al, 2000 for details).

Home Educational Resources Index

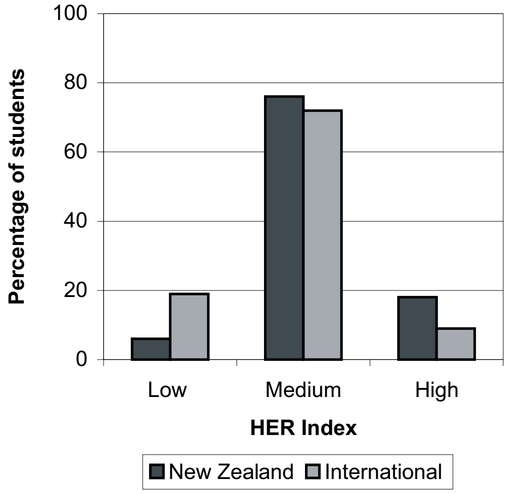
An index of student's Home Educational Resources (HER) was constructed by the International Study Centre to summarise students' responses to questions on the number of books in their home, the number of educational aids in their homes, and their parents highest level of education. Students who were categorised as high on the index reported having at least 100 books and the three core study aids in the home, and that they had at least one parent who had completed university. Students categorised as low on the index reported 25 or fewer books in the home, did not have all three core study aids, and indicated that neither parent finished secondary school. All other students were assigned to medium category on the index. Martin et al (2000) and Mullis et al (2000) describe the HER Index in more detail; a brief summary of these details follows.

For the 35 countries where it was possible to compute the index[5], only 12 were found to have at least 10 percent of students categorised as high on the HER Index including New Zealand with eighteen percent. The only countries to have greater proportions of students categorised as high on the HER Index than New Zealand were Canada (27%), Australia (24%), Israel (23%), United States (22%), and Hungary (19%).

In contrast, 15 countries had only five percent or fewer students categorised as high on the HER index, with South Africa, Thailand, Moldova, Iran, Turkey, Morocco, and Indonesia all having only one or two percent.

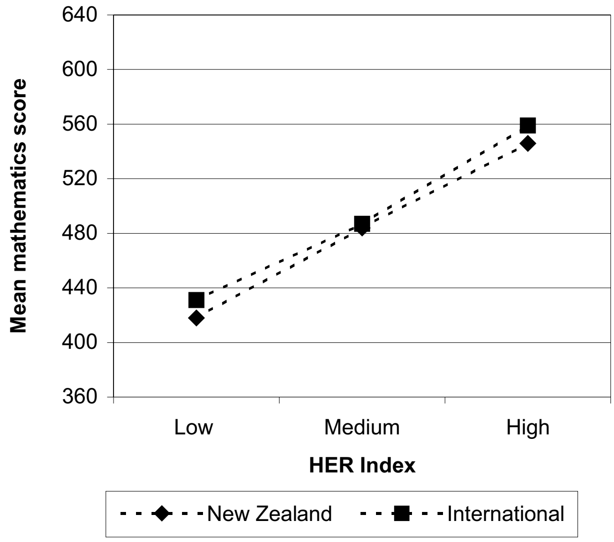
[5] *The HER Index was not calculated for England, Finland, or Japan.*

FIGURE 5.5: THE PROPORTIONS OF STUDENTS AT EACH LEVEL OF THE HOME EDUCATIONAL RESOURCES (HER) INDEX IN 1998



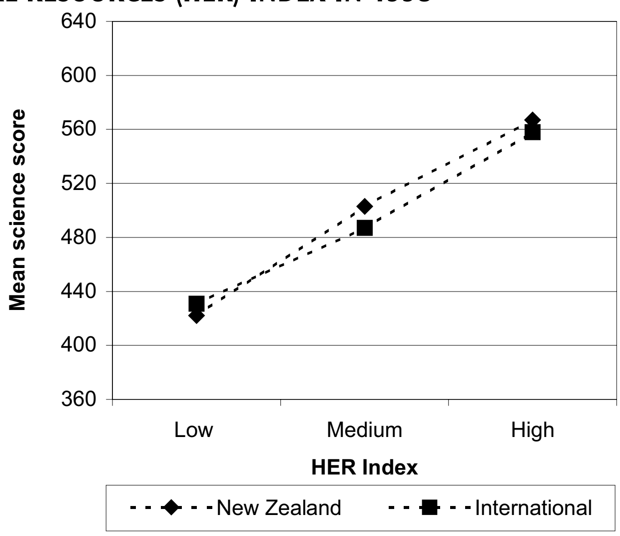
The high level of the HER Index denotes relatively more educational resources in the home.

FIGURE 5.6: MEAN MATHEMATICS SCORES FOR YEAR 9 STUDENTS AT EACH LEVEL OF THE HOME EDUCATIONAL RESOURCES (HER) INDEX IN 1998



The high level of the HER Index denotes relatively more educational resources in the home.

FIGURE 5.7: MEAN SCIENCE SCORES FOR YEAR 9 STUDENTS AT EACH LEVEL OF THE HOME EDUCATIONAL RESOURCES (HER) INDEX IN 1998



The high level of the HER Index denotes relatively more educational resources in the home.

Figure 5.5 presents the proportions of New Zealand Year 9 students at each level of the Home Educational Resource Index, along with the international mean proportions. Figures 5.6 and 5.7 present the mean achievement scores for New Zealand students at each level on the HER Index alongside the international country means.

In terms of achievement, the picture across countries was fairly consistent — the difference in mean achievement scores for those students high on the index and those categorised as low was generally more than 100 scale score points in both mathematics and science (see also Table D.6, Appendix D).

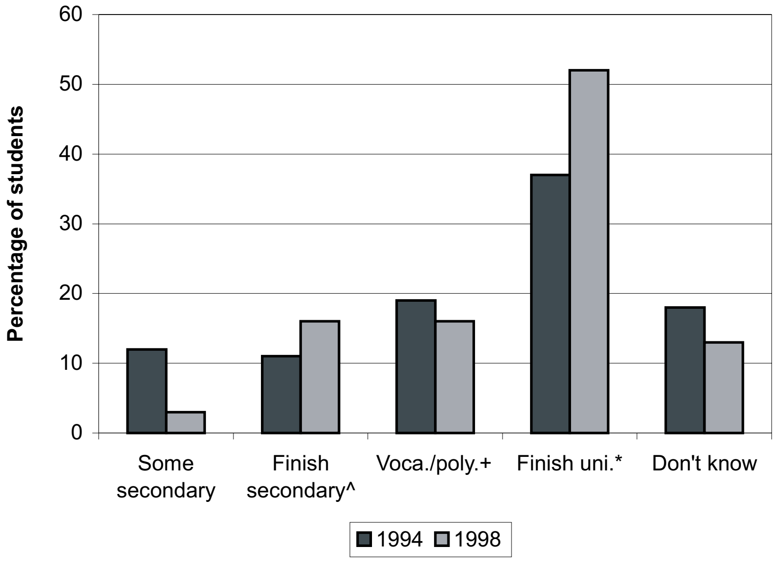
STUDENTS' EDUCATIONAL ASPIRATIONS, BELIEFS AND ATTITUDES

The following section examines Year 9 students' general aspirations for continuing their education beyond secondary school. Students' perceptions of their friends' and relatives' beliefs about doing well in mathematics and science are examined, as well as their attitudes towards mathematics and science and their self-concept in their abilities in these subjects.

Educational aspirations

Students were asked a question on how far they expected to take their education. Figure 5.8 presents a summary of New Zealand Year 9 students' responses to this question in TIMSS-94 and TIMSS-98. The responses have been condensed into five categories so that they are comparable with international reporting.

FIGURE 5.8: YEAR 9 STUDENTS' EDUCATIONAL ASPIRATIONS IN 1994 AND 1998



^ *Complete form 6 or 7.*

\+ *Includes trade certificate courses at polytechnics.*

* *Includes degree courses offered at a polytechnic and colleges of education programmes.*

As was the case in 1994, 'to finish university', was the most popular educational aspiration for Year 9 students in 1998. It is also worth noting the higher proportion of students aspiring to 'finish secondary school' in 1998. (Also refer to Table D.7 in Appendix D for further details.)

A greater proportion of Year 9 girls than boys in 1998 reported that they aimed to finish university (56% compared with 43%); by contrast, Year 9 boys were more likely to have a 'vocational or polytechnic' destination in mind than their female counterparts (65% compared with 35%).

Year 9 students in the Asian ethnic grouping had the highest proportion of students (just over three-quarters) with aspirations to complete university. Maori were least likely to report this particular aspiration (40%); Maori were, however, also most likely to indicate that they did not know how far they intended to go in education.

The proportion of New Zealand Year 9 students with aspirations to finish university (52%) was similar to the proportions reported by their counterparts in Australia (55%) and Singapore (57%), but lower than the proportions for Malaysia (65%), Canada (76%), and the United States (78%). The proportion of New Zealand students who indicated that they did not know how far they intended to go in education (13%) was similar to the proportions in many other countries, although there were some exceptions. For example, 29 percent of Belgian-Flemish students, 36 percent of Iranian students, but only four percent of Hungarian students reported that they did not know how far they intended to go in education (see Martin et al, 2000 and Mullis et al, 2000 for more detail on the international figures).

Views on the importance of doing well in school

Findings from TIMSS-94 showed that Year 9 students had strong positive beliefs about the importance of doing well at school and that they perceived their mothers to share similar views. However, students also tended to believe that their friends did not share such strong views on achieving at school (eg, see Martin, 1996a & 1996b).

In TIMSS-98 students were again asked to indicate the degree to which they, their mothers, and their friends believed that it is important to 'do well' in mathematics, science, and English, to be good at sports, and to have time to have fun. As was the case in 1994, students' beliefs about the importance of doing well were congruent with what they perceived their mothers' views to be. Students' perceptions of their friends' view of the importance of doing well in the 'academic' arena were less positive (see also Table D.8, Appendix D). This trend was also apparent across most countries, although there was little association between these perceptions and achievement (Also see Mullis et al, 2000 and Martin et al, 2000).

Students' attitudes towards mathematics

An important aim of mathematics education in New Zealand (and most other countries) is the development and fostering of positive attitudes towards mathematics (see Ministry of Education, 1992). Using a four point rating scale — strongly disagree to strongly agree — students in TIMSS-98 were asked to indicate their views on mathematics by responding to the following statements:

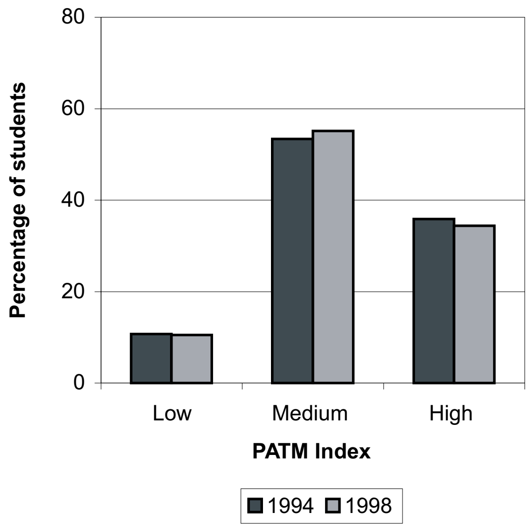
- I like mathematics;
- I enjoy learning mathematics;
- Mathematics is boring;
- Mathematics is a very easy subject;
- Mathematics is important to everyone's life;
- I would like a job that involved using mathematics.

While most Year 9 students endorsed the importance of mathematics in everyday life, they were less likely to agree that they liked or enjoyed learning mathematics, or even that they wanted a job where mathematics is used (see Table D.9 in Appendix D for further details).

Based on exploratory work undertaken by the International Study Centre in Boston, the researchers found a strong (linear) association between students' response patterns to the set of attitude questions and achievement. Mullis et al (2000) noted that those students who achieved well in mathematics generally held more positive attitudes towards the subject, while those students who held positive attitudes tended to achieve higher scores in mathematics. To summarise this relationship, students' responses to five out of the six questions listed on the previous page were combined to form an index — Positive Attitudes to Mathematics (PATM) Index. (Note the index excluded item 4). There were three levels to the index — a low level indicated negative or very negative attitudes towards mathematics, while students categorised as high on the index held positive or very positive attitudes towards mathematics.

Figure 5.9 presents the proportion of Year 9 students at each level of the index for TIMSS-94 and TIMSS-98. Note that there were only small changes in the proportions of students at each level of the PATM Index from 1994 to 1998.

FIGURE 5.9: THE PROPORTIONS OF YEAR 9 STUDENTS AT EACH LEVEL OF THE POSITIVE ATTITUDES TO MATHEMATICS (PATM) INDEX IN 1994 AND 1998



The high level of the PATM Index denotes positive or very positive attitudes towards mathematics whereas the low level of the index denotes negative or very negative attitudes towards mathematics.

The proportions of New Zealand Year 9 students at each level of the PATM index in 1998 were very similar to the average proportions across all countries. However, there was considerable variation among countries, particularly at the high and low levels. For example, 74 percent of Malaysian students were at the high level of the index compared to only nine percent of both Korean and Japanese students. The proportion of New Zealand students at the high level (34%) was similar to the proportions for Canada (35%) and the United States (35%) but slightly higher than the proportion observed in Australia (30%). With a few exceptions, there was a linear relationship with achievement, that is, those students low on the index had lower mean mathematics achievement compared to those categorised as high on the index. For South Africa, Jordan, and Macedonia, however, a slight curvilinear relationship was observed — that is, mean mathematics achievement was higher among students at each of the low and high levels of the PATM Index than it was for students at the medium level (see Mullis et al, 2000).

Attitudes towards mathematics and gender

Table 5.8 presents the proportions of New Zealand Year 9 students at each level on the PATM Index for TIMSS-98 by gender (see Table D.10 Appendix D for the equivalent data from TIMSS-94). Mean mathematics scores are also shown to illustrate the linear relationship that exists between achievement in mathematics and the extent to which students feel positive about mathematics.

TABLE 5.8: MEAN MATHEMATICS SCORES FOR YEAR 9 STUDENTS AT EACH LEVEL OF THE POSITIVE ATTITUDES TOWARDS MATHEMATICS (PATM) INDEX IN 1998, BY GENDER

Level of the PATM Index	Girls		Boys		Overall	
	% of students	Mean mathematics score (se)	% of students	Mean mathematics score (se)	% of all students	Mean mathematics score (se)
Low	11	466 (9.0)	10	460 (11.6)	10 (0.7)	463 (7.8)
Medium	57	492 (4.9)	53	484 (7.8)	55 (1.1)	488 (4.8)
High	32	514 (7.7)	37	508 (8.2)	34 (1.1)	510 (6.2)

The high level of the PATM index denotes positive or very positive attitudes towards mathematics, whereas the low level of the index denotes negative or very negative attitudes towards mathematics.

(se) Standard errors appear in parentheses.

In New Zealand, in both 1994 and 1998, higher proportions of boys than girls were at the high level of the PATM Index but while the gender difference in 1994 was statistically significant, this was not the case in 1998 (see Mullis et al, 2000).

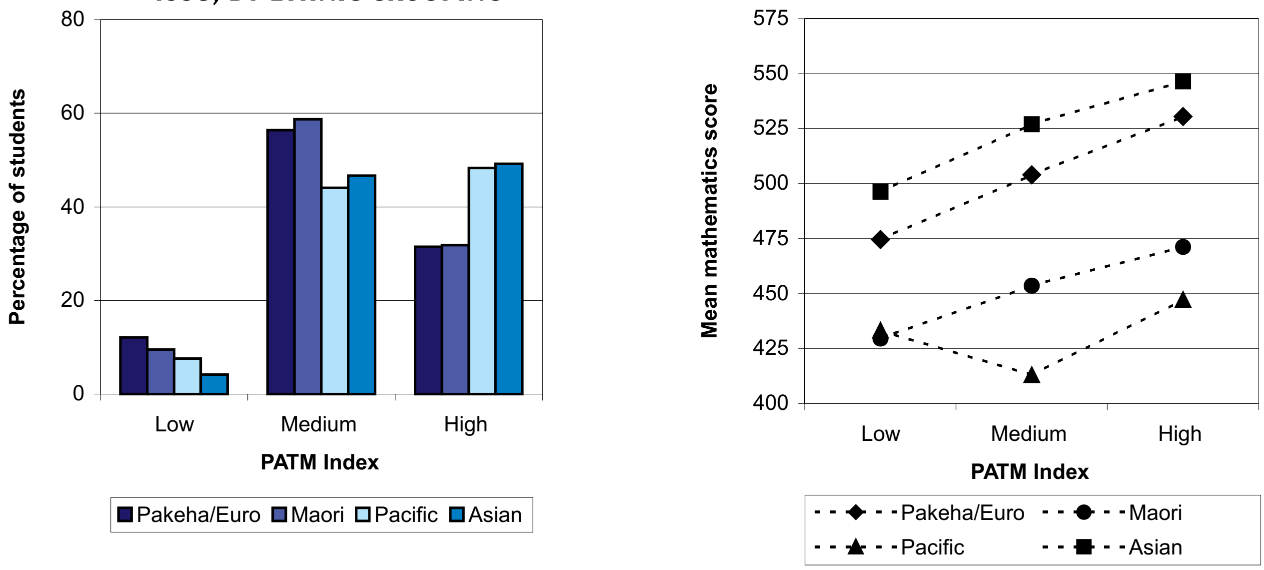
In TIMSS-98, significantly higher proportions of boys than girls were classified as high on the PATM Index in a range of countries including Australia, Canada, England, and United States. In addition, the average across all countries indicated that a statistically significantly greater proportion of boys than girls could be categorised as high on the PATM Index (39% compared to 35%; see Mullis et al, 2000).

Attitudes towards mathematics and ethnicity

Figure 5.10 presents the proportions of students in each ethnic grouping at each level of the PATM Index. The figure also provides an indication for each ethnic grouping of how positive attitudes towards mathematics are associated with achievement in this subject. It is of note that there was a consistent linear trend in this association for three of the four ethnic groupings. The exception was the curvilinear relationship between positive attitudes towards mathematics and achievement in mathematics for the Pacific grouping. It is possible that the attitude questions themselves led to Pacific students responding more positively than would be expected and this may be linked to cultural factors influencing their responses to these questions. It is important to note, however, that the number of students categorised as low on the PATM Index become very small when the population is split into ethnic groupings and the figures should therefore be considered as indicative only.

Higher proportions of Pacific and Asian students were at the high level of the PATM index than Pakeha/European and Maori students (see Table D.11, Appendix D). Because the proportions of students in each ethnic grouping at the low level of the PATM Index are very small, it is not possible to say anything definitive about the relative gender proportions within ethnic groupings at this level. However, it is possible to comment that both Pakeha/European boys and Maori girls were more likely to be at the high level on the PATM Index than Pakeha/European girls and Maori boys respectively.

FIGURE 5.10: THE PROPORTIONS OF YEAR 9 STUDENTS AT EACH LEVEL OF THE POSITIVE ATTITUDES TOWARDS MATHEMATICS (PATM) INDEX AND THEIR MEAN MATHEMATICS SCORES IN 1998, BY ETHNIC GROUPING



The high level of the PATM Index denotes positive or very positive attitudes towards mathematics whereas the low level of the index denotes negative or very negative attitudes towards mathematics.

Students' attitudes towards science

As well as enhancing achievement in science, positive attitudes and beliefs about science are also a very important facet of science education in New Zealand (Ministry of Education, 1993). Using a four point rating scale — strongly disagree to strongly agree — students were asked to indicate their views on science by responding to the following statements:

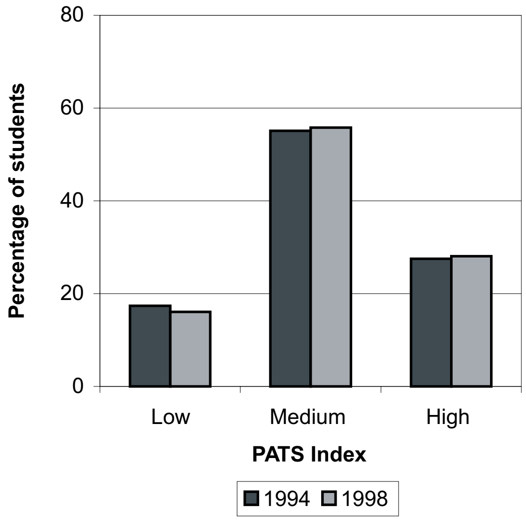
- I like science;
- I enjoy learning science;
- Science is boring;
- Science is a very easy subject;
- Science is important to everyone's life;
- I would like a job that involved using science.

Year 9 students generally did not respond as positively towards the science attitude statements as they did towards the equivalent mathematics statements; they were also more likely to disagree with the statement that science is important to everyone's life than they were to disagree with the corresponding mathematics statement (see Table D.12, in Appendix D).

As was the case for mathematics, an index — Positive Attitudes to Science Index (PATS) — was developed to summarise students' responses to the attitudinal questions on science. Students' responses to five of the six questions were combined to form the PATS Index (the index excluded item 4). Of the three levels of the PATS Index, a low level indicated negative or very negative attitudes towards science, while a high level denoted positive or very positive attitudes towards science (see Martin et al, 2000).

Figure 5.11 presents the proportion of Year 9 students at each level of the PATS Index for TIMSS-94 and TIMSS-98. It can be seen from this figure that there were only small changes in the proportions of students at each level of the index from 1994 to 1998.

FIGURE 5.11: THE PROPORTIONS OF YEAR 9 STUDENTS AT EACH LEVEL OF THE POSITIVE ATTITUDES TO SCIENCE (PATS) INDEX IN 1994 AND 1998



The high level of the PATS Index denotes positive or very positive attitudes towards science, whereas the low level of the index denotes negative or very negative attitudes towards science.

The proportions of New Zealand students at each level of the PATS Index in 1998 were very similar to the average proportions for all 23 countries for which the index was constructed[6]. However, as with the PATM Index, there was considerable variation in these proportions across countries. For example, 72 percent of Malaysian students were at the high level of the PATS Index compared to only 10 percent of both Korean and Japanese students. The proportion of New Zealand students (28%) at the high level of the PATS Index was lower than the proportions for England (39%) and the United States (32%), but similar to the proportions for Canada (30%) and Australia (28%). By way of contrast, 30 percent of Japanese students were at the low level on the index — indicating they had relatively negative attitudes towards science compared with students in other countries, despite having relatively high mean science achievement. Only one percent of Malaysian students were at the low level of the PATS Index.

With few exceptions, the relationship between attitudes to science and science achievement was linear — those students low on the PATS Index within a country had lower mean science achievement than students higher on the index. Those countries where a curvilinear relationship between the PATS Index and science achievement was evident (ie, mean science achievement was higher for students at both the low and high levels of the PATS Index than for students at the medium level) included Jordan and Chile.

[6] *This index was calculated for those countries that taught science as a single general/integrated subject. For those countries where science content is taught as separate subjects, indices were calculated for Earth Science, Physics, Chemistry, and Biology.*

Attitudes towards science and gender

Table 5.9 presents the proportions of Year 9 students at each level of the PATS Index in 1998 by gender (see Table D.13, Appendix D for equivalent data for 1994). Mean science scores are also given, to exemplify the linear relationship that exists between achievement in science and attitudes to science.

TABLE 5.9: MEAN SCIENCE SCORES FOR YEAR 9 STUDENTS AT EACH LEVEL OF THE POSITIVE ATTITUDES TOWARDS SCIENCE (PATS) INDEX IN 1998, BY GENDER

Level of the PATS Index	Girls		Boys		Overall	
	% of students	Mean science score (se)	% of students	Mean science score (se)	% of students	Mean science score (se)
Low	18	491 (5.6)	14	495 (9.0)	16	493 (5.7)
Medium	58	506 (5.4	54	515 (7.6)	56	511 (5.3)
High	24	522 (9.2)	32	528 (9.3)	28	525 (7.3)

The high level of the PATS Index denotes positive or very positive attitudes towards science, whereas the low level of the index denotes negative or very negative attitudes towards science.

(se) Standard errors appear in parentheses.

In 10 of the 23 countries that taught science as an integrated subject in TIMSS-98, including New Zealand, England, and the United States, there were significantly greater proportions of boys than girls categorised at the high level on the PATS Index. Chile was the only country where the proportion of girls classified at the high level of PATS was statistically significantly higher than the proportion of boys. Considerably higher proportions of girls than boys were at the low level of the PATS Index in six countries including Australia, Japan, and Korea — the differences were statistically significant at the five percent level (after adjusting for multiple comparisons).

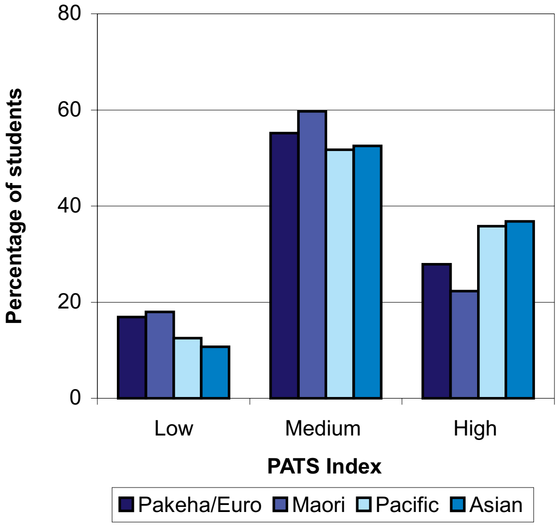
There was no change in the trend for the proportions of New Zealand girls and boys students at the high level of the PATS Index from 1994 to 1998. That is, New Zealand boys in both years typically held more positive attitudes towards science than their female counterparts.

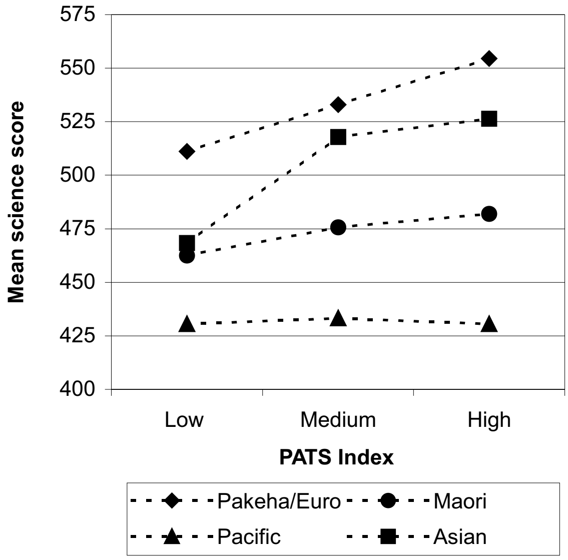
Attitudes towards science and ethnicity

Figure 5.12 presents the proportions of students in each ethnic grouping at each level of the PATS Index. To illustrate how the relationship between achievement and ethnic grouping applies across groupings, the mean science scores for students at each level on the index are presented. It is important to note, however, that the number of students categorised as low on the PATS Index become very small when the population is split into ethnic groupings and the figures should therefore be considered as indicative only.

A slightly higher proportion of Maori students were at the low level of the PATS Index than was the case for students from the other three groupings. (See also Table D.14 in Appendix D.) As was the case for mathematics, higher proportions of Asian and Pacific students than Pakeha/European and Maori students were at the high level on the index, indicating that these students had more positive attitudes towards science. Because the proportions of students in each ethnic grouping at the low level of the PATS Index are very small, it is not possible to say anything definitive about the relative gender proportions within ethnic groupings at this level of the index. However, one observation worth noting is that both Pakeha/European and Maori boys were more likely to hold positive attitudes towards science than their respective female counterparts.

FIGURE 5.12: THE PROPORTIONS OF YEAR 9 STUDENTS AT EACH LEVEL OF THE POSITIVE ATTITUDES TOWARDS SCIENCE (PATS) INDEX AND THEIR MEAN SCIENCE SCORES IN 1998, BY ETHNIC GROUPING





The high level on the PATS Index denotes positive or very positive attitudes towards science whereas the low level of the index denotes negative or very negative attitudes towards science.

Students' self-concept of their ability in mathematics

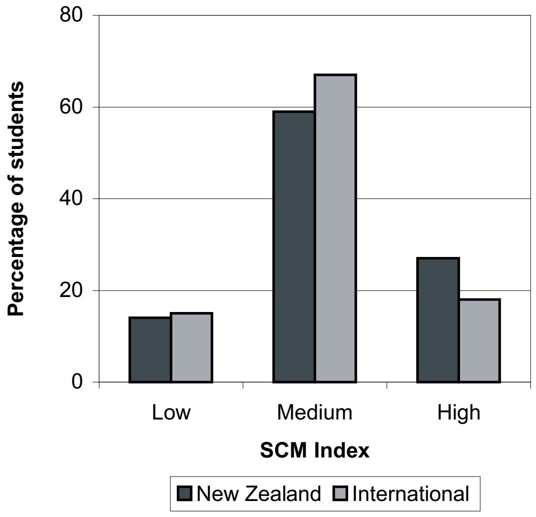
For TIMSS-98 an index was constructed to provide an indication of students' self-concept in their ability in mathematics (SCM Index) based on responses to the following questions:

- I would like mathematics much more if it were not so difficult;
- Although I do my best, mathematics is more difficult for me than my classmates;
- Nobody can be good in every subject, and I am just not talented in mathematics;
- Sometimes, when I do not understand a new topic in mathematics initially, I know I will never really understand it;
- Mathematics is not one of my strengths.

Students who disagreed with all of the above statements were categorised as high on the SCM Index; those who agreed with them all were categorised as low; the remaining students were categorised at the medium level of the SCM Index. Figure 5.13 presents the proportions of Year 9 students and the corresponding international mean proportions at each level of the index.

Compared with other countries in the study, New Zealand had a high proportion of students with high self-concept in mathematics — 27 percent compared to the international average of 18 percent). This was the eighth largest proportion across the 38 participating countries (the Russian Federation had the highest with 45%, and Thailand the lowest with 2%). However, it is possible that cultural factors had an impact on responses to this question, as some of the countries with higher mean mathematics achievement (in particular the Asian countries and especially Japan) had lower proportions of students with high self-concept in mathematics (Mullis et al, 2000).

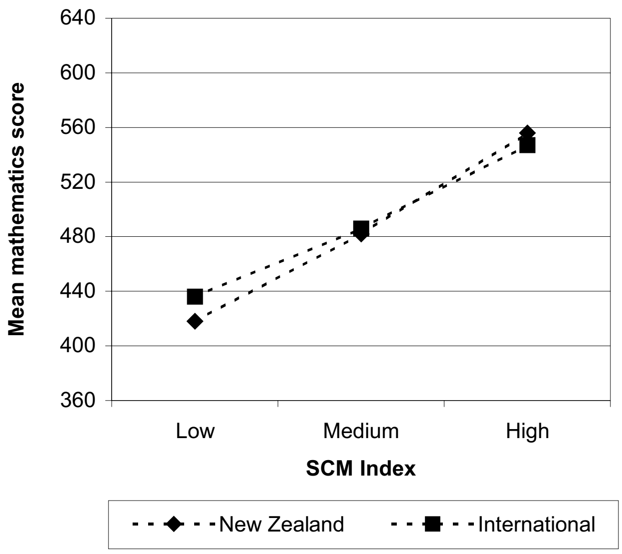
FIGURE 5.13 THE PROPORTIONS OF YEAR 9 STUDENTS AT EACH LEVEL OF THE STUDENTS' SELF-CONCEPT IN MATHEMATICS (SCM) INDEX IN 1998



The high level of the SCM Index denotes a high self-concept of mathematics ability, whereas the low level of the index denotes a low self-concept of mathematics ability.

Figure 5.14 plots the mean mathematics scores against the SCM Index for New Zealand and for the international country means. As the figure shows there was a discernible association between students' self-concept of ability in mathematics and mathematics achievement. In New Zealand, students grouped into the high level of the SCM Index achieved a statistically significantly higher mean mathematics score than students categorised as medium on the SCM Index. Likewise, New Zealand's students at the medium level of the SCM Index achieved a statistically significantly higher mean mathematics scores than students classified as low on the SCM Index. It is important to reiterate here that association does not imply causation and, on the basis of these figures alone, it is not possible to determine the degree to which a high self-concept in ability in mathematics contributes to or is reflective of higher mathematics achievement.

FIGURE 5.14: MEAN MATHEMATICS SCORES FOR YEAR 9 STUDENTS AT EACH LEVEL OF THE STUDENTS' SELF-CONCEPT IN MATHEMATICS (SCM) INDEX IN 1998



The high level of the SCM Index denotes a high self-concept of mathematics ability, whereas the low level of the index denotes a low self-concept of mathematics ability.

Self-concept in mathematics and gender

Table 5.10 compares New Zealand's Year 9 students mean mathematics achievement (overall, and by gender) with the extent to which they had a positive self-concept in mathematics according to the SCM Index. There was no significant difference in mean mathematics scores between boys and girls at any of the three levels of the SCM Index.

TABLE 5.10: MEAN MATHEMATICS SCORES FOR YEAR 9 STUDENTS AT EACH LEVEL OF THE STUDENTS' SELF-CONCEPT IN MATHEMATICS (SCM) INDEX IN 1998, BY GENDER

Level of the SCM Index	Girls		Boys		Overall	
	% of students	Mean mathematics score (se)	% of students	Mean mathematics score (se)	% of students	Mean mathematics score (se)
Low	14	422 (6.6)	14	415 (6.0)	14	418 (4.8)
Medium	59	486 (4.9)	58	478 (6.9)	59	482 (4.4)
High	27	560 (5.7)	28	551 (8.1)	27	556 (5.4)

The high level on the SCM Index denotes a high self-concept of mathematics ability whereas the low level on the index denotes a low self-concept of mathematics ability.

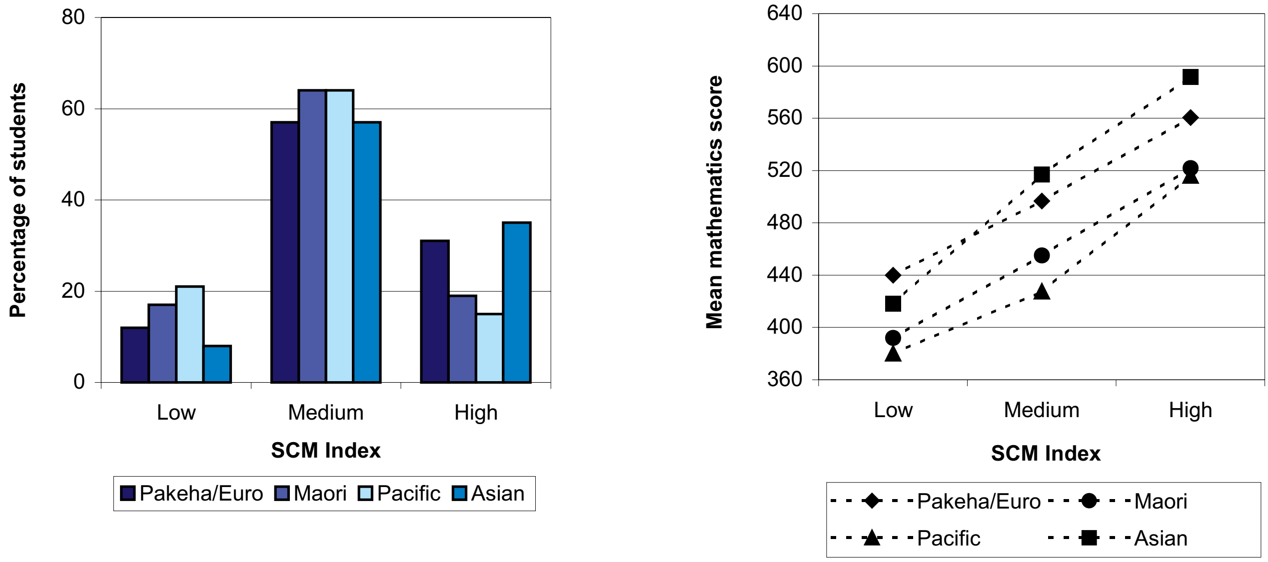
(se) Standard errors appear in parentheses.

Along with Hungary, New Zealand had the fourth largest proportion of girls (27% for both countries) categorised as having high self-concept in mathematics. The Russian Federation had the highest proportion of girls with high SCM (48%) followed by Canada (31%), and the United States and Australia (both 28%). In contrast, Indonesia, Japan, Morocco, Phillippines, and Thailand all had five percent or less of girls categorised as high on the SCM Index.

Self-concept in mathematics and ethnicity

As Figure 5.15 illustrates there were considerable differences between the ethnic groupings in the proportions of students categorised as high and low on the SCM Index. For example, compared to the Maori and Pacific student populations, at least one-third more of the Pakeha/European and Asian student populations were categorised as high on the SCM Index. Figure 5.15 also shows there was a fairly uniform linear relationship between students' self-concept in mathematics and their mathematics achievement across all four ethnic groups (although the relationship was more pronounced for the Asian ethnic grouping). It is important to note, however, that the number of students categorised as low on the SCM Index become very small when the population is split into ethnic groupings and the figures should therefore be considered as indicative only.

FIGURE 5.15 THE PROPORTIONS OF YEAR 9 STUDENTS AT EACH LEVEL OF THE STUDENTS' SELF-CONCEPT IN MATHEMATICS (SCM) INDEX AND THEIR MEAN MATHEMATICS SCORES IN 1998, BY ETHNIC GROUPING.



The high level of the SCM Index denotes a high self-concept of mathematics ability whereas the low level of the index denotes a low self-concept of mathematics ability.

Students' self-concept of ability in science

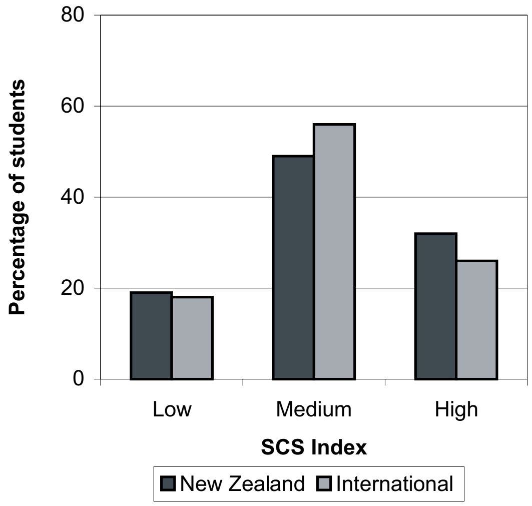
For TIMSS-98 an index was constructed to provide an indication of students' self-concept in science (SCS) based on responses to the following questions:

- I would like science much more if it were not so difficult;
- Although I do my best, science is more difficult for me than my classmates;
- Nobody can be good in every subject, and I am just not talented in science;
- Science is not one of my strengths.

Those students disagreeing with all of the above statements were categorised as high on the index, those who agreed with them all were categorised as low, while the remaining students were categorised as being at the medium level of the index.

Compared with other countries in the study who taught science as an integrated subject, New Zealand had a slightly higher proportion of students with a high self-concept in science — 32 percent compared to the international average of 26 percent (see Figure 5.16). This was the 10th largest proportion across the 23 participating countries who taught integrated science (the United States had the highest, with 45%, and the Philippines the lowest, with 8%). However, just as with the self-concept in mathematics questions, it is possible that there were cultural factors influencing the responses to this question as some countries with higher mean science achievement (in particular, the Asian countries, especially Chinese Taipei) had lower proportions of students with high self-concept in science (Martin et al, 2000).

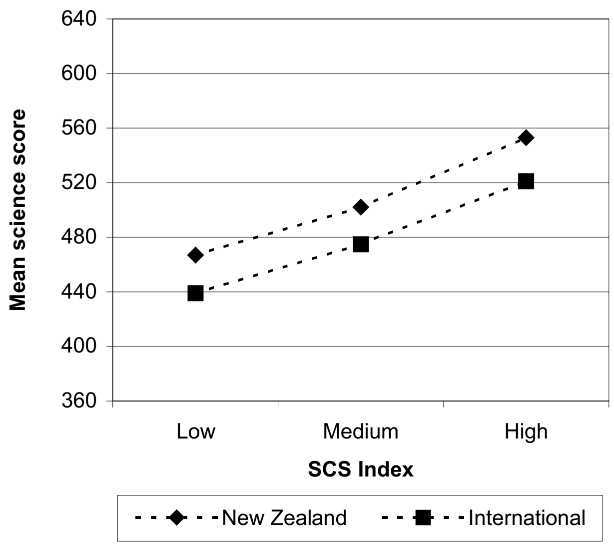
FIGURE 5.16: THE PROPORTIONS OF YEAR 9 STUDENTS AT EACH LEVEL ON THE STUDENTS' SELF-CONCEPT IN SCIENCE (SCS) INDEX IN 1998



The high level of the SCS Index denotes a high self-concept of ability in science whereas the low level of the index denotes a low self-concept of ability in science.

Figure 5.17 plots the mean science scores against the SCS Index for New Zealand and for the international country average. As was the case with mathematics, it can be seen from the figure that there is a discernible association between self-concept in science and achievement. In New Zealand, students with at the high level on the SCS Index had significantly higher mean science scores than students at the medium SCS level , who, in turn, had significantly higher mean science scores than students at the low level on the SCS Index. As stated in the discussion on self-concept of ability in mathematics, it is important to remember that the association does not imply causation and, on the basis of these figures alone, it is not possible to determine the degree to which a high self-concept in science ability contributes to or is reflective of higher science achievement.

FIGURE 5.17: MEAN SCIENCE SCORES FOR YEAR 9 STUDENTS AT EACH LEVEL OF SELF-CONCEPT IN SCIENCE (SCS) INDEX IN 1998



The high level of the SCS Index denotes a high self-concept of ability in science whereas the low level of the index denotes a low self-concept of ability in science.

Self-concept in science and gender

Table 5.11 provides further details of the relationship between New Zealand students' achievement in science (overall and by gender) and their self-concept in science (SCS). There was no statistically significant difference in mean science scores between boys and girls at any of the three levels of the SCS Index. It is interesting to note that of the 23 countries where science is taught as an integrated subject, New Zealand was one of nine in which a significantly higher proportion of boys was categorised as having a high self-concept in science.

TABLE 5.11: MEAN SCIENCE SCORES FOR YEAR 9 STUDENTS AT EACH LEVEL OF THE SELF-CONCEPT IN SCIENCE (SCS) INDEX IN 1998, BY GENDER

Level of the SCS Index	Girls		Boys		Overall	
	% of students	Mean science score (se)	% of students	Mean science score (se)	% of students	Mean science score (se)
Low	21	467 (7.8)	17	466 (9.1)	19	467 (6.5)
Medium	49	503 (5.0)	48	500 (6.7)	49	502 (4.4)
High	29	547 (6.3)	35	560 (7.7)	32	553 (5.4)

The high level of the SCS Index denotes a high self-concept in science ability whereas the low level of the index denotes a low self-concept in science ability.

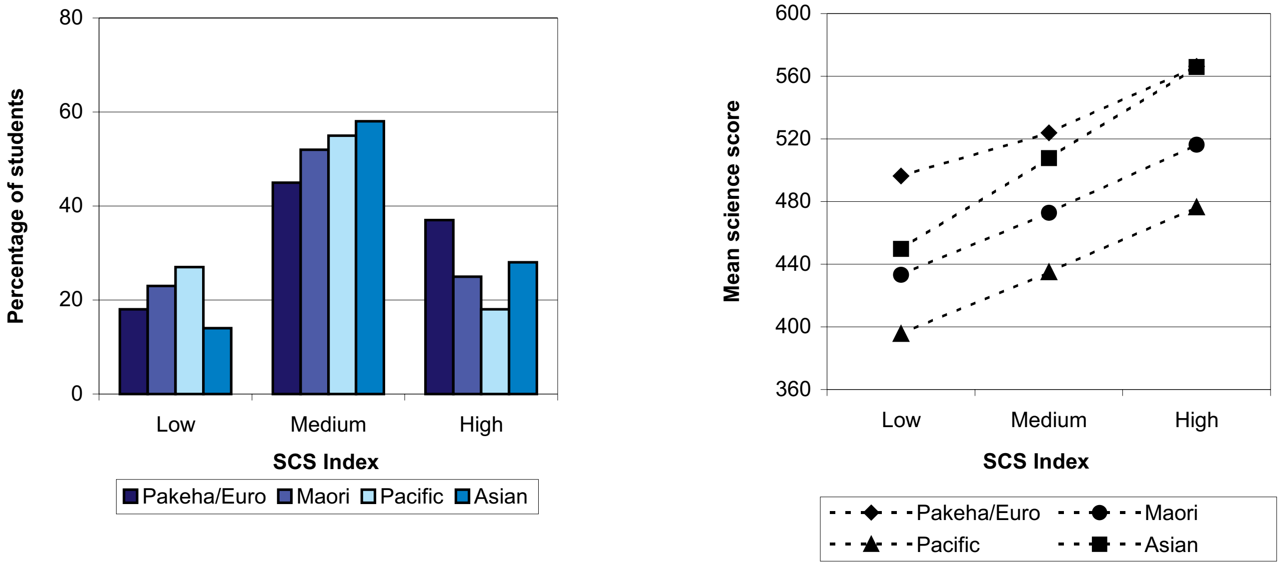
(se) Standard errors appear in parentheses.

Self-concept in science and ethnicity

As Figure 5.18 illustrates, there were differences between the ethnic groupings in the proportions of students categorised as high and low on the SCM index. It is interesting to note, however, that the differences at the high level were not as pronounced as they were for the self-concept in mathematics index. Notwithstanding this, the Pakeha/European grouping had a far greater proportion of its students categorised as high on the SCS index than any other ethnic grouping. Figure 5.18 also shows there was a fairly uniform linear relationship between students' self-concept in science and their science achievement across all four ethnic groupings (although, once again, the relationship was more pronounced for Asian).

It is important to note, however, that the number of students categorised as low on the SCS Index become very small when the population is split into ethnic groupings and the figures should therefore be considered as indicative only.

FIGURE 5.18: THE PROPORTIONS OF YEAR 9 STUDENTS AT EACH LEVEL OF THE STUDENTS' SELF-CONCEPT IN SCIENCE (SCS) INDEX AND THEIR MEAN SCIENCE SCORES IN 1998, BY ETHNIC GROUPING



The high level of the SCS Index denotes a high self-concept in science ability whereas the low level of the index denotes a low self-concept in science ability.

OUT-OF-SCHOOL ACTIVITIES

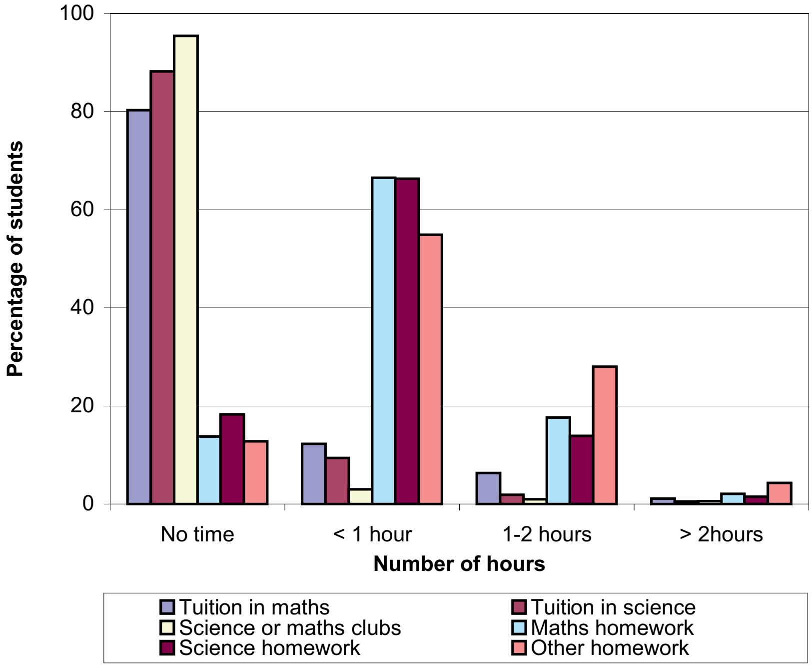
This final section of the chapter outlines some of the information gathered about how New Zealand students spend their time outside of school hours. Where appropriate, the relationship between out of school activities and achievement is described.

Out-of-school activities during the school week

Students were asked to report how much time they spent on a number of activities outside of school hours during the school week. These activities included receiving tuition in mathematics and science, watching television, and undertaking paid employment. Figure 5.19 summarises the responses of Year 9 students in 1998 for a selected range of academic-related activities.

In addition to the academic-related activities presented in Figure 5.19, there were a further eight and nine percent of students who reported being tutored in the weekends in mathematics and science, respectively, but who indicated they received no tuition *during* the school week.

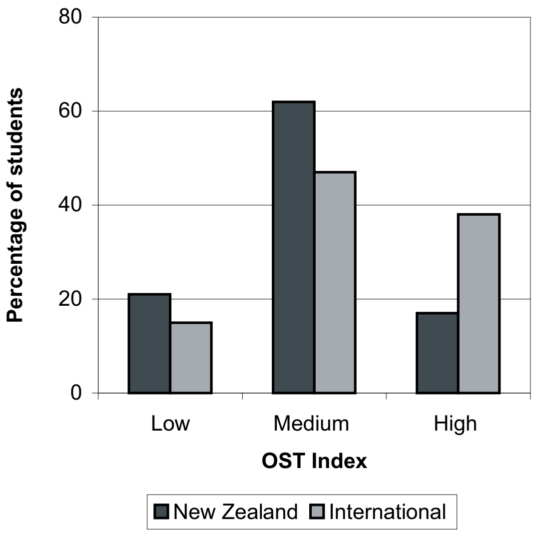
FIGURE 5.19: AMOUNT OF TIME YEAR 9 STUDENTS SPENT ON ACADEMIC-RELATED ACTIVITIES BEFORE OR AFTER SCHOOL IN 1998



Out-of-school study time

An index of out of school study time (the OST Index) was constructed based on three particular activities — mathematics study/homework, science study/homework and time spent on other study/homework. Students categorised as high on the OST Index indicated that they spent three or more hours a day after school doing some sort of study outside of school hours each school day; students categorised as medium were those who reported spending more than one hour and up to three hours a day studying; and those categorised as low say they spend one hour or less a day on study/homework. Figure 5.20 compares the proportions of students in New Zealand at each level of the OST Index with the international mean proportions in 1998.

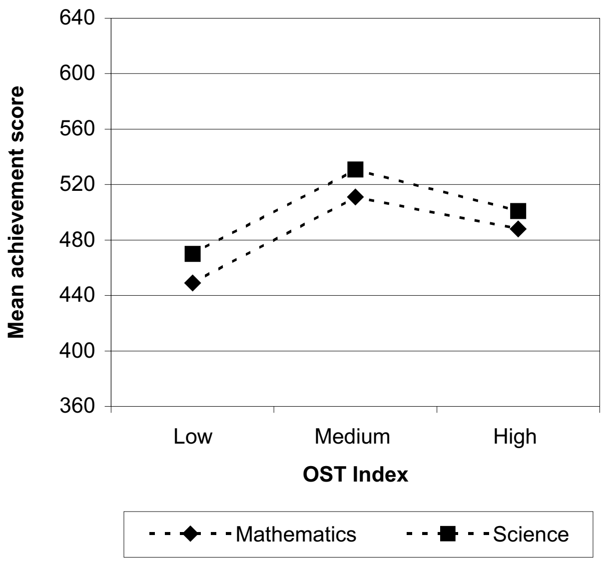
FIGURE 5.20: THE PROPORTIONS OF YEAR 9 STUDENTS AT EACH LEVEL OF THE OUT-OF-SCHOOL STUDY TIME (OST) INDEX IN 1998



When compared with other countries in the study, New Zealand had relatively small proportions of students categorised as high on the OST Index — in fact, compared to the proportion in New Zealand, 23 countries had at least twice the proportion of students as New Zealand who reported spending more than three hours studying (outside of school) each school day. However, the proportions of New Zealand students at each level of the OST Index were similar to those in Australia. It is also interesting to note that some of the higher performing countries had sizeable proportions of students who were *low* on the OST Index (indicating an hour or less study per day), including Chinese Taipei, Hong Kong (SAR), Japan, and Korea who all had more than a third of their students categorised as low OST. (See Mullis et al, 2000 and Martin et al, 2000).

In the majority of countries, including New Zealand, the relationship between time spent studying after school and mathematics and science achievement followed the same pattern — namely, there was a curvilinear relationship observed whereby those students categorised as medium on the OST Index achieved the higher mean scores.

FIGURE 5.21: MEAN MATHEMATICS AND SCIENCE SCORES FOR YEAR 9 STUDENTS AT EACH LEVEL OF THE OUT-OF-SCHOOL STUDY TIME (OST) INDEX IN 1998



Odd jobs and paid jobs

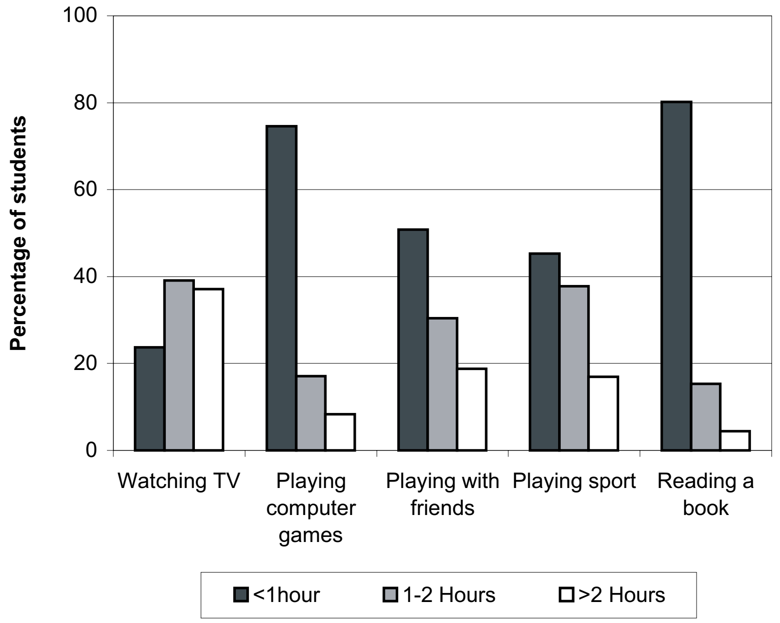
In addition to being asked about academic-related activities, students were asked about the amount of time they spent before or after school (ie, during the school week) in paid (part-time) employment. About 28 percent of New Zealand Year 9 students reported that they spent up to about two hours in paid employment during the week, while a further 12 percent spent three or more hours in a paid job. The majority of Year 9 students (60%) reported that they did not have a paid job during the school week, although about one-fifth of these students reported that they had paid job during the weekend.

Students were also asked for the time they spent daily, doing 'odd jobs' in their home. Ninety percent of students reported undertaking odd jobs around their home on a daily basis. On average, these students spent about one hour per day with the mean time for boys and girls being about the same. Pacific students, on average, spent more time doing odd jobs (1.5 hours per day) than students in the other groupings. The time spent by New Zealand students was comparable to the mean time for students in Australia (0.9), Canada and the United States (1.1) and a little higher than for students in England (0.8).

Leisure activities during the week

Students were also asked about their leisure activities before and after school, during the school week. Figure 5.22 presents a summary of selected data. It is clear that television watching was very popular, with almost half of the Year 9 students in 1998 reporting that they watched television or videos at least three hours per school day and another 40 percent saying they watched one to two hours. By contrast only 20 percent of Year 9 students reported reading for leisure for an hour or more each school day.

FIGURE 5.22: AMOUNT OF TIME YEAR 9 STUDENTS IN 1998 SPENT ON LEISURE ACTIVITIES DURING A TYPICAL SCHOOL WEEK



The mean times New Zealand students spent per day watching television or videos and reading were similar to the mean times reported by students in Australia, Canada, England, and the United States. While New Zealand and Australian students spent similar amounts of time playing with friends, Canadian, United States, and English students reported spending at least 25 percent more time doing this each day. Canadian and United States students also indicated spending around 25 percent more time than New Zealand students playing sports each day. English students appeared to spend about a third more time than New Zealand students playing computer games.