Mathematics and Science Literacy in the Final Year of Secondary School

Chapter 1

International Student Achievement in Mathematics and Science Literacy

This chapter summarizes achievement on the TIMSS mathematics and science literacy test for each of the participating countries. The test was designed to measure the mathematics and science learning of all final-year students, regardless of their school curriculum. These students, who are at the point of leaving school and entering the workforce or postsecondary education, may have specialized in mathematics and science in upper secondary school or have concentrated their studies in other areas. The mathematics and science literacy study is intended to provide information about how prepared all the school leavers in each country are to apply their knowledge in mathematics and science to meet the challenges of life beyond school.

Comparisons are provided for the populations of school leavers tested in each of the countries. The relationship between achievement and the population tested is examined from several perspectives, because not all of the countries were able to provide coverage of the entire school-leaving age cohort. In all of the participating countries, some members of the school-leaving age cohort no longer attended school, having completed their compulsory education or having dropped out for a variety of reasons. In some of the countries, portions of the students still attending school were not tested, usually because they were in on-site vocational education situations and difficult to locate for the testing.

How Does Performance Compare for the Students Participating in the Testing?

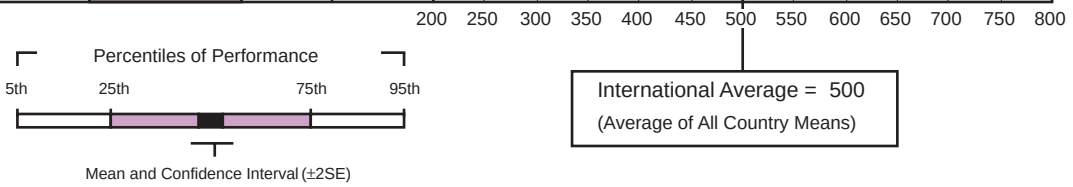
Table 1.1 presents the mean (or average) achievement for the 21 countries that participated in the mathematics and literacy study for students in their final year of secondary school.[1] The mean for each country can be compared with the international average of 500, which represents the average across the means for each of the 21 participants shown in the table. A number of countries had mean achievement well above the international average of 500, and others well below that level. A triangle pointing up next to the mean indicates that the country's performance was significantly higher than the international average, while a triangle pointing down indicates that its performance was significantly lower. Among the countries meeting the TIMSS sampling guidelines, Sweden, Switzerland, and New Zealand performed above the international average.

[1] TIMSS used item response theory (IRT) to summarize the achievement for mathematics literacy and for science literacy on two separate scales, each with a mean of 500 and a standard deviation of 100. Scaling averages students' responses to the subsets of items they took in a way that accounts for differences in the difficulty of those items. It allows students' performance to be summarized on a common metric even though individual students responded to different items in the mathematics and science literacy tests. The composite results for mathematics and science literacy represent an average of the results on the mathematics and science literacy scales (see Chapter 2 for separate results for mathematics and science literacy). For more detailed information, see the "IRT Scaling and Data Analysis" section of Appendix B.

Table 1.1

Distributions of Mathematics and Science Literacy Achievement for Students in Their Final Year of Secondary School*

Country	Mean	TCI ✦	Average Age	Mathematics and Science Literacy Achievement Scale Score
Sweden	▲ 555 (4.3)	71%	18.9	
Switzerland	▲ 531 (5.4)	82%	19.8	
† New Zealand	▲ 525 (4.7)	70%	17.6	
Hungary	▼ 477 (3.0)	65%	17.5	
[2] Russian Federation	▼ 476 (5.8)	48%	16.9	
Czech Republic	● 476 (10.5)	78%	17.8	
[1] Lithuania	▼ 465 (5.8)	43%	18.1	
[2] Cyprus	▼ 447 (2.5)	48%	17.7	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)				
Australia	● 525 (9.5)	68%	17.7	
[2] Austria	▲ 519 (5.4)	76%	19.1	
Canada	▲ 526 (2.6)	70%	18.6	
France	● 505 (4.9)	84%	18.8	
Iceland	▲ 541 (1.6)	55%	21.2	
[1] Italy	▼ 475 (5.3)	52%	18.7	
Norway	▲ 536 (4.0)	84%	19.5	
United States	▼ 471 (3.1)	63%	18.1	
Countries With Unapproved Student Sampling (See Appendix B for Details)				
† Germany	● 496 (5.4)	75%	19.5	
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)				
Denmark	▲ 528 (3.2)	58%	19.1	
[2] Netherlands	▲ 559 (4.9)	78%	18.5	
Slovenia	● 514 (8.2)	88%	18.8	
South Africa	▼ 352 (9.3)	49%	20.1	



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

▲ = Country mean significantly higher than international mean

▼ = Country mean significantly lower than international mean

● = No statistically significant difference between country mean and international mean

* See Appendix A for characteristics of students sampled.

✦ The TIMSS Coverage Index (TCI) is an estimate of the percentage of the school-leaving age cohort covered by the TIMSS final-year student sample (see Appendix B for more information).

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Figure 1.1

Multiple Comparisons of Mathematics and Science Literacy Achievement for Students in Their Final Year of Secondary School*

Instructions: Read ***across*** the row for a country to compare performance with the countries listed in the heading of the chart. The symbols indicate whether the mean achievement of the country in the row is significantly lower than that of the comparison country, significantly higher than that of the comparison country, or if there is no statistically significant difference between the two countries.†

Country	*Netherlands*	**Sweden**	*Iceland*	*Norway*	**Switzerland**	*Denmark*	*Canada*	**New Zealand**	*Australia*	*Austria*	*Slovenia*	*France*	*Germany*	**Hungary**	**Czech Republic**	**Russian Federation**	*Italy*	*United States*	**Lithuania**	**Cyprus**	*South Africa*
Netherlands		●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Sweden	●		▲	▲	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Iceland	▼	▼		●	●	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Norway	▼	▼	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Switzerland	▼	▼	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Denmark	▼	▼	▼	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Canada	▼	▼	▼	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
New Zealand	▼	▼	▼	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	▼	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲
Austria	▼	▼	▼	●	●	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovenia	▼	▼	▼	●	●	●	●	●	●	●		●	●	▲	●	▲	▲	▲	▲	▲	▲
France	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	▲	●	▲	▲	▲	▲	▲	▲
Germany	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●		▲	●	●	●	▲	▲	▲	▲
Hungary	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		●	●	●	●	●	▲	▲
Czech Republic	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	●	●	▲
Russian Federation	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	●	▲	▲
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	▲	▲
United States	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	▲	▲
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●		▲
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

Countries are ordered by mean achievement across the heading and down the rows.

▲ Mean achievement significantly higher than comparison country

● No statistically significant difference from comparison country

▼ Mean achievement significantly lower than comparison country

* See Appendix A for characteristics of the students sampled.

† Statistically significant at .05 level, adjusted for multiple comparisons.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

The eight countries shown in decreasing order of mean achievement in the upper part of the table were judged to have met the TIMSS requirements for testing a representative sample of the students in their nationally defined target populations. Lithuania is footnoted because its nationally defined population did not include part of the internationally desired population, that is, it included only students in schools providing instruction in Lithuanian (see Table B.4). The Russian Federation and Cyprus are footnoted for not testing final-year students in some vocational tracks (see Table B.4). New Zealand is annotated because it met the sampling guidelines only after including replacement schools (see Table B.10).

Although countries tried very hard to meet the TIMSS sampling requirements, many of them encountered resistance from schools, teachers, and students, and thus did not have the participation rates – 85% or higher for schools and for students both, or a combined rate of 75% – specified in the TIMSS guidelines. Obtaining a high participation rate for secondary school students is particularly challenging when participation is voluntary, because these students have many demands on their time. Also, their educational situations may make testing difficult; for example, in some countries students are engaged in on-site vocational training. The eight countries shown in the second category in Table 1.1 followed procedures but were unable to meet the TIMSS guidelines for sample participation. Beyond the difficulty of encouraging students to attend the testing sessions, the five countries in the remaining two categories encountered various obstacles in implementing the prescribed methods for sampling schools or students within schools, usually because of the organization of the education system. Because Israel did not clearly document its procedures for sampling schools, its achievement results (unweighted) are presented in Appendix D. Appendix B includes a full discussion of the sampling procedures and outcomes for each country.

As mentioned previously, some members of the school-leaving age cohort are no longer attending school. As explained in the Introduction, the degree of coverage of the entire school-leaving age cohort is indicated by the TIMSS Coverage Index (TCI). If the TCI also reflects exclusion of part of the final-year student population, that is noted for the countries concerned: the Russian Federation, Cyprus, Austria, and the Netherlands. (See Table 2 in the Introduction as well as Appendix B for more details about the TCI.)

As shown in the table, there is quite a range in the TCI. About half the countries were able to cover 70% or more of the entire school-leaving age cohort by their in-school sampling procedures, including Slovenia (88%), France (84%), Norway (84%), Switzerland (82%), the Czech Republic (78%), the Netherlands (78%), Austria (76%), Germany (75%), Sweden (71%), New Zealand (70%), and Canada (70%). Countries covering less than half of this cohort included South Africa (49%), the Russian Federation (48%), Cyprus (48%), and Lithuania (43%).

To aid in interpretation, the table also contains the average age of the students. Equivalence of chronological age does not necessarily mean that students have had the same number of years of formal schooling or have studied the same curriculum. Countries with a high percentage of older students may have policies that include retaining students in lower grades. Still, the average age, in combination with the

information about secondary school for each country presented in Appendix A, will provide an indication of the amount of schooling received by the students in each country.

Table 1.1 also graphically shows the differences in average mathematics and science literacy achievement between the highest- and lowest-performing countries and the distribution of student performance within each country. Achievement for each country is shown for the 25th and 75th percentiles as well as for the 5th and 95th percentiles.[2] Each percentile point indicates the percentages of students performing below and above that point on the scale. For example, 25% of the students in each country performed below the 25th percentile for that country, and 75% performed above the 25th percentile.

The range between the 25th and 75th percentiles represents performance by the middle half of the students. In contrast, performance at the 5th and 95th percentiles represents the extremes in lower and higher achievement. The dark boxes at the midpoints of the distributions are the 95% confidence intervals around the average achievement in each country.[3]

Comparisons can be made across the means and percentiles. For example, average performance in Sweden was comparable to or even exceeded performance at the 75th percentile in a number of countries, including Hungary, the Russian Federation, the Czech Republic, Lithuania, Cyprus, Italy, the United States, and especially South Africa. Also, the differences between the extremes in performance were very large in most countries.

Figure 1.1 provides a method for making appropriate comparisons of overall mean achievement between countries.[4] The figure shows whether or not the differences in mean achievement between pairs of countries are statistically significant. Selecting a country of interest and reading across the table, a triangle pointing up indicates significantly higher performance than the country listed across the top, a dot indicates no significant difference, and a triangle pointing down indicates significantly lower performance. Countries shown in italics failed to satisfy one or more guidelines for sample participation rates or student sampling (see Appendix B for details).

The Netherlands and Sweden, with mostly triangles pointing up, had significantly higher mean achievement than the other participating countries, and performed similarly. However, the Netherlands had particular difficulty in meeting the TIMSS sampling guidelines. Students in apprenticeship programs were excluded (21% of final-year students), and overall sample participation rates were very low (49%).

[2] Tables of the percentile values and standard deviations for all countries are presented in Appendix E.

[3] See the "IRT Scaling and Data Analysis" section of Appendix B for more details about calculating standard errors and confidence intervals.

[4] The significance tests in Figure 1.1 are based on a Bonferroni procedure for multiple comparisons that holds to 5% the probability of erroneously declaring the mean of one country to be different from another country.

Iceland, Norway, and Switzerland performed similarly, but had lower mean achievement than the Netherlands and Sweden. However, of those three countries, only Switzerland met the sampling guidelines. It also can be observed that Switzerland and Norway had among the highest TCIs, 82% and 84%, respectively. Because the measurement in Australia was somewhat less precise than in many other participating countries, it has a rather large confidence interval around its mean achievement, and tends to overlap with more countries than might otherwise be the case. Australia's mean performance is more similar to that of Denmark, Canada, New Zealand, Austria, and Slovenia. Of these countries, only New Zealand met the sampling guidelines. France performed similarly to New Zealand, Australia, Austria, Slovenia, and Germany. Germany's performance resembled that of Slovenia and France as well as the Czech Republic, the Russian Federation, and Italy.

The lower-performing countries included Hungary, the Czech Republic, the Russian Federation, Italy, the United States, Lithuania, Cyprus, and South Africa. Only South Africa had significantly lower mean achievement than the other participating countries. Because of the pattern of relatively small differences from one country to the next, most countries had lower mean achievement than some countries, about the same mean achievement as some countries, and higher mean achievement than other countries.

How Does Performance Compare, Taking Differences in Population Coverage into Account?

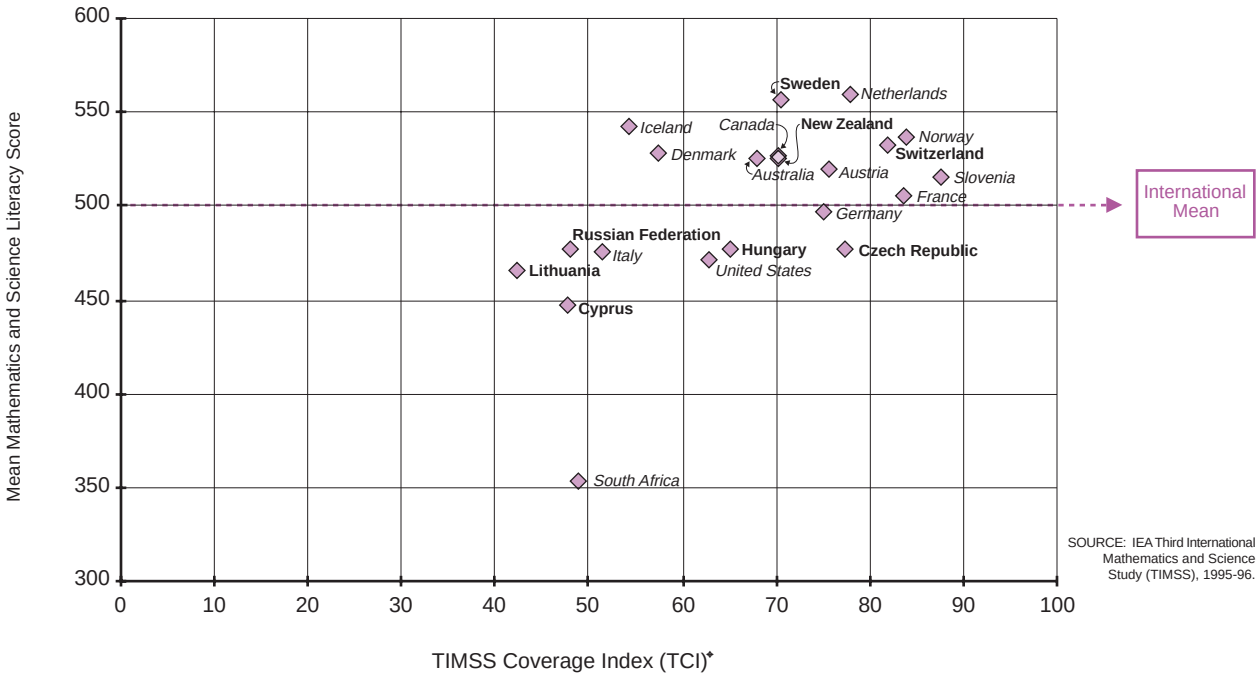
Figure 1.2 shows the relationship between achievement and the TIMSS Coverage Index. It is designed to show whether countries may have achieved higher performance because they tested fewer students – in particular, a more elite group of students. In general, however, the relationship between performance and the degree of sample coverage of the entire school-leaving population shows that the higher-performing countries actually tended to have better coverage than the lower-performing countries.[5] For example, the countries in the upper right corner of the graph had a high percentage of coverage of the entire school-leaving age cohort, as well as high performance. In particular, Switzerland exceeded 80% coverage, met the sampling guidelines, and performed above the international average.

If anything, the countries with greater coverage (more than 70%) tended to have mean performance above the international average, and those with less coverage tended to perform below the international average. The only two high-performing countries with a low degree of coverage (less than 60%) were Denmark and Iceland. The remaining countries with coverage less than 60% all performed below the international average.

[5] The relationship between mathematics and science literacy achievement and the TIMSS Coverage Index has a correlation coefficient of 0.56.

Figure 1.2

Mean Mathematics and Science Literacy Achievement by TIMSS Coverage Index for Students in Their Final Year of Secondary School*



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

✦ The TIMSS Coverage Index (TCI) is an estimate of the percentage of the school-leaving age cohort covered by the TIMSS final-year student sample (see Appendix B for more information).

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

Table 1.2 offers another way of examining performance, regardless of whether or not countries may have tested only their elite students. The table shows the 75th percentile of performance for the entire school-leaving age cohort for each country. It also presents the mean achievement of students performing above the 75th percentile – the top 25% of the students in the entire school-leaving age cohort for each country. The 75th percentile is the point on the mathematics and science literacy composite scale that divides the higher-performing 25% of the students from the lower-performing 75%.

The 75th percentile is a useful summary statistic on which to compare performance across countries. It is used instead of the mean in this table because it can be reliably estimated even when scores from some members of the population are not available (that is, students in the school-leaving age cohort not included in the samples tested).

As indicated by the TCI, the samples in some countries represented nearly all of the students in the school-leaving age cohort, while other countries covered only about half of these students. To compute the 75th percentile, TIMSS assumed that students in the school-leaving age cohort not covered by the sample in each country would score below the 75th percentile, primarily because they were no longer in the system by virtue of dropping out, being tracked out of the system, or being in difficult-to-test vocational tracks. The percentages of students assumed to be below the 75th percentile were added to the lower tail of the achievement distribution before calculating the 75th percentile using the modified distribution.

Notwithstanding the additional difficulties in estimating achievement for the entire school-leaving age cohort for each country, rather than for the population of students actually tested, the results for the top 25% of the students in each country appear quite consistent with those obtained for the tested students. Of the countries meeting the sampling guidelines, Sweden, Switzerland, and New Zealand had the highest mean achievement for the top 25% of their school-leaving age cohorts.

Figure 1.3 presents the country comparison chart for the top 25% of all students in the school-leaving age cohort. Among the top-performing countries, Sweden, the Netherlands, and Norway performed similarly, with Switzerland also performing similarly to Norway. In summary, the four top-performing countries had rankings very similar to those obtained for the populations of tested students. In particular, Sweden and Switzerland met the sampling guidelines and had high performance. Norway, too, performed very well even though participation rates were slightly below the guidelines (71%). The Netherlands also performed well, but had low participation rates (49%).

Looking at the top 25% of performance for the school-leaving age cohort shows a block of countries with very similar mid-range performance, including New Zealand, Australia, Canada, Slovenia, Austria, Iceland, and Denmark. Germany, France, and the Czech Republic performed similarly but generally below the aforementioned countries. The lower-performing countries included Hungary and the United States, followed by Italy and the Russian Federation. Lithuania, Cyprus, and South Africa had lower performance than the other participating countries. The relative standing

Table 1.2

Mathematics and Science Literacy Achievement for the Top 25 Percent@ of All Students in the School-Leaving Age Cohort*

Country	75th Percentile	Mean Achievement of the Top 25% of Students (Above 75th Percentile)	TCI
Sweden	584 (6.3)	654 (3.4)	71%
Switzerland	575 (4.1)	633 (2.6)	82%
† New Zealand	559 (7.5)	621 (1.9)	70%
Czech Republic	508 (12.0)	584 (4.6)	78%
Hungary	496 (2.8)	563 (3.1)	65%
2 Russian Federation	464 (6.3)	539 (4.8)	48%
1 Lithuania	447 (6.8)	519 (3.6)	43%
2 Cyprus	438 (4.0)	501 (3.4)	48%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)			
Australia	555 (8.9)	620 (4.8)	68%
2 Austria	552 (5.6)	610 (4.2)	76%
Canada	555 (5.6)	613 (2.6)	70%
France	546 (8.0)	592 (2.6)	84%
Iceland	546 (3.0)	609 (1.4)	55%
1 Italy	475 (5.6)	543 (4.3)	52%
Norway	578 (3.9)	641 (2.8)	84%
United States	490 (3.1)	559 (2.5)	63%
Countries With Unapproved Student Sampling (See Appendix B for Details)			
† Germany	533 (5.6)	593 (2.9)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)			
Denmark	539 (4.3)	603 (2.3)	58%
2 Netherlands	600 (6.0)	653 (4.9)	78%
Slovenia	560 (9.6)	612 (4.9)	88%
South Africa	328 (4.4)	412 (11.4)	49%
International Average	520 (1.4)	585 (0.9)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

@ To compute the 75th percentile, TIMSS assumed that the students in the school-leaving age cohort not tested would have scored below the 75th percentile and added them to the lower tail of the distribution.

* See Appendix A for characteristics of students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

1 National Desired Population does not cover all of International Desired Population (see Table B.4).

2 National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Figure 1.3

Multiple Comparisons of Average Mathematics and Science Literacy Achievement for the Top 25 Percent of All Students in the School-Leaving Age Cohort*

Instructions: Read ***across*** the row for a country to compare performance with the countries listed in the heading of the chart. The symbols indicate whether the mean achievement of the country in the row is significantly lower than that of the comparison country, significantly higher than that of the comparison country, or if there is no statistically significant difference between the two countries.†

Country	Sweden	Netherlands	Norway	Switzerland	New Zealand	Australia	Canada	Slovenia	Austria	Iceland	Denmark	Germany	France	Czech Republic	Hungary	United States	Italy	Russian Federation	Lithuania	Cyprus	South Africa
Sweden		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Netherlands	●		●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Norway	●	●		●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Switzerland	▼	▼	●		▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
New Zealand	▼	▼	▼	▼		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	▼	▼	▼	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Canada	▼	▼	▼	▼	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovenia	▼	▼	▼	▼	●	●	●		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Austria	▼	▼	▼	▼	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Iceland	▼	▼	▼	▼	▼	●	●	●	●		●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Denmark	▼	▼	▼	▼	▼	▼	●	●	●	●		●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Germany	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	●	▲	▲	▲	▲	▲	▲	▲
France	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	▲	▲	▲	▲	▲	▲	▲
Czech Republic	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		▲	▲	▲	▲	▲	▲	▲
Hungary	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		●	▲	▲	▲	▲	▲
United States	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		▲	▲	▲	▲	▲
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		●	▲	▲	▲
Russian Federation	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		▲	▲	▲
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		▲	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		▲
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

Countries are ordered by mean achievement across the heading and down the rows.

▲ Mean achievement significantly higher than comparison country

● No statistically significant difference from comparison country

▼ Mean achievement significantly lower than comparison country

* See Appendix A for characteristics of the students sampled.

† Statistically significant at .05 level, adjusted for multiple comparisons.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

of Iceland, Denmark, and the Russian Federation dropped somewhat in this analysis compared to the analysis based only on the samples of students tested. This may be because the assumptions of lower performance (below the 75th percentile) for students not represented in the sample do not completely apply in these two countries. For example, in the Russian Federation students not covered in the sampling included those in technical tracks that take mathematics and science, some of whom may have achieved above the 75th percentile.

How Does Performance Compare by Gender?

Table 1.3 shows the differences in mathematics and science literacy achievement by gender for the final-year students in each country. The table presents mean achievement separately for males and females for each country, as well as the difference between the means. The graphic representation of the gender difference, indicated by a bar, shows the amount of the difference, whether the direction of the difference favors females or males, and whether the difference is statistically significant (indicated by a darkened bar). As can be seen, all of the differences favored males rather than females, and all of the differences were statistically significant except in South Africa.

Since the TIMSS science results for seventh and eighth grades showed significant gender differences favoring males to be pervasive across most countries,[6] and the direction of the differences in mathematics favored males much more often than females,[7] these results might have been anticipated for the secondary school students. Still, it is distressing to see such uniform gender differences favoring males in the general population of school-leaving students. There may be many reasons for such differences, including the fact that society encourages males more than females to have an interest in mathematics and science topics. This tends to lead to more outside activities in mathematics and science areas for males and taking more courses in these subjects, which serves to differentiate performance as students progress through school.

Course-taking patterns are explored in more detail in Chapter 4 and in the second section of this report, which presents results for students having taken advanced mathematics courses (Chapter 5) and physics (Chapter 8) during their final years of secondary school. Briefly, however, while males take more mathematics and science courses than females in some countries, especially in physics, course-taking patterns alone do not seem to explain these pervasive gender differences for the overall population of school-leaving students.

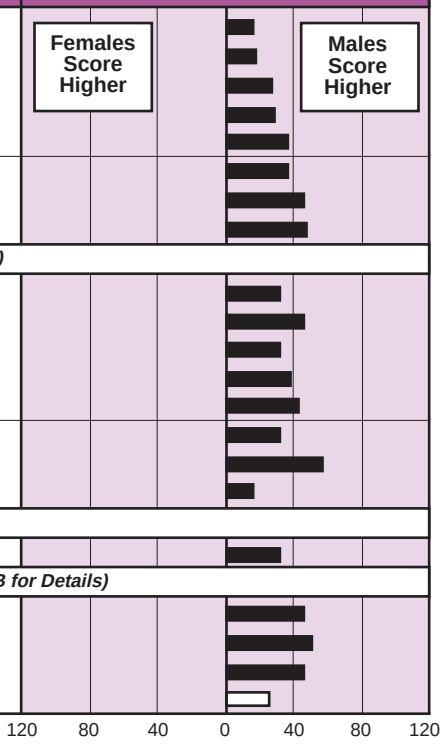
[6] Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996). *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

[7] Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

Table 1.3

Gender Differences in Mathematics and Science Literacy Achievement for Students in Their Final Year of Secondary School*

Country	Males		Females		Difference	TCI	Gender Difference
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement			
Hungary	52 (2.5)	485 (4.5)	48 (2.5)	468 (4.5)	17 (6.3)	65%	
[2] Cyprus	45 (2.1)	456 (4.9)	55 (2.1)	439 (3.0)	18 (5.8)	48%	
[1] Lithuania	35 (3.0)	483 (6.7)	65 (3.0)	456 (7.4)	27 (10.0)	43%	
[†] New Zealand	49 (1.7)	540 (5.7)	51 (1.7)	511 (5.5)	28 (7.9)	70%	
Switzerland	56 (2.5)	547 (6.0)	44 (2.5)	511 (7.5)	37 (9.6)	82%	
[2] Russian Federation	38 (1.0)	499 (5.9)	62 (1.0)	462 (6.5)	37 (8.8)	48%	
Sweden	49 (2.5)	579 (5.8)	51 (2.5)	533 (3.6)	46 (6.8)	71%	
Czech Republic	51 (5.1)	500 (9.9)	49 (5.1)	452 (13.8)	48 (17.0)	78%	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)							
Australia	42 (2.9)	543 (10.7)	58 (2.9)	511 (9.3)	32 (14.2)	68%	
[2] Austria	39 (3.2)	549 (7.8)	61 (3.2)	502 (5.5)	47 (9.6)	76%	
Canada	47 (1.4)	544 (3.4)	53 (1.4)	511 (3.4)	33 (4.8)	70%	
France	47 (3.1)	526 (5.9)	53 (3.1)	487 (4.8)	38 (7.6)	84%	
Iceland	48 (0.8)	565 (2.9)	52 (0.8)	522 (1.9)	43 (3.5)	55%	
[1] Italy	46 (3.3)	492 (6.9)	54 (3.3)	461 (5.7)	31 (8.9)	52%	
Norway	51 (2.0)	564 (5.0)	49 (2.0)	507 (4.5)	57 (6.8)	84%	
United States	50 (1.3)	479 (4.2)	50 (1.3)	462 (3.5)	17 (5.5)	63%	
Countries With Unapproved Student Sampling (See Appendix B for Details)							
[†] Germany	56 (5.2)	512 (8.2)	44 (5.2)	479 (8.5)	32 (11.8)	75%	
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)							
Denmark	45 (2.0)	554 (4.5)	55 (2.0)	507 (3.7)	47 (5.8)	58%	
[2] Netherlands	52 (2.3)	584 (5.5)	48 (2.3)	533 (5.9)	51 (8.0)	78%	
Slovenia	51 (3.3)	538 (12.6)	49 (3.3)	492 (7.1)	46 (14.4)	88%	
South Africa	49 (1.6)	366 (10.3)	51 (1.6)	341 (11.8)	25 (15.7)	49%	



International Averages

Males	Females	Difference
519	483	36

(Averages of All Country Means)

Gender difference statistically significant at .05 level.
Gender difference not statistically significant.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of students tested.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

Chapter 2

Achievement in Mathematics Literacy and Science Literacy

This chapter presents data summarizing achievement separately on the mathematics literacy scale and the science literacy scale. The mathematics literacy items address number sense, including fractions, percentages, and proportionality. Algebraic sense, measurement, and estimation are also covered, as are data representation and analysis. Several of the items emphasize reasoning and social utility. A general criterion in selecting the items was that they should involve the types of mathematics questions that could arise in real-life situations and that they be contextualized accordingly. Similarly, the science items selected for the literacy test were organized according to three areas of science – earth science, life science, and physical science – and included a reasoning and social utility component. Again, the emphasis was on trying to measure how well students can use their knowledge in addressing real-world problems having a science component. For both the mathematics literacy and science literacy items, students were permitted to use a calculator if they wished (see Chapter 4 for students' reports on calculator use).

Following the discussion in this chapter of average achievement in mathematics literacy and science literacy, Chapter 3 contains further information about the types of mathematics and science items, including seven example items for each area and the percentage of correct responses on those items for each TIMSS country.

As we have seen in Chapter 1, there are differences in achievement among the participating countries on the TIMSS mathematics and science literacy test. Given that the test was designed to include mathematics and science items, it is interesting to examine whether the participating countries have particular strengths or weaknesses in their achievement in one or the other of the two areas. Thus, this chapter presents the results for the mathematics and science scales that formed the basis for the average composite results presented in Chapter 1.

How Does Performance Compare Between the Mathematics and Science Areas?

Table 2.1 presents the achievement results for the mathematics literacy scale. It shows the mean achievement for each country and the distribution of student performance within each country. Countries with a triangle pointing up performed above the international average of 500, those with a dot performed about the same as the international average, and those with triangles pointing down performed below the international average. The countries conforming to the TIMSS sampling guidelines and performing above the international average in mathematics literacy included Sweden, Switzerland, and New Zealand. Austria, Canada, France, Iceland, Norway, Denmark, and the Netherlands also achieved above the international average, although they encountered various difficulties in their sampling. The countries performing below the international average were Hungary, the Russian Federation, Lithuania, Cyprus, Italy, the United States, and South Africa.

Figure 2.1 provides the information for comparing mean mathematics achievement between countries. This figure shows whether or not the differences in mean achievement between pairs of countries are statistically significant. The top-performing countries in mathematics literacy included the Netherlands, Sweden, Denmark, and Switzerland; both Sweden and Switzerland met the sampling guidelines. Iceland, Norway, France, Australia, New Zealand, Canada, Austria, and Slovenia all tended to perform similarly to Switzerland and to each other. However, of these countries, only New Zealand met the TIMSS sampling guidelines.

Table 2.2 and Figure 2.2 show the corresponding results for the science literacy scale. Table 2.2 reveals that of the countries meeting the TIMSS sampling requirements, Sweden, New Zealand, and Switzerland performed above the international average (triangles pointing up). This parallels the findings in mathematics literacy. Other countries performing above the international average were Austria, Canada, Iceland, Norway, and the Netherlands. The countries performing below the international average in science literacy (triangle pointing down) included the Russian Federation, Hungary, Lithuania, Cyprus, Italy, the United States, and South Africa.

The country comparison chart (Figure 2.2) shows that the countries with the highest mean achievement in science literacy were Sweden, the Netherlands, Iceland, and Norway, with only Sweden meeting the TIMSS sampling guidelines. Canada, New Zealand, and Australia performed similarly to Norway and to each other, with New Zealand meeting the sampling guidelines. Switzerland, which met the sampling guidelines, achieved at about the same level as Canada, New Zealand, and Australia, as did Austria and Slovenia.

Table 2.3 compares performance in mathematics and science literacy. It presents mean literacy achievement separately for mathematics and science, as well as the difference between the means. The last column shows the amount of the difference, whether its direction favors mathematics or science, and whether it is statistically significant (darkened bar). Regardless of direction, the differences between mathematics and science literacy were small or negligible in nearly half of the countries. However, Lithuania, Hungary, Switzerland, France, and Denmark performed significantly higher

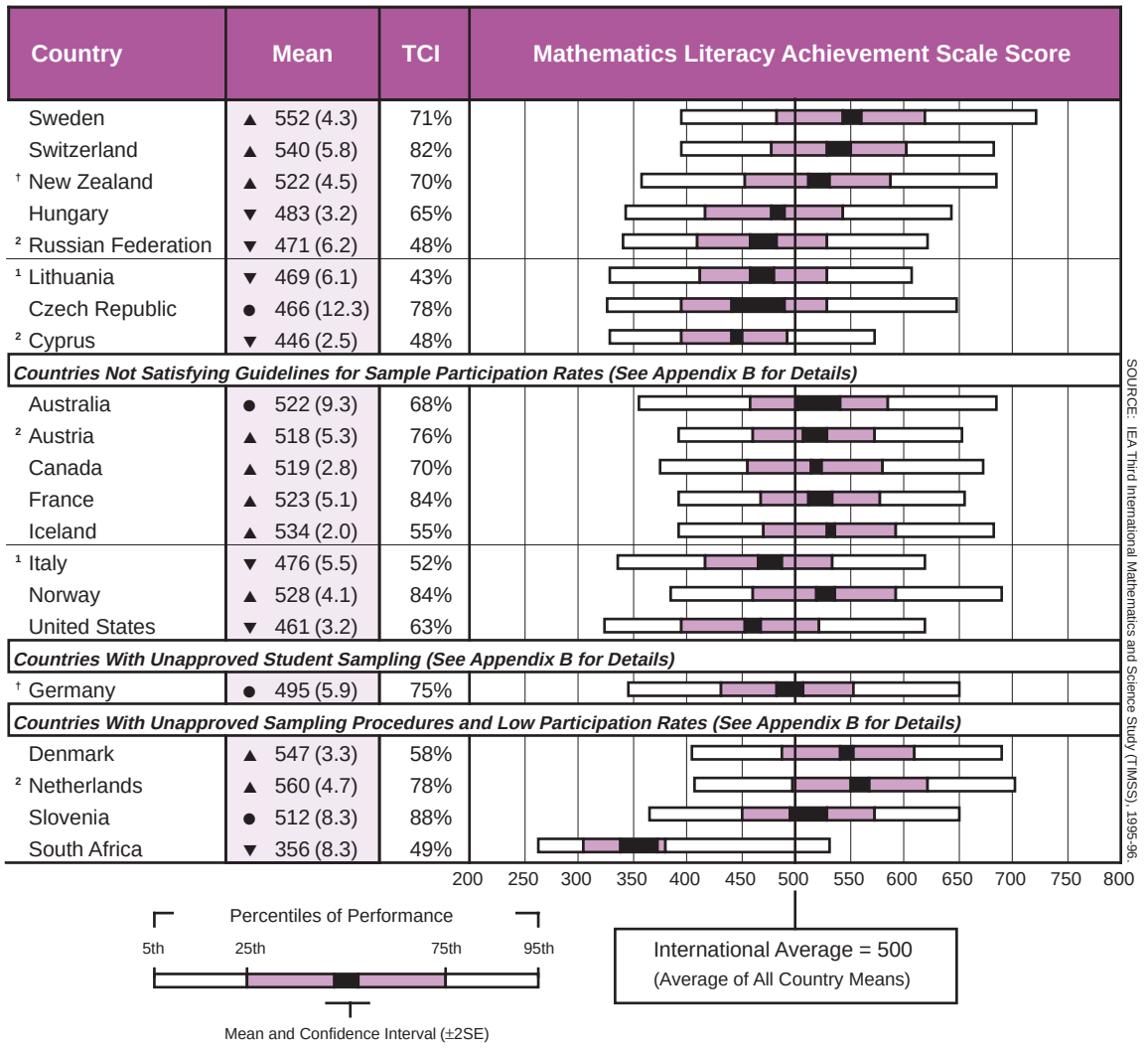
in mathematics literacy than in science literacy. In contrast, Sweden, the Russian Federation, the Czech Republic, Canada, Iceland, Norway, and the United States had significantly higher achievement in science literacy than in mathematics literacy.

Table 2.4 shows the differences in mathematics literacy performance by gender, and Table 2.5 presents the corresponding gender differences for science literacy. The results differ somewhat from the patterns noted in TIMSS at the eighth grade, where gender differences favoring males were found in both mathematics and science but the differences were more pervasive in science. For students in their final year of school, the gender differences favoring males are significant in mathematics as well as science in most countries. In mathematics literacy, most of the countries showed gender differences favoring males, although these were not statistically significant in Hungary, the United States, and South Africa. All countries except South Africa showed statistically significant gender differences in science literacy favoring males. Thus, it appears that as students leave school the achievement differences favoring males are found nearly equally in mathematics and science literacy.

Table 2.1

Distributions of Achievement in Mathematics Literacy for Students in Their Final Year of Secondary School*

Country	Mean	TCI
Sweden	▲ 552 (4.3)	71%
Switzerland	▲ 540 (5.8)	82%
† New Zealand	▲ 522 (4.5)	70%
Hungary	▼ 483 (3.2)	65%
² Russian Federation	▼ 471 (6.2)	48%
¹ Lithuania	▼ 469 (6.1)	43%
Czech Republic	● 466 (12.3)	78%
² Cyprus	▼ 446 (2.5)	48%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)		
Australia	● 522 (9.3)	68%
² Austria	▲ 518 (5.3)	76%
Canada	▲ 519 (2.8)	70%
France	▲ 523 (5.1)	84%
Iceland	▲ 534 (2.0)	55%
¹ Italy	▼ 476 (5.5)	52%
Norway	▲ 528 (4.1)	84%
United States	▼ 461 (3.2)	63%
Countries With Unapproved Student Sampling (See Appendix B for Details)		
† Germany	● 495 (5.9)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)		
Denmark	▲ 547 (3.3)	58%
² Netherlands	▲ 560 (4.7)	78%
Slovenia	● 512 (8.3)	88%
South Africa	▼ 356 (8.3)	49%



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

▲ = Country mean significantly higher than international mean

▼ = Country mean significantly lower than international mean

● = No statistically significant difference between country mean and international mean

* See Appendix A for characteristics of students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

1 National Desired Population does not cover all of International Desired Population (see Table B.4).

2 National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Figure 2.1

Multiple Comparisons of Mathematics Literacy Achievement for Students in Their Final Year of Secondary School*

Instructions: Read ***across*** the row for a country to compare performance with the countries listed in the heading of the chart. The symbols indicate whether the mean achievement of the country in the row is significantly lower than that of the comparison country, significantly higher than that of the comparison country, or if there is no statistically significant difference between the two countries.†

Country	*Netherlands*	**Sweden**	*Denmark*	**Switzerland**	*Iceland*	*Norway*	*France*	*Australia*	**New Zealand**	*Canada*	*Austria*	*Slovenia*	*Germany*	**Hungary**	*Italy*	**Russian Federation**	**Lithuania**	**Czech Republic**	*United States*	**Cyprus**	*South Africa*
Netherlands		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Sweden	●		●	●	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Denmark	●	●		●	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Switzerland	●	●	●		●	●	●	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Iceland	▼	▼	▼	●		●	●	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Norway	▼	▼	▼	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
France	▼	▼	▼	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	▼	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲
New Zealand	▼	▼	▼	●	●	●	●	●		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Canada	▼	▼	▼	▼	▼	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Austria	▼	▼	▼	●	●	●	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲
Slovenia	▼	▼	▼	●	●	●	●	●	●	●	●		●	▲	▲	▲	▲	▲	▲	▲	▲
Germany	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●		●	●	●	●	●	▲	▲	▲
Hungary	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	●	●	●	▲	▲	▲
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	●	●	▲	▲
Russian Federation	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	●	▲	▲
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	▲	▲
Czech Republic	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	▲
United States	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		▲	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼		▲
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

Countries are ordered by mean achievement across the heading and down the rows.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

▲ Mean achievement significantly higher than comparison country

● No statistically significant difference from comparison country

▼ Mean achievement significantly lower than comparison country

* See Appendix A for characteristics of the students sampled.

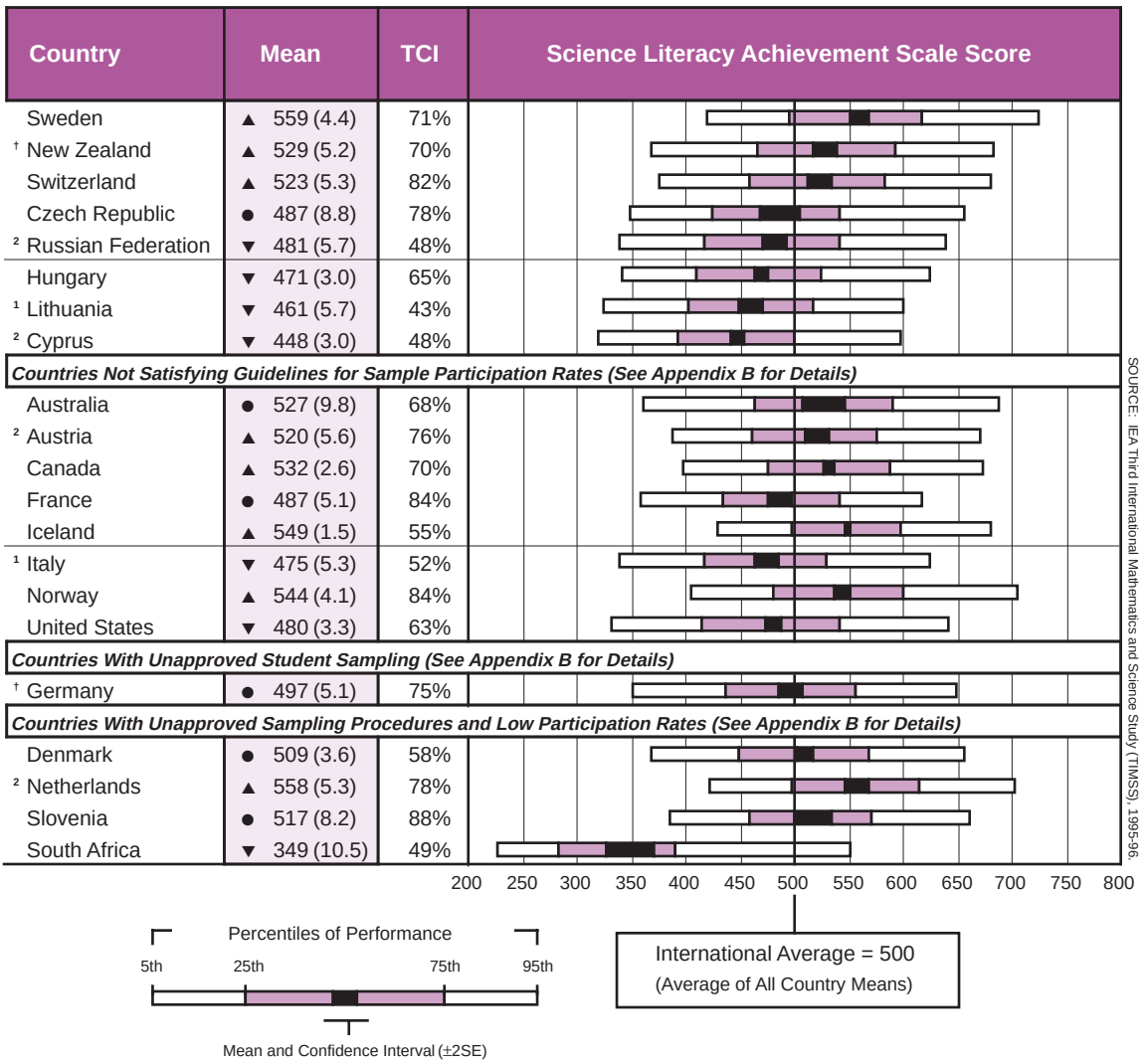
† Statistically significant at .05 level, adjusted for multiple comparisons.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

Table 2.2

Distributions of Achievement in Science Literacy for Students in Their Final Year of Secondary School*

Country	Mean	TCI
Sweden	▲ 559 (4.4)	71%
† New Zealand	▲ 529 (5.2)	70%
Switzerland	▲ 523 (5.3)	82%
Czech Republic	● 487 (8.8)	78%
² Russian Federation	▼ 481 (5.7)	48%
Hungary	▼ 471 (3.0)	65%
¹ Lithuania	▼ 461 (5.7)	43%
² Cyprus	▼ 448 (3.0)	48%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)		
Australia	● 527 (9.8)	68%
² Austria	▲ 520 (5.6)	76%
Canada	▲ 532 (2.6)	70%
France	● 487 (5.1)	84%
Iceland	▲ 549 (1.5)	55%
¹ Italy	▼ 475 (5.3)	52%
Norway	▲ 544 (4.1)	84%
United States	▼ 480 (3.3)	63%
Countries With Unapproved Student Sampling (See Appendix B for Details)		
† Germany	● 497 (5.1)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)		
Denmark	● 509 (3.6)	58%
² Netherlands	▲ 558 (5.3)	78%
Slovenia	● 517 (8.2)	88%
South Africa	▼ 349 (10.5)	49%



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

▲ = Country mean significantly higher than international mean

▼ = Country mean significantly lower than international mean

● = No statistically significant difference between country mean and international mean

* See Appendix A for characteristics of students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

1 National Desired Population does not cover all of International Desired Population (see Table B.4).

2 National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Figure 2.2

Multiple Comparisons of Science Literacy Achievement for Students in Their Final Year of Secondary School*

Instructions: Read ***across*** the row for a country to compare performance with the countries listed in the heading of the chart. The symbols indicate whether the mean achievement of the country in the row is significantly lower than that of the comparison country, significantly higher than that of the comparison country, or if there is no statistically significant difference between the two countries.†

Country	Sweden	Netherlands	Iceland	Norway	Canada	New Zealand	Australia	Switzerland	Austria	Slovenia	Denmark	Germany	France	Czech Republic	Russian Federation	United States	Italy	Hungary	Lithuania	Cyprus	South Africa
Sweden		●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Netherlands	●		●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Iceland	●	●		●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Norway	●	●	●		●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Canada	▼	▼	▼	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
New Zealand	▼	▼	▼	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Switzerland	▼	▼	▼	▼	●	●	●		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Austria	▼	▼	▼	▼	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovenia	▼	▼	▼	●	●	●	●	●	●		●	●	▲	●	▲	▲	▲	▲	▲	▲	▲
Denmark	▼	▼	▼	▼	▼	▼	●	●	●	●		●	▲	●	▲	▲	▲	▲	▲	▲	▲
Germany	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●		●	●	●	●	●	▲	▲	▲	▲
France	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	●	●	●	●	▲	▲	▲
Czech Republic	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	●	●	▲	▲
Russian Federation	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	●	●	▲	▲
United States	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	▲	▲
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	▲	▲
Hungary	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	▲	▲
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		▲
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

Countries are ordered by mean achievement across the heading and down the rows.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

▲ Mean achievement significantly higher than comparison country

● No statistically significant difference from comparison country

▼ Mean achievement significantly lower than comparison country

* See Appendix A for characteristics of the students sampled.

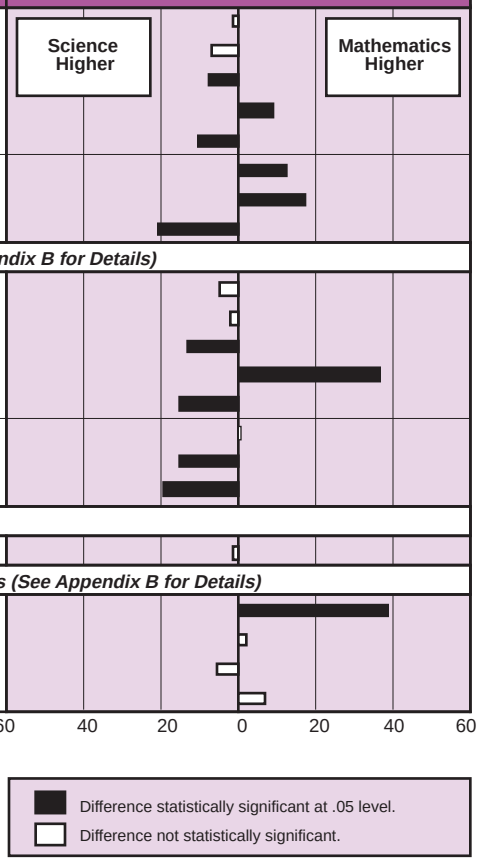
† Statistically significant at .05 level, adjusted for multiple comparisons.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

Table 2.3

Differences in Performance Between Mathematics Literacy and Science Literacy for Students in Their Final Year of Secondary School*

Country	Mathematics Literacy Mean Score	Science Literacy Mean Score	Difference	Subject Difference
[2] Cyprus	446 (2.5)	448 (3.0)	2 (2.4)	
[†] New Zealand	522 (4.5)	529 (5.2)	7 (2.8)	
Sweden	552 (4.3)	559 (4.4)	7 (1.3)	
[1] Lithuania	469 (6.1)	461 (5.7)	9 (2.2)	
[2] Russian Federation	471 (6.2)	481 (5.7)	10 (2.5)	
Hungary	483 (3.2)	471 (3.0)	13 (1.3)	
Switzerland	540 (5.8)	523 (5.3)	18 (2.3)	
Czech Republic	466 (12.3)	487 (8.8)	20 (4.1)	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)				
Australia	522 (9.3)	527 (9.8)	5 (2.4)	
[2] Austria	518 (5.3)	520 (5.6)	2 (2.1)	
Canada	519 (2.8)	532 (2.6)	13 (1.7)	
France	523 (5.1)	487 (5.1)	36 (2.9)	
Iceland	534 (2.0)	549 (1.5)	15 (1.7)	
[1] Italy	476 (5.5)	475 (5.3)	1 (2.2)	
Norway	528 (4.1)	544 (4.1)	16 (1.8)	
United States	461 (3.2)	480 (3.3)	19 (1.5)	
Countries With Unapproved Student Sampling (See Appendix B for Details)				
[†] Germany	495 (5.9)	497 (5.1)	2 (2.4)	
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)				
Denmark	547 (3.3)	509 (3.6)	38 (2.8)	
[2] Netherlands	560 (4.7)	558 (5.3)	2 (2.3)	
Slovenia	512 (8.3)	517 (8.2)	6 (2.3)	
South Africa	356 (8.3)	349 (10.5)	7 (2.9)	



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of students sampled.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

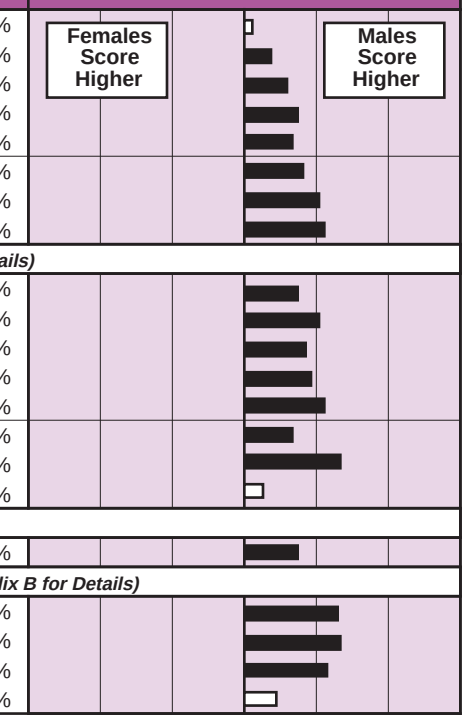
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

Table 2.4

Achievement in Mathematics Literacy by Gender for Students in Their Final Year of Secondary School*

Country	Males		Females		Difference	TCI	Gender Difference
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement			
Hungary	52 (2.5)	485 (4.9)	48 (2.5)	481 (4.8)	5 (6.9)	65%	
[2] Cyprus	45 (2.1)	454 (4.9)	55 (2.1)	439 (3.7)	15 (6.1)	48%	
[1] Lithuania	35 (3.0)	485 (7.3)	65 (3.0)	461 (7.7)	23 (10.6)	43%	
† New Zealand	49 (1.7)	536 (4.9)	51 (1.7)	507 (6.2)	29 (7.9)	70%	
[2] Russian Federation	38 (1.0)	488 (6.5)	62 (1.0)	460 (6.6)	27 (9.2)	48%	
Switzerland	56 (2.5)	555 (6.4)	44 (2.5)	522 (7.4)	33 (9.8)	82%	
Sweden	49 (2.5)	573 (5.9)	51 (2.5)	531 (3.9)	42 (7.0)	71%	
Czech Republic	51 (5.1)	488 (11.3)	49 (5.1)	443 (16.8)	45 (20.2)	78%	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)							
Australia	42 (2.9)	540 (10.3)	58 (2.9)	510 (9.3)	30 (13.9)	68%	
[2] Austria	39 (3.2)	545 (7.2)	61 (3.2)	503 (5.5)	41 (9.0)	76%	
Canada	47 (1.4)	537 (3.8)	53 (1.4)	504 (3.5)	34 (5.2)	70%	
France	47 (3.1)	544 (5.6)	53 (3.1)	506 (5.3)	38 (7.7)	84%	
Iceland	48 (0.8)	558 (3.4)	52 (0.8)	514 (2.2)	44 (4.1)	55%	
[1] Italy	46 (3.3)	490 (7.4)	54 (3.3)	464 (6.0)	26 (9.5)	52%	
Norway	51 (2.0)	555 (5.3)	49 (2.0)	501 (4.8)	54 (7.1)	84%	
United States	50 (1.3)	466 (4.1)	50 (1.3)	456 (3.6)	11 (5.5)	63%	
Countries With Unapproved Student Sampling (See Appendix B for Details)							
† Germany	56 (5.2)	509 (8.8)	44 (5.2)	480 (8.8)	29 (12.4)	75%	
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)							
Denmark	45 (2.0)	575 (4.0)	55 (2.0)	523 (4.0)	52 (5.7)	58%	
[2] Netherlands	52 (2.3)	585 (5.6)	48 (2.3)	533 (5.9)	53 (8.2)	78%	
Slovenia	51 (3.3)	535 (12.7)	49 (3.3)	490 (8.0)	46 (15.0)	88%	
South Africa	49 (1.6)	365 (9.3)	51 (1.6)	348 (10.8)	17 (14.3)	49%	



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

International Averages

Males	Females	Difference
518	485	33

(Averages of All Country Means)

Gender difference statistically significant at .05 level.
Gender difference not statistically significant.

* See Appendix A for characteristics of students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

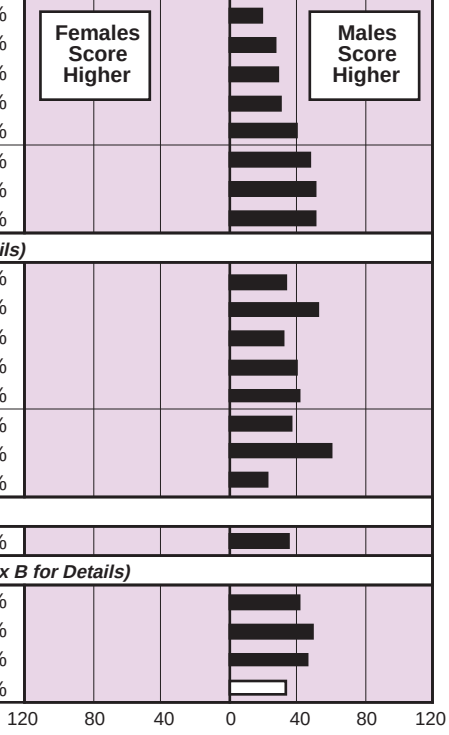
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

Table 2.5

Achievement in Science Literacy by Gender for Students in Their Final Year of Secondary School*

Country	Males		Females		Difference	TCI	Gender Difference
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement			
[2] Cyprus	45 (2.1)	459 (5.8)	55 (2.1)	439 (3.0)	20 (6.5)	48%	
[†] New Zealand	49 (1.7)	543 (7.1)	51 (1.7)	515 (5.2)	28 (8.8)	70%	
Hungary	52 (2.5)	484 (4.2)	48 (2.5)	455 (4.3)	29 (6.0)	65%	
[1] Lithuania	35 (3.0)	481 (6.4)	65 (3.0)	450 (7.3)	31 (9.7)	43%	
Switzerland	56 (2.5)	540 (6.1)	44 (2.5)	500 (7.8)	40 (9.9)	82%	
[2] Russian Federation	38 (1.0)	510 (5.7)	62 (1.0)	463 (6.7)	47 (8.8)	48%	
Sweden	49 (2.5)	585 (5.9)	51 (2.5)	534 (3.5)	50 (6.8)	71%	
Czech Republic	51 (5.1)	512 (8.8)	49 (5.1)	460 (11.0)	51 (14.0)	78%	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)							
Australia	42 (2.9)	547 (11.5)	58 (2.9)	513 (9.4)	34 (14.8)	68%	
[2] Austria	39 (3.2)	554 (8.7)	61 (3.2)	501 (5.8)	53 (10.4)	76%	
Canada	47 (1.4)	550 (3.6)	53 (1.4)	518 (3.8)	32 (5.2)	70%	
France	47 (3.1)	508 (6.7)	53 (3.1)	468 (4.8)	39 (8.3)	84%	
Iceland	48 (0.8)	572 (2.7)	52 (0.8)	530 (2.1)	41 (3.4)	55%	
[1] Italy	46 (3.3)	495 (6.7)	54 (3.3)	458 (5.6)	37 (8.8)	52%	
Norway	51 (2.0)	574 (5.1)	49 (2.0)	513 (4.5)	61 (6.8)	84%	
United States	50 (1.3)	492 (4.5)	50 (1.3)	469 (3.9)	23 (5.9)	63%	
Countries With Unapproved Student Sampling (See Appendix B for Details)							
[†] Germany	56 (5.2)	514 (7.9)	44 (5.2)	478 (8.5)	35 (11.6)	75%	
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)							
Denmark	45 (2.0)	532 (5.4)	55 (2.0)	490 (4.1)	41 (6.8)	58%	
[2] Netherlands	52 (2.3)	582 (5.7)	48 (2.3)	532 (6.2)	49 (8.4)	78%	
Slovenia	51 (3.3)	541 (12.7)	49 (3.3)	494 (6.4)	47 (14.3)	88%	
South Africa	49 (1.6)	367 (11.5)	51 (1.6)	333 (13.0)	34 (17.4)	49%	



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

International Averages

Males	Females	Difference
521	482	39

(Averages of All Country Means)

Gender difference statistically significant at .05 level.
Gender difference not statistically significant.

* See Appendix A for characteristics of students sampled.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

How Does Final-Year Performance in Secondary School Compare with Eighth-Grade Performance?

Achievement for students in the final year of secondary school was estimated separately from achievement at the middle school grades. That is, different tests were used and different content areas emphasized. Therefore, the scale scores are not comparable, and no direct comparison can be made between the performance of the upper secondary school students and that of the eighth-grade students. One way to gauge relative performance at the two levels, however, is to compare a country's performance with the international mean at each of the two points in school. For example, for the countries participating in both the middle school and upper secondary school testing, mean mathematics achievement in comparison with the international average is portrayed in Figure 2.3, with the eighth-grade results for each country derived from *Mathematics in the Middle School Years: IEA's Third International Mathematics and Science Study*[1] and the results for the final year of secondary school taken from Table 2.1 of the present report.

As shown in Figure 2.3, Switzerland, the Netherlands, Austria, France, and Canada were above the international average both at the eighth grade and for their upper secondary school students. However, the countries ranking high in mathematics achievement at the eighth grade did not always rank high in mathematics literacy at the upper secondary level. The Czech Republic, Slovenia, and Australia were above the international average at the eighth grade, but at about the international average for upper secondary school students. Hungary and the Russian Federation performed above the international average at the eighth grade but below it for the final year of secondary school. The United States performed about at the international average at the eighth grade, but below it for upper secondary school students. Conversely, Sweden, New Zealand, and Denmark performed similarly to the international average at the eighth grade, but above it at the upper secondary level, while Norway and Iceland moved from below the international average at the eighth grade to above it for upper secondary school students.

Figure 2.4 shows the results for science achievement relative to the international average at the eighth grade and for science literacy at the upper secondary school level. The eighth-grade results for countries also participating in the science testing of students in the eighth grade were derived from *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study.*[2]

[1] Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

[2] Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996). *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

Just as with the mathematics results, the high-ranking countries were not the same for the eighth grade and the final year of secondary school. Although the Netherlands, Austria, Sweden, Canada, and Norway were above the international average at both levels, the Czech Republic, Slovenia, Australia, and Germany moved toward the international average at the upper secondary level and the Russian Federation and the United States moved below it. In contrast, New Zealand and Switzerland performed at about the international average at the eighth grade, but above it at the upper secondary level. Iceland moved from below the international average at the eighth grade to above it at the upper secondary level, while France and Denmark moved from below the international average to about the international average.

In reading Figures 2.3 and 2.4, however, it is important to remember that the scales for the eighth grade and the upper secondary level are not directly comparable. For example, looking at the international averages, it cannot be said that the eighth-grade students as a whole outperformed the students in their final year of secondary school. Since seventh and eighth graders were given the same mathematics and science tests, the international average of the TIMSS scales for the two grades combined was set at 500. As would be expected, the eighth graders outperformed the seventh graders, resulting in a mean somewhat higher than 500 (i.e., 511 in mathematics and 515 in science, as shown in Figures 2.3 and 2.4, respectively). Using the same approach, the international average for the secondary school students also was arbitrarily set at 500. Therefore, the differences in the international means between the eighth grade and the final year of secondary school are simply an artifact of the scaling procedures used. Also, note that the international averages shown for the eighth grade in Figures 2.3 and 2.4 will not match those reported previously for all 41 countries participating at the eighth grade, because they are based only on the 20 countries that also participated in the testing of students in their final year of secondary school. (Even though Italy's results are contained in the present report, its eighth-grade results were not available.)

Figure 2.3

Mathematics Performance at Eighth Grade† and Final Year of Secondary School* Compared with the International Averages

Eighth Grade Mathematics Scale	
Country	**Difference from International Average**
Czech Republic	53 (4.9)
Switzerland	35 (2.8)
Netherlands	30 (6.7)
Slovenia	30 (3.1)
Austria	29 (3.0)
France	27 (2.9)
Hungary	27 (3.2)
Russian Federation	25 (5.3)
Australia	19 (4.0)
Canada	17 (2.4)
Sweden	8 (3.0)
Germany	-1 (4.5)
New Zealand	-3 (4.5)
Denmark	-8 (2.8)
United States	-11 (4.6)
Norway	-7 (2.2)
Iceland	-24 (4.5)
Lithuania	-33 (3.5)
Cyprus	-37 (1.9)
South Africa	-157 (4.4)
International Average (Average of All Country Means)	511 (0.8)

Final Year of Secondary School Mathematics Literacy Scale		
Country	**TCI**	**Difference from International Average**
Netherlands	78%	60 (4.7)
Sweden	71%	52 (4.3)
Denmark	58%	47 (3.3)
Switzerland	82%	40 (5.8)
Iceland	55%	34 (2.0)
Norway	84%	28 (4.1)
France	84%	23 (5.1)
New Zealand	70%	22 (4.5)
Canada	70%	19 (2.8)
Austria	76%	18 (5.3)
Australia	68%	22 (9.3)
Slovenia	88%	12 (8.3)
Germany	75%	-5 (5.9)
Czech Republic	78%	-34 (12.3)
Hungary	65%	-17 (3.2)
Russian Federation	48%	-29 (6.2)
Lithuania	43%	-31 (6.1)
United States	63%	-39 (3.2)
Cyprus	48%	-54 (2.5)
South Africa	49%	-144 (8.3)
International Average (Average of All Country Means)		500 (1.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

Significantly Higher than International Average

Not Significantly Different from International Average

Significantly Lower than International Average

† Eighth grade in most countries.

* See Appendix A for characteristics of the students sampled.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling procedures (see Figure B.4).

Includes countries that participated in TIMSS testing at both eighth grade and final year of secondary school. The eighth-grade results are derived from those reported in *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study.*

Figure 2.4

Science Performance at Eighth Grade† and Final Year of Secondary School* Compared with the International Averages

Eighth Grade Science Scale		Final Year of Secondary School Science Literacy Scale		
Country	**Difference from International Average**	**Country**	**TCI**	**Difference from International Average**
Czech Republic	59 (4.3)	**Sweden**	71%	59 (4.4)
Netherlands	45 (5.0)	*Netherlands*	78%	58 (5.3)
Slovenia	45 (2.5)	*Iceland*	55%	49 (1.5)
Austria	43 (3.7)	*Norway*	84%	44 (4.1)
Hungary	39 (2.8)	*Canada*	70%	32 (2.6)
Australia	30 (3.9)	**New Zealand**	70%	29 (5.2)
Russian Federation	23 (4.0)	**Switzerland**	82%	23 (5.3)
Sweden	20 (3.0)	*Austria*	76%	20 (5.6)
United States	20 (4.7)	*Australia*	68%	27 (9.8)
Germany	16 (4.8)	*Slovenia*	88%	17 (8.2)
Canada	16 (2.6)	*Denmark*	58%	9 (3.6)
Norway	12 (1.9)	*Germany*	75%	-3 (5.1)
New Zealand	11 (4.4)	*France*	84%	-13 (5.1)
Switzerland	7 (2.5)	**Czech Republic**	78%	-13 (8.8)
France	-17 (2.5)	**Russian Federation**	48%	-19 (5.7)
Iceland	-21 (4.0)	*United States*	63%	-20 (3.3)
Denmark	-37 (3.1)	**Hungary**	65%	-29 (3.0)
Lithuania	-38 (3.4)	**Lithuania**	43%	-39 (5.7)
Cyprus	-52 (1.9)	**Cyprus**	48%	-52 (3.0)
South Africa	-189 (6.6)	*South Africa*	49%	-151 (10.5)
International Average (Average of All Country Means)	515 (0.8)	International Average (Average of All Country Means)		500 (1.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

Significantly Higher than International Average

Not Significantly Different from International Average

Significantly Lower than International Average

† Eighth grade in most countries.

* See Appendix A for characteristics of the students sampled.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling procedures (see Figure B.4).

Includes countries that participated in TIMSS testing at both eighth grade and final year of secondary school. The eighth-grade results are derived from those reported in *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study.*

Chapter 3

Performance on Mathematics and Science Literacy Example Items

This chapter presents seven example test questions in the mathematics literacy area and seven in the science literacy area, and performance on each of the 14 items for each of the TIMSS countries. The example items in this chapter were chosen to illustrate the different topics covered in each area, the different performance expectations, and the range of item formats used. To provide some sense of what types of items were answered correctly by higher-performing students as compared with lower-performing students, the items in each area span a range of difficulty. Finally, it should be noted that all these items and others have been released for use by the public.[1]

The presentation for each of the two subject areas begins with a brief description of the major topics included in that area, followed by seven tables showing achievement on the example items. Each table presents the example item in its entirety and shows the percentages of correct responses for each of the TIMSS countries. The correct answer is circled for multiple-choice items and shown in the answer space for short-answer items. For extended-response questions, the answer shown exemplifies the types of student responses that were given full credit. All of the responses shown have been reproduced from students' actual test booklets. The extended-response questions were scored using a method that provided partial credit for responses indicating some conceptual understanding by students, despite a lack of completeness. For these questions, the tables show the percentages of students receiving partial credit in each country as well as the percentages of those receiving full credit.

The seven tables showing the country-by-country results on each item within the subject area are followed by a "difficulty map" relating achievement on each of the example items to performance on the TIMSS international mathematics literacy or science literacy scale.

[1] The IEA retained about 60% of the TIMSS items as secure for possible future use in measuring international trends in mathematics and science literacy achievement. All remaining items are available for general use.

What Are Some Examples of Performance in Mathematics Literacy?

The items selected for mathematics literacy were designed to define the content area adequately, while restricting the test items to the few content areas most closely related to the notion of mathematical literacy.[2] The items represent the domains of number sense (including fractions and percentages as well as proportionality); algebraic sense; data representation; and measurement and estimation. Several items were designed to measure the component of reasoning and social utility in mathematics. These items emphasize the types of understanding students will need for full participation in today's technology-dependent, information-rich society.

As shown in Table 3.1, final-year students in most countries selected the correct answer to the proportionality problem requiring calculating the number of calories in a portion of food (Example Item 1). The international average percentage of correct responses across the participating countries was 71%, with 80% or more of the students in the Netherlands and France answering correctly.

Table 3.2 presents Example Item 2, asking students to determine the number of defective light bulbs in a batch on the basis of testing a sample. This proportionality task is set in the context of sampling, which students might encounter in quality-control procedures in the workplace, in opinion polling, or in market research. As with Example Item 1, final-year students in many countries did relatively well on this item (international average 66%). More than three-fourths of the students in New Zealand, Sweden, the Netherlands, and Slovenia selected the correct response.

Example Item 3 was a two-part item, requiring students to interpret the information in a travel graph and respond in an open-ended format. The results are shown in Table 3.3. In part A of the item, which was relatively straightforward, students had to be able to read the line graph and use the labeled information on the vertical axis to provide the answer of 60 km per hour as the car's maximum speed. Students were somewhat less successful with part B, which required interpretation of the information in the graph based on events and the ability to read a marked but unlabeled point on the horizontal axis. Whereas the international average was 74% correct responses on part A, only 59% of the final-year students, on average, provided the correct answer of 9:07 for the time that Kelly slammed on her brakes (part B). About 7% of the students, on average, across countries responded that Kelly slammed on her brakes at 9:06, the closest labeled point on the horizontal axis.

Example Item 4 also asked final-year students to interpret the information in graphs. Students were given a bar graph presenting information about the yearly value of sales in Zedland of music cassettes, records, and CDs, and a pie graph showing the percentage of CD sales by purchasers' age in 1992 (see Table 3.4). Students were asked to use the information in the two graphs to determine the amount of money spent by 12- to 19-year-olds in 1992, and to show their calculations. On average, 44% of the students gave a fully correct response. A number of students responded

[2] For a full discussion of the mathematics literacy items, see Orpwood, G. and Garden, R.A. (1998). *Assessing Mathematics and Science Literacy, TIMSS Monograph No. 4.* Vancouver, B.C.: Pacific Educational Press.

correctly with 86.4 million zeds (720 million zeds x .12) supported by an explanation of how the answer was obtained. However, students did not need to read the bar concerned as representing exactly 720 million zeds; any number in the range of 700 million to 730 million zeds was acceptable. For example, the answer shown for Example Item 4 used 715 million zeds. Thus any answer in the range of 84 million to 87.6 million zeds was given full credit as long as the method of obtaining it was appropriate. Sixty percent or more of the students provided fully correct responses to this question in Sweden, Switzerland, Denmark, and the Netherlands. Another one-fifth to two-fifths of the students in many countries received partial credit for their responses. The latter omitted the factor of 1 million, made a decimal or other computation error, or provided other calculations that indicated understanding of the problem even though the final answer was missing or incorrect.

Example Item 5 is a multi-step measurement item involving volume and percentages. Students were asked about the increase in volume of a cube-shaped carton if each of its sides was increased by 10%. As revealed by the results in Table 3.5, this multiple-choice item was quite difficult for students in most countries. Except in the Netherlands, fewer than half the final-year students selected the correct answer in each of the participating TIMSS countries. Fewer than one-fifth answered correctly in the United States and South Africa.

Example Item 6 is an open-ended question, asking students to explain whether a reporter's statement about a "huge increase" was a reasonable interpretation of a graph showing the number of robberies per year. As shown in Table 3.6, on average approximately one-fifth of the students across countries received full credit for their responses. They did so by noting that only a small part of the graph is shown, that 10 (2%) is not a very large increase over the whole, or that the graph is misleading for some other reason. Another one-fourth of the final-year students, on average, received partial credit for this problem. They disagreed with the reporter, or said that 10 was not a large increase but did not say why, or rejected the interpretation for other reasons not relevant to the task. More than 60% of the students in New Zealand, Sweden, Australia, and Iceland provided either fully or partially correct responses to this question.

In Example Item 7, students were asked to sketch their own line graph. They were presented with a grid and asked to show the relationship between a person's height and age from birth to 30 years. Students were specifically asked to label their graphs and to use a realistic height scale along that axis. To receive full credit, students needed to think out how such a graph might look, and then produce a reasonable sketch. Fully correct responses had correct scales and labels on both axes – Age 0 to 30 years and Height 0 to 200 cm (or 0 to 80 inches, or to 7 feet). Also, the line relating height to age needed to start at approximately 50 cm (20 inches) and reach a reasonable maximum at a realistic age (14 to 20 years), after which it would remain essentially flat. The results are presented in Table 3.7 for students providing fully correct and partially correct responses. Across the participating countries, approximately one-fifth of the final-year students drew fully correct graphs. On average, another 28% drew partially correct graphs. In graphs receiving partial credit, all except one of the features were correct. For example, partially correct graphs may have started the height

line incorrectly (e.g., with a height of zero), had an unrealistic age for maximum height, had the line decrease after its peak, or included incorrect scales or labels. More than 60% of the students in Canada and Norway received either full or partial credit for their graphs.

Figure 3.1 shows the relationship between performance on the TIMSS international mathematics literacy scale and achievement on the seven example items in the mathematics literacy area.[3] The international achievement on each example item is indicated by both the average percentage correct across all countries and the international mathematics literacy scale value, or item difficulty level, for each item.

For the figure, the item results have been placed on the scale at the point where students at that level were more likely than not (65% probability) to answer the question correctly. For example, final-year students scoring at or above 478 were likely to provide a correct response to the item asking about the number of defective light bulbs, and those scoring at or above 646 were likely to respond correctly to the problem about the increase in volume of the cube-shaped carton. Considering that the international average on the scale was 500, students achieving at about the level of the international average were unlikely to have answered the latter item correctly. These results, however, varied dramatically by country. For example, students in higher-performing countries were much more likely than students in lower-performing countries to answer correctly all but the most difficult of the mathematics literacy questions. In general, the most difficult questions asked students to apply their knowledge of mathematics to particular real-world situations or to use multiple pieces of information in responding.

[3] The three-digit item label shown in the lower right corner of the box locating each example item on the item difficulty map refers to the original item identification number used in the student test booklets.

Table 3.1 Mathematics Literacy

Percent Correct for Example Item 1

Final Year of Secondary School*

Country	Percent Correct	TCI
[2] Cyprus	66 (3.2)	48%
Czech Republic	61 (5.1)	78%
Hungary	59 (1.3)	65%
[1] Lithuania	67 (2.6)	43%
† New Zealand	75 (2.9)	70%
[2] Russian Federation	71 (2.4)	48%
Sweden	74 (1.6)	71%
Switzerland	79 (1.8)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	71 (2.9)	68%
[2] Austria	78 (2.2)	76%
Canada	73 (2.3)	70%
France	80 (2.0)	84%
Iceland	75 (1.5)	55%
[1] Italy	71 (2.3)	52%
Norway	72 (1.4)	84%
United States	68 (1.3)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
† Germany	74 (2.3)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	75 (1.5)	58%
[2] Netherlands	84 (1.5)	78%
Slovenia	75 (2.4)	88%
South Africa	45 (2.5)	49%
International Average Percent Correct	71 (0.5)	

Example 1

Calories in food portion.

If there are 300 calories in 100 grams of a certain food, how many calories are there in a 30 gram portion of that food?

A. 90
B. 100
C. 900
D. 1000
E. 9000

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.2 Mathematics Literacy

Percent Correct for Example Item 2

Final Year of Secondary School*

Country	Percent Correct	TCI
[2] Cyprus	52 (3.5)	48%
Czech Republic	63 (2.8)	78%
Hungary	52 (1.4)	65%
[1] Lithuania	54 (3.0)	43%
† New Zealand	77 (1.8)	70%
[2] Russian Federation	57 (2.4)	48%
Sweden	77 (1.3)	71%
Switzerland	72 (2.3)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	74 (2.4)	68%
[2] Austria	73 (2.2)	76%
Canada	70 (2.6)	70%
France	73 (1.9)	84%
Iceland	68 (1.5)	55%
[1] Italy	60 (2.6)	52%
Norway	67 (1.5)	84%
United States	62 (1.8)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
† Germany	66 (3.3)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	73 (1.5)	58%
[2] Netherlands	85 (1.5)	78%
Slovenia	77 (2.4)	88%
South Africa	34 (2.3)	49%
International Average Percent Correct	66 (0.5)	

Example 2

Number of defective light bulbs.

From a batch of 3000 light bulbs, 100 were selected at random and tested. If 5 of the light bulbs in the sample were found to be defective, how many defective light bulbs would be expected in the entire batch?

A. 15

B. 60

C. 150

D. 300

E. 600

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.3 Mathematics Literacy

Percent Correct for Example Item 3, Part A

Final Year of Secondary School*

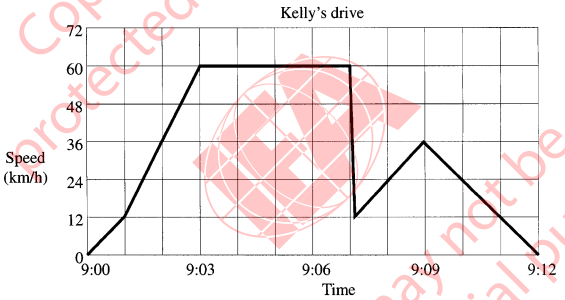
Country	Percent Correct	TCI
[2] Cyprus	54 (3.4)	48%
Czech Republic	66 (2.1)	78%
Hungary	56 (1.4)	65%
[1] Lithuania	61 (3.0)	43%
[†] New Zealand	91 (1.7)	70%
[2] Russian Federation	62 (2.8)	48%
Sweden	85 (1.0)	71%
Switzerland	75 (2.6)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	88 (1.5)	68%
[2] Austria	84 (1.7)	76%
Canada	80 (2.7)	70%
France	71 (3.0)	84%
Iceland	74 (1.4)	55%
[1] Italy	62 (3.0)	52%
Norway	78 (1.4)	84%
United States	85 (1.0)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
[†] Germany	74 (1.5)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	78 (1.2)	58%
[2] Netherlands	91 (1.6)	78%
Slovenia	80 (2.0)	88%
South Africa	60 (3.1)	49%
International Average Percent Correct	74 (0.5)	

Example 3, Part A

Kelly/Maximum speed of car.

Kelly went for a drive in her car. During the drive, a cat ran in front of the car. Kelly slammed on the brakes and missed the cat.

Slightly shaken, Kelly decided to return home by a shorter route. The graph below is a record of the car's speed during the drive.



a) What was the maximum speed of the car during the drive?

60

b) What time was it when Kelly slammed on the brakes to avoid the cat?

9:07

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.3 Mathematics Literacy (Continued)

Percent Correct for Example Item 3, Part B

Final Year of Secondary School*

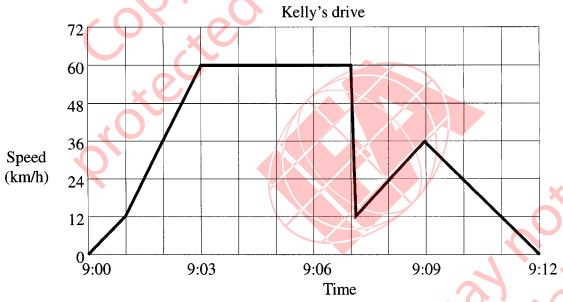
Country	Percent Correct	TCI
[2] Cyprus	33 (2.9)	48%
Czech Republic	47 (2.3)	78%
Hungary	- -	65%
[1] Lithuania	47 (3.0)	43%
† New Zealand	74 (2.0)	70%
[2] Russian Federation	46 (2.2)	48%
Sweden	69 (1.7)	71%
Switzerland	62 (2.7)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	68 (3.3)	68%
[2] Austria	65 (2.4)	76%
Canada	67 (2.6)	70%
France	65 (2.9)	84%
Iceland	63 (1.7)	55%
[1] Italy	47 (2.6)	52%
Norway	65 (1.6)	84%
United States	67 (1.4)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
† Germany	62 (2.2)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	67 (1.9)	58%
[2] Netherlands	83 (1.9)	78%
Slovenia	62 (2.7)	88%
South Africa	19 (3.2)	49%
International Average Percent Correct	59 (0.5)	

Example 3, Part B

Kelly/Time slammed on brakes.

Kelly went for a drive in her car. During the drive, a cat ran in front of the car. Kelly slammed on the brakes and missed the cat.

Slightly shaken, Kelly decided to return home by a shorter route. The graph below is a record of the car's speed during the drive.



a) What was the maximum speed of the car during the drive?

60

b) What time was it when Kelly slammed on the brakes to avoid the cat?

9:07

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available. Internationally comparable data are unavailable for Hungary on Example Item 3B.

Table 3.4 Mathematics Literacy

Percent Correct for Example Item 4

Final Year of Secondary School*

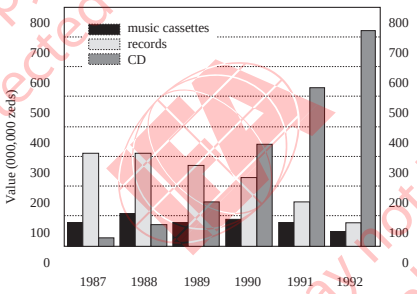
Country	Percent Partially Correct	Percent Fully Correct	TCI
[2] Cyprus	16 (1.1)	25 (1.5)	48%
Czech Republic	10 (1.1)	39 (4.6)	78%
Hungary	15 (0.7)	46 (1.2)	65%
[1] Lithuania	13 (1.2)	45 (2.4)	43%
† New Zealand	22 (1.6)	38 (1.8)	70%
[2] Russian Federation	15 (1.4)	37 (2.2)	48%
Sweden	8 (0.7)	64 (1.5)	71%
Switzerland	14 (1.2)	60 (1.9)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	21 (1.4)	45 (2.7)	68%
[2] Austria	19 (1.4)	50 (2.3)	76%
Canada	17 (1.5)	50 (1.7)	70%
France	12 (1.3)	56 (2.4)	84%
Iceland	17 (1.0)	56 (1.3)	55%
[1] Italy	23 (1.9)	34 (2.4)	52%
Norway	17 (0.7)	53 (1.8)	84%
United States	23 (1.0)	21 (1.2)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):			
† Germany	13 (1.3)	47 (2.3)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	12 (0.8)	62 (1.3)	58%
[2] Netherlands	17 (1.2)	61 (2.0)	78%
Slovenia	37 (3.2)	23 (2.5)	88%
South Africa	7 (1.2)	8 (1.9)	49%
International Average Percent Correct	17 (0.3)	44 (0.5)	

Example 4

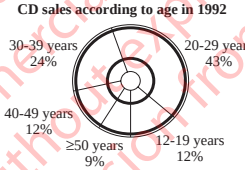
Data from two graphs.

The graphs give information about sales of CDs and other sound recording media in Zedland. Zeds are the monetary units used in Zedland.

Value of various sound recording media sold in Zedland (millions of zeds)



CD sales according to age in 1992



With the aid of both graphs calculate how much money was spent by 12-19 year olds on CDs in 1992. Show your work.

12% of 715 ⇒ 12/100 = n/715

⇒ 12 · 715 ÷ 100 = 85.8 mil zeds

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.5 Mathematics Literacy

Percent Correct for Example Item 5

Final Year of Secondary School*

Country	Percent Correct	TCI
[2] Cyprus	- -	48%
Czech Republic	21 (3.6)	78%
Hungary	24 (1.3)	65%
[1] Lithuania	29 (3.6)	43%
† New Zealand	36 (2.4)	70%
[2] Russian Federation	30 (2.7)	48%
Sweden	41 (1.6)	71%
Switzerland	42 (2.6)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	30 (3.1)	68%
[2] Austria	33 (2.7)	76%
Canada	29 (1.8)	70%
France	31 (2.4)	84%
Iceland	42 (1.8)	55%
[1] Italy	27 (2.4)	52%
Norway	25 (1.6)	84%
United States	17 (1.4)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
† Germany	25 (2.4)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	41 (2.1)	58%
[2] Netherlands	50 (2.4)	78%
Slovenia	42 (3.4)	88%
South Africa	6 (1.7)	49%
International Average Percent Correct	31 (0.5)	

Example 5

Increase volume cube-shaped carton.

Brighto soap powder is packed in cube-shaped cartons. A carton measures 10 cm on each side.

The company decides to increase the length of each edge of the carton by 10 per cent.

How much does the volume increase?

A. 10 cm^3

B. 21 cm^3

C. 100 cm^3

D. 331 cm^3

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (-) indicates data are not available. Internationally comparable data are unavailable for Cyprus on Example Item 5.

Table 3.6 Mathematics Literacy

Percent Correct for Example Item 6

Final Year of Secondary School*

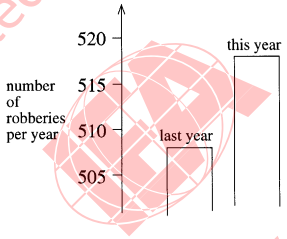
Country	Percent Partially Correct	Percent Fully Correct	TCI
[2] Cyprus	13 (2.2)	5 (1.7)	48%
Czech Republic	26 (2.1)	6 (1.2)	78%
Hungary	25 (1.0)	4 (0.7)	65%
[1] Lithuania	17 (2.6)	2 (0.4)	43%
† New Zealand	38 (3.2)	33 (3.2)	70%
[2] Russian Federation	13 (1.8)	7 (1.8)	48%
Sweden	29 (1.8)	37 (2.2)	71%
Switzerland	27 (2.2)	23 (1.5)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	39 (2.3)	26 (2.8)	68%
[2] Austria	28 (2.4)	19 (2.4)	76%
Canada	35 (2.6)	23 (1.5)	70%
France	25 (2.7)	22 (2.3)	84%
Iceland	25 (1.4)	38 (1.9)	55%
[1] Italy	13 (1.9)	12 (2.1)	52%
Norway	24 (1.3)	34 (1.4)	84%
United States	41 (1.8)	14 (1.3)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):			
† Germany	26 (2.8)	20 (2.4)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	25 (1.7)	26 (1.9)	58%
[2] Netherlands	27 (2.0)	30 (2.6)	78%
Slovenia	31 (2.1)	6 (1.4)	88%
South Africa	12 (2.1)	3 (1.0)	49%
International Average Percent Correct	26 (0.5)	19 (0.4)	

Example 6

Graph with robberies per year.

A TV reporter showed this graph and said:

"There's been a huge increase in the number of robberies this year."



Do you consider the reporter's statement to be a reasonable interpretation of the graph? Briefly explain.

I don't think it is a reasonable interpretation of the graph because if they were to show the whole graph you would see that there is only a slight increase in robberies

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.7 Mathematics Literacy

Percent Correct for Example Item 7

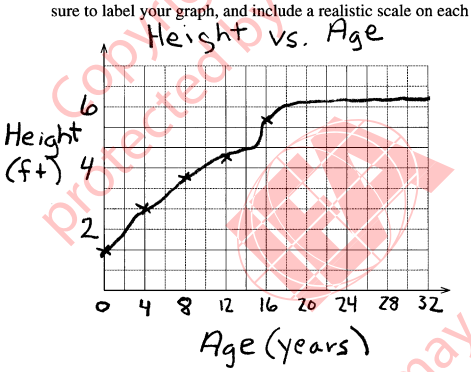
Final Year of Secondary School*

Country	Percent Partially Correct	Percent Fully Correct	TCI
[2] Cyprus	18 (2.3)	8 (1.2)	48%
Czech Republic	23 (1.1)	15 (1.6)	78%
Hungary	27 (0.7)	28 (0.9)	65%
[1] Lithuania	21 (1.2)	13 (1.3)	43%
† New Zealand	33 (1.8)	25 (1.5)	70%
[2] Russian Federation	24 (1.7)	11 (1.1)	48%
Sweden	29 (1.4)	19 (1.1)	71%
Switzerland	29 (1.4)	25 (1.5)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	41 (2.3)	14 (2.1)	68%
[2] Austria	21 (1.6)	13 (1.5)	76%
Canada	44 (1.6)	22 (1.3)	70%
France	34 (1.9)	24 (1.5)	84%
Iceland	34 (1.0)	25 (1.1)	55%
[1] Italy	22 (1.6)	13 (1.6)	52%
Norway	27 (1.1)	41 (1.3)	84%
United States	30 (1.6)	11 (0.8)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):			
† Germany	30 (2.4)	20 (1.8)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	31 (1.3)	28 (1.2)	58%
[2] Netherlands	32 (1.6)	23 (1.3)	78%
Slovenia	33 (2.4)	12 (1.8)	88%
South Africa	11 (2.0)	3 (0.8)	49%
International Average Percent Correct	28 (0.4)	19 (0.3)	

Example 7

Draw graph relating height and age.

Using the set of axes below, sketch a graph which shows the relationship between the height of a person and his/her age from birth to 30 years. Be sure to label your graph, and include a realistic scale on each axis.



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

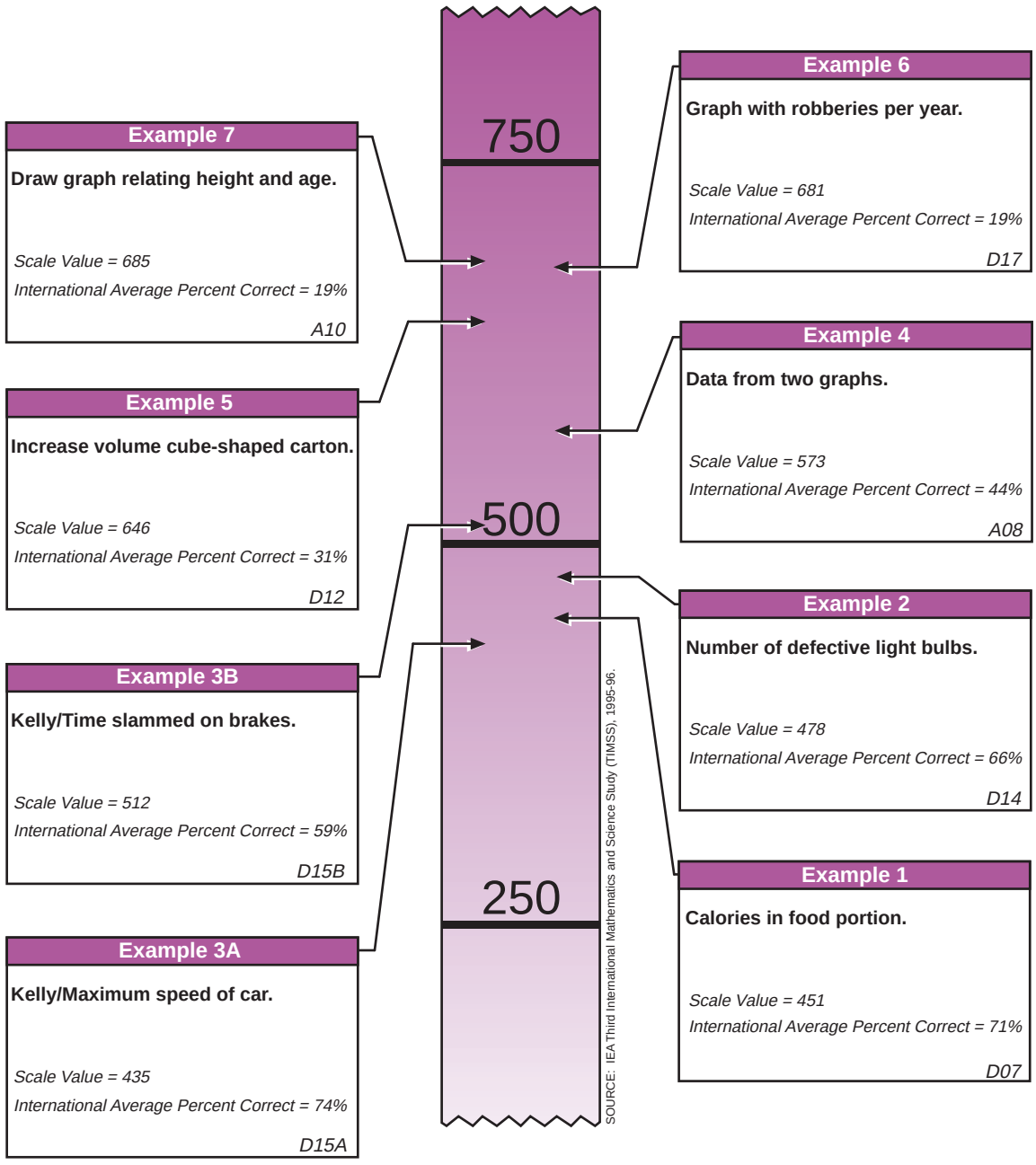
[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Figure 3.1

International Difficulty Map for Mathematics Literacy Example Items
Final Year of Secondary School*



* See Appendix A for characteristics of students sampled.

Note: Items are shown at the point on the TIMSS mathematics literacy scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

What Are Some Examples of Performance in Science Literacy?

In the science literacy area, the items covered earth science, life science (human biology and other life science), and physical science (energy and other physical science).[4] In the least difficult of the science literacy example items, Example Item 1, final-year students were asked how to determine whether cooked or uncooked vegetables were more nutritious. As shown in Table 3.8, students in most countries selected the correct answer to this question, which required an understanding that vitamin content and nutrition are related. The international average of correct responses was 87%, and 90% or more of the students selected the correct response in the Czech Republic, Sweden, Switzerland, Austria, Canada, Norway, Denmark, and Slovenia.

Example Item 2 required an understanding of the dangers of chlorofluorocarbons (CFCs) polluting the atmosphere. In particular, it dealt with the risks to the ozone layer caused by the continued use of CFCs. As shown in Table 3.9, this multiple-choice question was answered correctly by a large percentage of students in many countries. More than 90% selected the correct answer in the Czech Republic, Sweden, and Iceland, and more than 80% in Cyprus, Canada, France, Norway, Denmark, and the Netherlands.

On Example Item 3, requiring an understanding of how influenza is transmitted, about two-thirds of the final-year students, on average, responded correctly (see Table 3.10). Correct responses on this open-ended question included specific mention of the transmission of germs; references to transmission by sneezing, coughing, or close contact; or simply the statement that José got influenza from someone who had it. Approximately 11% of the students, on average, across countries responded incorrectly that José got influenza from getting too cold.

Example Item 4 is an open-ended question asking students to explain why a flying stone would crack a window whereas a tennis ball with the same mass and speed would not. Correct responses referred to the longer time the ball would take to reach the window, and (therefore) the smaller force of the ball. These responses could have mentioned the softness or deformability of the ball versus the hardness or solidity of the stone, the larger impact area of the ball versus the smaller area or higher density of the stone, or the compression of the ball compared to the unchanging stone. Table 3.11 reveals considerable variation across countries in performance on this item. For example, two-thirds or more of the final-year students provided correct responses in New Zealand, Sweden, Australia, Canada, Iceland, and Denmark. In contrast, fewer than 40% provided correct responses in Cyprus, Lithuania, the Russian Federation, and South Africa.

Example Item 5 sought to assess the degree to which final-year students could distinguish between the physics concepts of force and pressure when presented with a practical situation. Students were asked why very high heels with a base diameter of about 0.5 cm may cause more damage to floors than ordinary heels with a base

[4] For a full discussion of the science literacy items, see Orpwood, G. and Garden, R.A. (1998). *Assessing Mathematics and Science Literacy, TIMSS Monograph No. 4.* Vancouver, B.C.: Pacific Educational Press.

diameter of about 3 cm. As shown in Table 3.12, about two-fifths of the students, on average, provided fully correct responses. These students referred to greater pressure on the floor because of the small area of the high heels, or to the weight or force acting on a smaller area (without mentioning pressure). Another one-fifth of the students, on average, received partial credit for referring to greater pressure without mentioning the area of the heels, or for communicating correct thinking but misusing the terms force, pressure, mass, or weight.

Example Item 6 concerned the difference between nuclear fusion and fission, and why nuclear fusion is not used by public utilities. As shown in Table 3.13, performance varied across countries. About 40% of the students, on average, correctly answered this multiple-choice question. Half or more of the final-year students selected the correct answer in the Russian Federation, Sweden, Austria, and Denmark.

As shown in Table 3.14, Example Item 7 was a difficult question assessing students' understanding of energy. Correct responses gave reasons why the amount of light energy produced by a lamp is less than the amount of electrical energy used to power it. Specifically, these students mentioned that much of the electrical energy is transformed to heat, or that it is needed to warm up the lamp, or that energy or heat is lost to the surroundings. In general, final-year students in the participating TIMSS countries appear to be unfamiliar with this concept, since only about one-fifth, on average, provided correct responses.

The item difficulty map for the science literacy items is shown in Figure 3.2. The results indicate that students had the most difficulty recognizing the application of physical science principles to practical situations.

Table 3.8 Science Literacy

Percent Correct for Example Item 1

Final Year of Secondary School*

Country	Percent Correct	TCI
[2] Cyprus	84 (2.5)	48%
Czech Republic	92 (1.1)	78%
Hungary	85 (1.0)	65%
[1] Lithuania	88 (1.6)	43%
† New Zealand	86 (3.4)	70%
[2] Russian Federation	88 (1.2)	48%
Sweden	90 (1.1)	71%
Switzerland	91 (1.2)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	89 (2.2)	68%
[2] Austria	91 (1.3)	76%
Canada	91 (1.1)	70%
France	87 (1.6)	84%
Iceland	87 (1.2)	55%
[1] Italy	82 (2.0)	52%
Norway	93 (0.8)	84%
United States	81 (1.8)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
† Germany	87 (1.6)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	93 (1.0)	58%
[2] Netherlands	89 (1.4)	78%
Slovenia	90 (1.3)	88%
South Africa	55 (2.8)	49%
International Average Percent Correct	87 (0.4)	

Example 1

Nutrition of vegetables.

It is often claimed that "cooked vegetables are not as nutritious as the same kinds of vegetables uncooked." What could be done to find out if this statement is true?

A. Compare the weight of the vegetables before and after they are cooked.

B. Compare the colour of the cooked and uncooked vegetables.

C. Test the acidity of the water in which the vegetables are cooked.

(D.) Compare the vitamin content of the cooked and uncooked vegetables.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.9 Science Literacy

Percent Correct for Example Item 2

Final Year of Secondary School*

Country	Percent Correct	TCI
[2] Cyprus	82 (1.8)	48%
Czech Republic	92 (0.9)	78%
Hungary	68 (0.9)	65%
[1] Lithuania	68 (2.4)	43%
† New Zealand	79 (1.6)	70%
[2] Russian Federation	66 (2.4)	48%
Sweden	93 (0.7)	71%
Switzerland	73 (1.6)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	69 (1.5)	68%
[2] Austria	76 (1.8)	76%
Canada	84 (1.1)	70%
France	86 (1.2)	84%
Iceland	93 (0.7)	55%
[1] Italy	78 (1.8)	52%
Norway	82 (1.0)	84%
United States	77 (1.1)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
† Germany	66 (2.2)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	83 (1.0)	58%
[2] Netherlands	89 (1.0)	78%
Slovenia	71 (2.4)	88%
South Africa	39 (3.3)	49%
International Average Percent Correct	77 (0.4)	

Example 2

Effects of CFCs.

CFCs (chlorofluorocarbons) revolutionized personal and industrial life for 30 years. They were the coolant in refrigerators and the propellants in aerosols, pressure packs and fire extinguishers. There are now very strong international moves to stop the use of these substances because

A. they are chemically inert.

B. they contribute to the greenhouse effect.

C. they are poisonous to humans.

D. they destroy the ozone layer.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.10 Science Literacy

Percent Correct for Example Item 3

Final Year of Secondary School*

Country	Percent Correct	TCI
[2] Cyprus	20 (3.2)	48%
Czech Republic	67 (2.8)	78%
Hungary	68 (1.2)	65%
[1] Lithuania	55 (2.2)	43%
† New Zealand	74 (2.7)	70%
[2] Russian Federation	76 (2.1)	48%
Sweden	88 (1.1)	71%
Switzerland	78 (2.0)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	61 (3.3)	68%
[2] Austria	81 (1.7)	76%
Canada	64 (2.0)	70%
France	68 (2.8)	84%
Iceland	91 (1.2)	55%
[1] Italy	52 (2.6)	52%
Norway	88 (1.1)	84%
United States	59 (2.1)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
† Germany	66 (2.8)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	86 (1.0)	58%
[2] Netherlands	76 (1.7)	78%
Slovenia	78 (2.9)	88%
South Africa	24 (3.1)	49%
International Average Percent Correct	68 (0.5)	

Example 3

José's influenza.

José caught influenza. Write down one way he could have caught it.

if a friend in school has the flu and if he is sneezing on him and coughing on him.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.11 Science Literacy

Percent Correct for Example Item 4

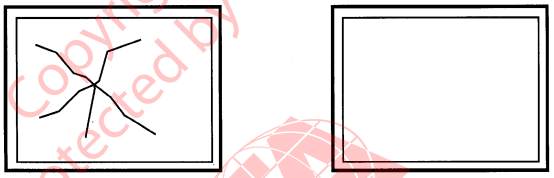
Final Year of Secondary School*

Country	Percent Correct	TCI
[2] Cyprus	26 (3.7)	48%
Czech Republic	62 (2.9)	78%
Hungary	54 (1.3)	65%
[1] Lithuania	37 (2.4)	43%
† New Zealand	76 (1.8)	70%
[2] Russian Federation	35 (2.1)	48%
Sweden	67 (1.6)	71%
Switzerland	61 (2.0)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	72 (2.2)	68%
[2] Austria	64 (2.4)	76%
Canada	67 (1.9)	70%
France	48 (2.8)	84%
Iceland	73 (1.9)	55%
[1] Italy	44 (2.3)	52%
Norway	66 (1.5)	84%
United States	54 (1.5)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
† Germany	65 (2.7)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	70 (2.1)	58%
[2] Netherlands	66 (2.5)	78%
Slovenia	56 (3.0)	88%
South Africa	38 (3.6)	49%
International Average Percent Correct	57 (0.5)	

Example 4

Impact of stone and tennis ball.

The sketch below shows two windows. The left window has been cracked by a flying stone. A tennis ball, with the same mass and speed as the stone, strikes the adjacent, similar window, but does not crack it.



What is one important reason why the impact of the stone cracks the window but the impact of the tennis ball does not?

The tennis ball has air or a hollow inside give it some leeway when it hits the window, But the rock is solid and just hits with full force.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.12 Science Literacy

Percent Correct for Example Item 5

Final Year of Secondary School*

Country	Percent Partially Correct	Percent Fully Correct	TCI
[2] Cyprus	12 (1.3)	45 (2.1)	48%
Czech Republic	22 (2.8)	28 (3.8)	78%
Hungary	20 (0.7)	47 (1.2)	65%
[1] Lithuania	24 (1.7)	21 (1.4)	43%
† New Zealand	23 (1.8)	45 (2.3)	70%
[2] Russian Federation	22 (1.5)	31 (2.1)	48%
Sweden	24 (1.1)	47 (1.7)	71%
Switzerland	22 (1.2)	48 (1.6)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	17 (1.2)	53 (3.6)	68%
[2] Austria	17 (1.3)	51 (2.0)	76%
Canada	18 (1.5)	51 (1.7)	70%
France	12 (1.6)	36 (1.3)	84%
Iceland	22 (0.7)	56 (0.9)	55%
[1] Italy	9 (1.1)	45 (2.3)	52%
Norway	22 (0.9)	50 (1.5)	84%
United States	18 (0.8)	24 (1.3)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):			
† Germany	13 (1.7)	52 (2.4)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	25 (1.5)	39 (1.8)	58%
[2] Netherlands	23 (1.5)	55 (1.8)	78%
Slovenia	51 (2.8)	20 (2.2)	88%
South Africa	9 (1.2)	10 (2.2)	49%
International Average Percent Correct	20 (0.3)	41 (0.5)	

Example 5

Pressure of heels on floor.

Some high heeled shoes are claimed to damage floors. The base diameter of these very high heels is about 0.5 cm and of ordinary heels about 3 cm. Briefly explain why the very high heels may cause damage to floors.

Other shoes have a wider base No matter the size, the same weight ~~that~~ will be distributed all through that area. Therefore, high heels will have all the weight of a person concentrated to that 1 pt. causing more stress.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.13 Science Literacy

Percent Correct for Example Item 6

Final Year of Secondary School*

Country	Percent Correct	TCI
[2] Cyprus	29 (1.6)	48%
Czech Republic	38 (1.9)	78%
Hungary	41 (1.1)	65%
[1] Lithuania	45 (2.9)	43%
† New Zealand	37 (1.9)	70%
[2] Russian Federation	50 (2.0)	48%
Sweden	54 (1.1)	71%
Switzerland	42 (1.6)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	42 (2.4)	68%
[2] Austria	51 (2.0)	76%
Canada	40 (1.6)	70%
France	31 (1.7)	84%
Iceland	28 (0.8)	55%
[1] Italy	40 (2.2)	52%
Norway	38 (1.3)	84%
United States	41 (1.2)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
† Germany	44 (2.6)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	51 (1.6)	58%
[2] Netherlands	41 (1.4)	78%
Slovenia	29 (2.1)	88%
South Africa	26 (1.3)	49%
International Average Percent Correct	40 (0.4)	

Example 6

Nuclear energy source.

Nuclear energy can be generated by fission or fusion. Fusion is not currently being used in reactors as an energy source. Why is this?

A. The scientific principles on which fusion is based are not yet known.

(B.) The technological processes for using fusion safely are not developed.

C. The necessary raw materials are not readily available.

D. Waste products from the fusion process are too dangerous.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Table 3.14 Science Literacy

Percent Correct for Example Item 7

Final Year of Secondary School*

Country	Percent Correct	TCI
[2] Cyprus	13 (3.1)	48%
Czech Republic	23 (4.0)	78%
Hungary	16 (1.1)	65%
[1] Lithuania	12 (1.5)	43%
† New Zealand	24 (2.2)	70%
[2] Russian Federation	18 (2.1)	48%
Sweden	31 (2.0)	71%
Switzerland	27 (2.3)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):		
Australia	26 (2.7)	68%
[2] Austria	21 (2.4)	76%
Canada	23 (1.8)	70%
France	19 (2.1)	84%
Iceland	20 (1.6)	55%
[1] Italy	16 (1.8)	52%
Norway	19 (1.5)	84%
United States	11 (1.3)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):		
† Germany	23 (2.2)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):		
Denmark	20 (1.5)	58%
[2] Netherlands	42 (2.3)	78%
Slovenia	35 (3.5)	88%
South Africa	5 (1.4)	49%
International Average Percent Correct	21 (0.5)	

Example 7

Electrical energy and lamp.

Electrical energy is used to power a lamp.

Is the amount of light energy produced more than, less than, or the same as the amount of electrical energy used?

The amount of light energy produced is

____ more than

__✓__ less than (check one)

____ the same as

the amount of electrical energy used.

Give a reason to support your answer.

Because the lamp heats up, some of the electrical energy is used for this. The rest of the energy produces light.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix B for details).

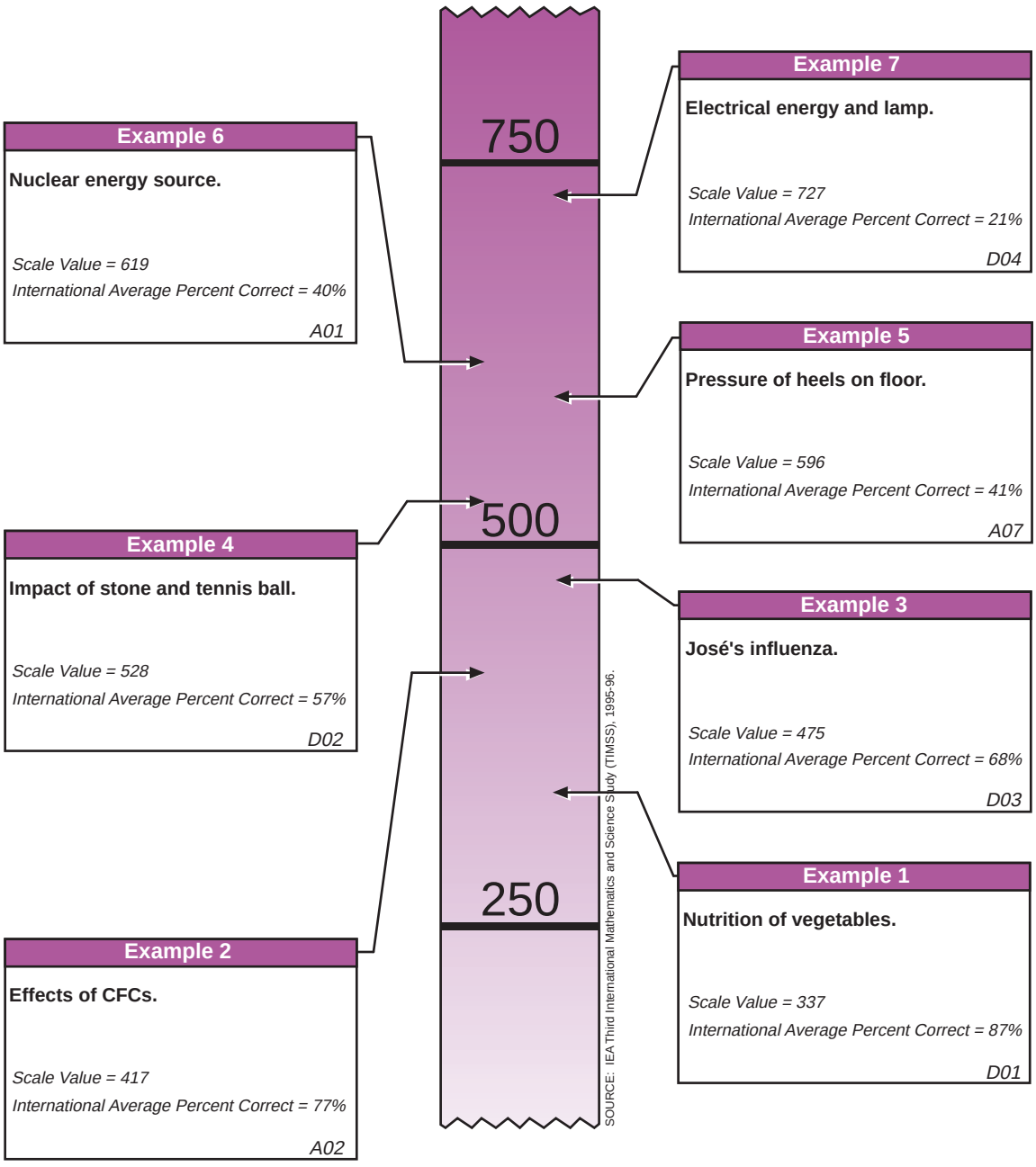
[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Figure 3.2

International Difficulty Map for Science Literacy Example Items
Final Year of Secondary School*



* See Appendix A for characteristics of students sampled.

Note: Items are shown at the point on the TIMSS science literacy scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

Chapter 4

Contexts for Mathematics and Science Literacy Achievement

To provide an educational context for interpreting the results for mathematics and science literacy, TIMSS collected a full range of descriptive information from students about their backgrounds as well as their activities in and out of school. This chapter presents the responses of students in the final year of secondary school to a subset of these questions. In many countries, students at this stage of their education have been assigned to educational programs or tracks that reflect their interests and abilities, and these programs in turn determine to a great extent the opportunities for further study or employment that will be available.

Several of the questions presented in this chapter concern students' academic preparation and their plans for future education. Because students' attitudes towards mathematics and science and their perceptions of success in these subjects are closely related to each other and to achievement, results are also described for several questions in these domains. In an effort to explore the degree to which the students' home and social environments foster academic development, some of the questions presented herein concern the availability of educational resources in the home. Since the optimal use of calculators and computers by students learning mathematics and science remains an area of debate, several questions on this issue are included. Another group of questions examines whether or not students typically spend their out-of-school time in ways that support their academic performance. Finally, since a secure and supportive school environment is generally accepted as a prerequisite for effective learning, results for several questions about students' experiences in school are presented.

What Are Secondary School Students' Educational Experiences and Plans?

In many countries, students in the upper secondary grades either choose or are assigned to educational programs or tracks that reflect their abilities and interests. The program to which a student is assigned often largely determines that student's future educational and career prospects. Even in countries with comprehensive systems, students have some latitude in choosing between more and less demanding course options. While it is very informative to compare the achievement of students across different educational programs within a country, it is quite difficult to define international categories that are comparable across countries. Although countries vary widely in the way upper secondary education is organized, four broad categories can be distinguished to which most programs may be assigned – academic, technical, vocational, and general.

While none of the TIMSS countries had programs that fit into all four categories, most included national options that distinguished between academic and vocational programs. The percentage of students in each of the four program types is presented in Table 4.1 for each country, together with mean achievement in mathematics and

science literacy. The source of the data varied across countries: in 12 countries, the data are based on students' responses to questions about their educational track or program, while in the other 9 countries, they are based on school tracking information.

In most countries, the majority of students were following programs of study that could be broadly categorized as academic or general. In particular, in Australia, Canada, France, Iceland, Slovenia, and the United States, fewer than one-fifth of final-year secondary students covered by the TIMSS testing were enrolled in vocational programs. In contrast, a well-developed vocational sector is a feature of many of the education systems in continental Europe. Between half and three-fourths of the students in Austria, the Czech Republic, Germany, the Netherlands, and Switzerland were in vocational programs or tracks. In the Czech Republic, France, Hungary, and Italy, more than one-fourth of the students were enrolled in technical programs; Austria and Slovenia also had a substantial proportion of students in this sector.

As might be expected, students enrolled in academic programs had higher mean achievement than students in vocational programs, often by a wide margin. The largest differences were in the Czech Republic and Slovenia, where the mean for the academic students exceeded that for vocational students by approximately 140 scale-score points (almost one and one-half standard deviations on the international mathematics and science literacy scale). The mean achievement of students in technical programs generally was somewhere between that of the academic and vocational students.

Figure 4.1 summarizes the programs or tracks in each country, and indicates the category to which they were assigned for the purpose of this report. Although there is no single definition of these broad program categories that applies across all countries, the following international working definitions based on the program options across countries are used for the purpose of this report.

Academic programs include general academic programs or tracks in academic, general, or comprehensive schools. The focus of coursework is mainly academic and may include many different areas of concentration (e.g., math, natural or physical sciences, languages, humanities, economics, social science, the arts). In many countries, a final leaving examination or university-preparation examination is required on completion of these programs. Students from these programs may attend university or equivalent institutions of higher education. In nearly all countries, the academic programs terminate after grade 12 or 13. In three countries with comprehensive schools (Australia, Canada, and the United States), a distinction was made between pre-university programs and general studies in the question asked of students. In these countries, only the pre-university programs are included in the academic program category, although the distinction between pre-university and general is based on the emphasis on specific types of courses within the comprehensive schools and may not be uniformly interpreted by all students. In contrast, in the Netherlands and the Russian Federation, the academic program category includes both the academic and general programs.

Table 4.1

Mathematics and Science Literacy Achievement by Educational Program†
Final Year of Secondary School*

Country	Academic Program		Technical Program		Vocational Program		General Education Program	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	54 (2.4)	561 (8.8)	- -	- -	10 (1.1)	466 (13.5)	36 (2.1)	497 (11.9)
Austria	23 (1.9)	565 (8.5)	22 (1.3)	569 (8.3)	55 (2.4)	482 (5.9)	- -	- -
Canada	77 (1.6)	538 (3.3)	- -	- -	7 (0.6)	497 (8.3)	16 (1.4)	485 (7.7)
Cyprus	89 (0.7)	452 (2.5)	11 (0.7)	408 (8.8)	- -	- -	- -	- -
Czech Republic	14 (2.0)	582 (7.2)	29 (5.5)	523 (10.8)	57 (6.5)	427 (5.4)	- -	- -
Denmark	56 (2.9)	550 (3.5)	- -	- -	44 (2.9)	499 (6.2)	- -	- -
France	54 (3.5)	534 (6.7)	34 (4.5)	486 (5.0)	12 (3.2)	435 (6.7)	- -	- -
Germany	26 (3.2)	567 (4.1)	11 (4.9)	502 (20.9)	63 (5.0)	466 (7.2)	- -	- -
Hungary	27 (1.3)	530 (5.5)	35 (1.2)	504 (5.4)	39 (1.1)	416 (3.4)	- -	- -
Iceland	82 (0.6)	551 (1.5)	- -	- -	18 (0.6)	516 (4.9)	- -	- -
Italy	38 (2.4)	501 (8.4)	37 (2.0)	481 (6.6)	25 (2.4)	426 (12.2)	- -	- -
Lithuania	74 (3.8)	475 (5.4)	- -	- -	26 (3.8)	437 (16.3)	- -	- -
Netherlands	43 (1.5)	612 (9.9)	- -	- -	57 (1.5)	519 (5.3)	- -	- -
New Zealand	100 (0.0)	525 (4.7)	- -	- -	- -	- -	- -	- -
Norway	57 (2.5)	560 (4.5)	- -	- -	43 (2.5)	503 (6.3)	- -	- -
Russian Federation	100 (0.0)	476 (5.8)	- -	- -	- -	- -	- -	- -
Slovenia	67 (4.1)	547 (7.3)	24 (2.9)	469 (7.1)	9 (3.2)	408 (10.5)	- -	- -
South Africa	100 (0.0)	352 (9.3)	- -	- -	- -	- -	- -	- -
Sweden	66 (2.7)	587 (4.8)	- -	- -	34 (2.7)	500 (4.6)	- -	- -
Switzerland	23 (1.5)	607 (3.9)	- -	- -	69 (1.5)	506 (6.5)	7 (1.9)	530 (13.8)
United States	55 (1.4)	504 (3.7)	- -	- -	12 (0.9)	410 (4.4)	33 (1.4)	444 (3.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Program options were defined by each country to conform to their own educational system and may not be comparable across countries. See Figure 4.1 for national definitions of program options included in each category.

* See Appendix A for characteristics of the students sampled.

Source of data varies across countries:

Data are based on students' reports of their educational program in Austrialia, Canada, Cyprus, Czech Republic, France, Iceland, Netherlands, Norway, Slovenia, Sweden, Switzerland, and the United States.

Data are based on students' school tracking information in Austria, Denmark, Germany, Hungary, Italy, Lithuania, New Zealand, Russian Federation, and South Africa.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates the program category is not included for that country.

Figure 4.1

Definitions of National Options Included in the International Categories for Students' Educational Programs† Mathematics and Science Literacy

Final Year of Secondary School*

Australia	Austria	Canada	Cyprus	Czech Republic	Denmark	France
Academic: Full academic (preparation for university)	Academic: Academic (AHS)	Academic: University/college preparation program (general or with specialization in math, science, or both)	Academic: Lyceum (math/science, classical, economics, commercial/secretarial, and foreign language tracks)	Academic: Gymnasium (general program or program specializing in mathematics, physical science, natural science, computer science, humanities, or foreign language)	Academic: Gymnasia	Academic: Lycees Serie S (scientific), L (literacy), or ES (economic and social)
Vocational: Program in specific area (e.g. business) or school-industry link	Technical: Higher technical/vocational school (BHS)	Vocational: Trade/technical school preparation program	Technical: Technical/vocational schools	Technical: Secondary technical school	Vocational: Commercial or technical schools (Handelsskoler, Tekniskeskoler) with both academic and non-academic programs	Technical: Lycees technical serie STT or other technical tracks
General: Part academic/part general	Vocational: Intermediate vocational/technical school (BMS) or apprenticeship program (BS)	General: Other general graduation program		Vocational: Vocational training center or secondary school without maturita.		Vocational: Long or short vocational/professional degree program (Baccalaureat professionnels, BAC, or Brevet d'etudes professionnels, BEP)

Germany	Hungary	Iceland	Italy	Lithuania	Netherlands	New Zealand
Academic: Gymnasia or comprehensive schools (GS, IGS)	Academic: General academic	Academic: Academic programs in gymnasia or comprehensive schools (general or with specialization in mathematics, science, arts, or language)	Academic: Classical schools (classics, languages, teaching, and sciences) or art schools	Academic: Gymnasia or general school	Academic: Academic or senior general schools (VWO or HAVO)	Academic: General academic/comprehensive education
Technical: Technical/professional or applied science programs (Fachgymnasia or Fachoberschulen)	Technical: Vocational/professional programs in vocational schools (industrial, agricultural, merchant, and humanities)	Vocational: Vocational programs in comprehensive schools (Fjölbrautarskólar) or special vocational schools	Technical: Technical schools	Vocational: Vocational school	Vocational: Short or long vocational programs (MBO or KMBO in technology, economics, agriculture, home economics)	
Vocational: Apprenticeship (Berufsschulen) or full-time vocational programs (Berufsfachschulen)	Vocational: Vocational trade schools (trade, merchant, or agricultural)		Vocational: Vocational schools			

Norway	Russian Federation	Slovenia	South Africa	Sweden	Switzerland	United States
Academic: Academic programs (general or math/science specialization)	Academic: General and specialized programs (mathematics science, humanities, foreign languages, etc.) in general secondary schools and gymnasiums	Academic: Gymnasia (matura program)	Academic: General academic/comprehensive education	Academic: General academic programs (with specialization in math/physics; social science and economics; and humanities)	Academic: Gymnasia programs (specialization in science, languages, economics) or matura-level preparation for teacher training	Academic: College preparatory program (high percentage of college-preparatory courses)
Vocational: Vocational programs in commerce (HK), industry (HI), health (HS), home economics (HH) or other	Vocational: vocational schools (not included in sample)	Technical: Technical/professional schools		Vocational: Vocationally-oriented programs	Vocational: Apprenticeship (Berufslehre), full-time vocational school, or apprenticeship plus additional general education leading to technical school-leaving certificate (Berufsmaturitat)	Vocational: Vocational/technical program (high percentage of vocational courses)
		Vocational: 3- or 4-year vocational program			General: Intermediate diploma school (Diplommittelschule)	General: General academic program (combining general academic and vocational coursework)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Educational program or track options were defined by each country to conform to their national systems. The options included in each international reporting category are shown to aid in the interpretation of Table 4.1.

* See Appendix A for characteristics of the students sampled.

Technical programs include technically or professionally oriented programs provided either in separate technical schools or in higher-level technical/vocational tracks within general academic or technical/vocational schools. These programs are usually of a higher level than many vocational/occupational programs and, in several countries, are comparable to the general academic program both in duration and in preparing students for a final exam or for entry into university or an equivalent institution of higher education. The technical tracks, however, focus more on specialized courses required for specific professions than the more general academic tracks. The technical programs category is included only for countries with clearly defined separate national options for technical schools or tracks that are differentiated from both general academic programs and primarily vocational/occupational tracks.

Vocational programs include vocationally or occupationally oriented programs provided either in separate vocational schools or in specific vocational programs within general or comprehensive schools. The focus of these programs is, in general, more practical than that of the general academic programs, typically preparing students for immediate employment after completion of their upper secondary education and terminating with a certificate, vocational license, or diploma. In many countries, there are clearly defined vocational schools or tracks that are differentiated from the general academic tracks. In other countries with more comprehensive schools, the vocational option refers more to a general program with a focus on vocationally oriented courses than on a formal vocational school or track. The type and duration of vocational programs vary both across and within countries, terminating in nearly all countries after grade 10, 11, 12, or 13. The national options included in the vocational programs category cover a broad range of programs including both full- and part-time programs in vocational/technical/trade schools and apprenticeship programs in industry and business. A large number of occupational programs are offered, including many in skilled-trades, business, and applied science/engineering. Depending on the program, students may continue their education after completing a vocational program. In some countries, the vocational programs category includes some vocational programs terminating with a diploma that may lead directly to university, such as the Baccalaureat professionnel in France. In others, however, students continuing their education after completing vocational programs may attend other tertiary institutions for higher-level vocational training or further upper secondary education.

General programs include any other program or track options not included in the academic, technical, or vocational categories. Only four countries have options in this category: general schools in Switzerland, and the general programs (not fully pre-university) in comprehensive schools in Australia, Canada, and the United States.

One of the consequences of the differentiation in programs and courses that is characteristic of upper secondary education is that students often have the option to discontinue the study of mathematics and science. Table 4.2 presents students' reports on whether or not they were taking mathematics in the final year of secondary school, together with mean achievement on the mathematics literacy test. In most of the countries, a high proportion of final-year students was still enrolled in mathematics class. In nine countries (Australia, Cyprus, the Czech Republic, France, Hungary, Italy, Lithuania, the Russian Federation, and Slovenia), 85% or more of students

Table 4.2

Students' Reports on Currently Taking Mathematics – Mathematics Literacy
Final Year of Secondary School*

Country	Yes		No	
	Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Mathematics Literacy Achievement
Australia	87 (2.2)	534 (8.3)	13 (2.2)	465 (15.5)
Austria	74 (3.6)	526 (5.7)	26 (3.6)	503 (12.0)
Canada	54 (2.6)	541 (3.6)	46 (2.6)	496 (3.8)
[1] **Cyprus**	100 (0.0)	446 (2.4)	0 (0.0)	~ ~
Czech Republic	95 (2.1)	465 (12.9)	5 (2.1)	493 (22.9)
Denmark	78 (2.4)	568 (4.1)	22 (2.4)	481 (5.0)
France	100 (0.0)	524 (5.2)	0 (0.0)	~ ~
Germany	- -	- -	- -	- -
Hungary	100 (0.0)	484 (3.2)	0 (0.0)	~ ~
Iceland	65 (1.0)	551 (2.6)	35 (1.0)	506 (4.8)
Italy	88 (3.3)	480 (5.3)	12 (3.3)	450 (17.2)
Lithuania	90 (2.1)	473 (5.1)	10 (2.1)	434 (22.0)
Netherlands	60 (2.6)	601 (6.2)	40 (2.6)	498 (7.7)
New Zealand	73 (1.8)	545 (4.4)	27 (1.8)	461 (5.2)
Norway	68 (2.5)	542 (4.8)	32 (2.5)	500 (5.8)
[1] **Russian Federation**	100 (0.1)	471 (6.1)	0 (0.1)	~ ~
Slovenia	95 (2.7)	519 (8.2)	5 (2.7)	407 (17.4)
South Africa	69 (2.9)	372 (11.5)	31 (2.9)	328 (3.1)
Sweden	70 (2.0)	578 (5.2)	30 (2.0)	494 (4.8)
Switzerland	61 (3.2)	561 (4.0)	39 (3.2)	513 (8.9)
United States	66 (1.9)	477 (3.6)	34 (1.9)	436 (3.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

[1] Vocational schools excluded (see Table B.4).

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

reported that they were currently taking mathematics. In contrast, countries where as many as one-third of final-year students reported that they were not currently taking mathematics included Canada, Iceland, the Netherlands, Switzerland, and the United States.

In general, the students no longer taking mathematics performed less well in mathematics literacy than those who were still studying the subject. Differences were particularly pronounced in Australia, Denmark, the Netherlands, New Zealand, Slovenia, and Sweden, where the achievement gap between those taking and not taking mathematics exceeded 50 scale-score points, which is half of a standard deviation on the international mathematics literacy scale.

In some countries, more males than females reported that they were currently taking mathematics (see Table 4.3). One of the largest differences was in Denmark, where the percentage of female students not taking mathematics (31%) was more than twice the percentage for males (12%). The other countries where the difference between males and females was at least 10 percentage points included Canada, Iceland, the Netherlands, New Zealand, and Norway.

In upper secondary school, science typically is not taught as a single subject; rather, subjects such as physics, chemistry, biology, and earth science are taught as separate subjects, and students may have the option to take one or more (or perhaps none) of them. In TIMSS, final-year students were asked to indicate which of the science subjects (physics, chemistry, biology, earth science, or other science) they were currently taking. The results are summarized in Table 4.4. Compared with mathematics, higher percentages of students in most countries reported that they were taking no science subject at the time of testing. Half or more of the students in the Czech Republic, Denmark, Norway, Sweden, and Switzerland, reported that they were not taking science, and nearly half of the final-year students so reported in Canada and the United States. Countries where the majority of students reported that they were taking two or more science subjects included Austria, Cyprus, France, Lithuania, the Russian Federation, and South Africa.

There was a positive association between taking science subjects and performance in science literacy in almost every country. This may be the result of a combination of factors, such as students who had not done well in science in earlier years deciding to take fewer science subjects, and those who took more science subjects learning more science.

Compared with mathematics, somewhat fewer countries exhibited substantial differences in the percentages of males and females currently taking science classes (Table 4.5). In only four countries – France, the Netherlands, Sweden, and Switzerland – were the differences in the percentages not taking any science greater than 10%. Of these, France, the Netherlands, and Sweden had higher percentages of females not taking science, while in Switzerland a higher percentage of males reported taking no science.

Table 4.3

Students' Reports on Currently Taking Mathematics by Gender – Mathematics Literacy
Final Year of Secondary School*

Country	Females				Males			
	Yes		No		Yes		No	
	Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Mathematics Literacy Achievement
Australia	85 (2.9)	523 (8.8)	15 (2.9)	455 (11.4)	89 (2.8)	550 (9.4)	11 (2.8)	483 (40.8)
Austria	75 (4.8)	511 (5.7)	25 (4.8)	482 (14.2)	72 (3.5)	551 (8.7)	28 (3.5)	533 (10.8)
Canada	50 (2.8)	525 (4.7)	50 (2.8)	483 (6.0)	60 (3.0)	557 (4.1)	40 (3.0)	514 (5.5)
Cyprus	100 (0.0)	439 (3.7)	0 (0.0)	~ ~	100 (0.0)	456 (4.9)	0 (0.0)	~ ~
Czech Republic	93 (3.3)	440 (17.3)	7 (3.3)	486 (22.5)	97 (1.6)	488 (11.7)	3 (1.6)	508 (41.0)
Denmark	69 (2.9)	546 (4.6)	31 (2.9)	475 (4.6)	88 (1.8)	589 (5.6)	12 (1.8)	498 (10.5)
France	100 (0.0)	506 (5.4)	0 (0.0)	~ ~	100 (0.0)	544 (5.7)	0 (0.0)	~ ~
Germany	- -	- -	- -	- -	- -	- -	- -	- -
Hungary	100 (0.0)	481 (4.7)	0 (0.0)	~ ~	100 (0.0)	486 (4.9)	0 (0.0)	~ ~
Iceland	60 (1.7)	529 (2.8)	40 (1.7)	492 (4.5)	70 (1.3)	572 (3.9)	30 (1.3)	526 (7.7)
Italy	91 (3.3)	469 (5.5)	9 (3.3)	414 (24.6)	84 (4.4)	494 (8.3)	16 (4.4)	472 (14.4)
Lithuania	90 (2.4)	465 (6.2)	10 (2.4)	430 (30.7)	91 (3.9)	489 (6.9)	9 (3.9)	444 (11.0)
Netherlands	48 (2.6)	593 (8.5)	52 (2.6)	476 (7.8)	71 (3.9)	606 (6.4)	29 (3.9)	534 (11.5)
New Zealand	66 (2.6)	534 (6.2)	34 (2.6)	456 (6.9)	80 (2.1)	554 (6.3)	20 (2.1)	470 (6.8)
Norway	63 (3.0)	512 (6.1)	37 (3.0)	483 (5.9)	73 (2.7)	568 (6.5)	27 (2.7)	522 (7.5)
Russian Federation	100 (0.0)	461 (6.6)	0 (0.0)	~ ~	100 (0.1)	488 (6.6)	0 (0.1)	~ ~
Slovenia	95 (3.1)	495 (7.6)	5 (3.1)	376 (4.2)	94 (3.3)	543 (13.1)	6 (3.3)	429 (10.0)
South Africa	67 (3.5)	363 (15.1)	33 (3.5)	325 (4.1)	71 (3.0)	381 (12.3)	29 (3.0)	331 (4.4)
Sweden	68 (2.2)	555 (4.1)	32 (2.2)	485 (5.6)	72 (2.8)	601 (7.6)	28 (2.8)	504 (6.4)
Switzerland	63 (4.5)	538 (5.8)	37 (4.5)	498 (14.0)	60 (3.4)	579 (5.5)	40 (3.4)	524 (9.7)
United States	63 (2.4)	472 (4.5)	37 (2.4)	433 (4.6)	70 (1.9)	481 (4.7)	30 (1.9)	440 (4.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available.

A tilde (~) indicates insufficient data to report achievement.

Table 4.4

Students' Reports on Currently Taking Science† – Science Literacy
Final Year of Secondary School*

Country	No Science		One Science Course		Two Science Courses		Three or More Science Courses	
	Percent of Students	Mean Science Literacy Achievement	Percent of Students	Mean Science Literacy Achievement	Percent of Students	Mean Science Literacy Achievement	Percent of Students	Mean Science Literacy Achievement
Australia	27 (3.6)	469 (10.2)	36 (1.4)	528 (10.3)	30 (2.8)	578 (11.6)	7 (1.3)	602 (15.5)
Austria	12 (1.7)	478 (8.3)	26 (2.3)	498 (10.8)	24 (2.4)	532 (8.4)	38 (3.3)	552 (8.1)
Canada	45 (2.2)	508 (3.9)	34 (2.0)	543 (5.4)	15 (1.3)	575 (8.6)	6 (0.6)	585 (6.0)
Cyprus	0 (0.0)	~ ~	3 (0.6)	390 (23.0)	77 (1.3)	438 (3.6)	20 (1.5)	496 (8.5)
Czech Republic	66 (5.7)	469 (10.0)	18 (3.7)	490 (13.9)	6 (1.6)	530 (21.7)	11 (1.5)	589 (5.4)
Denmark	r 58 (2.3)	487 (4.6)	26 (1.4)	552 (4.4)	13 (1.6)	571 (8.6)	3 (0.6)	564 (12.1)
France	35 (2.4)	452 (5.4)	11 (2.6)	461 (8.2)	12 (1.7)	490 (12.9)	42 (3.0)	523 (4.8)
Germany	x x	x x	x x	x x	x x	x x	x x	x x
Hungary	22 (1.9)	446 (4.7)	36 (2.4)	459 (5.3)	32 (1.6)	492 (5.4)	9 (0.7)	509 (7.5)
Iceland	37 (1.2)	526 (2.5)	30 (1.5)	541 (4.1)	15 (1.1)	586 (4.7)	18 (0.8)	597 (3.1)
Italy	19 (2.8)	448 (8.8)	32 (2.5)	465 (7.8)	30 (2.7)	492 (6.4)	20 (2.5)	500 (14.2)
Lithuania	12 (2.4)	434 (18.8)	8 (2.8)	435 (11.8)	6 (1.3)	454 (7.1)	75 (3.4)	470 (5.6)
Netherlands	43 (3.3)	509 (5.8)	24 (2.7)	567 (7.7)	20 (2.0)	597 (7.7)	13 (2.6)	642 (16.0)
New Zealand	32 (1.6)	478 (6.9)	34 (1.7)	521 (6.6)	25 (1.1)	581 (5.2)	9 (1.1)	617 (9.3)
Norway	63 (2.7)	519 (3.9)	23 (2.1)	568 (6.1)	13 (1.6)	633 (10.4)	1 (0.2)	~ ~
Russian Federation	0 (0.1)	~ ~	1 (0.4)	~ ~	2 (0.5)	~ ~	98 (0.7)	483 (5.8)
Slovenia	16 (2.8)	480 (10.8)	47 (3.0)	510 (8.1)	23 (2.4)	547 (8.6)	14 (3.0)	571 (22.4)
South Africa	8 (1.1)	353 (13.6)	22 (2.1)	323 (10.8)	27 (2.4)	363 (15.7)	43 (3.0)	367 (14.0)
Sweden	57 (2.0)	529 (3.2)	22 (1.7)	567 (10.3)	6 (0.7)	605 (11.8)	15 (1.8)	658 (6.4)
Switzerland	50 (2.6)	489 (6.3)	23 (1.9)	545 (7.7)	16 (1.3)	574 (9.3)	11 (1.8)	580 (13.3)
United States	47 (1.7)	456 (3.5)	46 (1.6)	505 (4.6)	6 (0.8)	537 (13.5)	1 (0.1)	~ ~

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Students were asked which of the following science courses they were currently taking: Biology, Chemistry, Physics, Earth Science, and Other Science.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates a 70-84% student response rate.

An "x" indicates data available for <50% students.

A tilde (~) indicates insufficient data to report achievement.

Table 4.5

Students' Reports on Currently Taking Science by Gender† – Science Literacy
Final Year of Secondary School*

Country	Females				Males			
	Yes		No		Yes		No	
	Percent of Students	Mean Science Literacy Achievement	Percent of Students	Mean Science Literacy Achievement	Percent of Students	Mean Science Literacy Achievement	Percent of Students	Mean Science Literacy Achievement
Australia	72 (3.7)	540 (8.5)	28 (3.7)	459 (7.4)	74 (4.4)	577 (11.0)	26 (4.4)	484 (17.7)
Austria	88 (2.7)	508 (5.6)	12 (2.7)	468 (10.2)	88 (1.9)	567 (8.6)	12 (1.9)	495 (11.0)
Canada	53 (3.7)	543 (5.8)	47 (3.7)	493 (6.5)	58 (2.8)	571 (5.5)	42 (2.8)	528 (4.4)
Cyprus	100 (0.0)	437 (3.5)	0 (0.0)	~ ~	100 (0.0)	461 (6.2)	0 (0.0)	~ ~
Czech Republic	32 (8.9)	509 (16.5)	68 (8.9)	442 (12.0)	37 (5.5)	543 (14.8)	63 (5.5)	495 (10.6)
Denmark	r 39 (2.8)	539 (5.9)	61 (2.8)	472 (4.4)	r 47 (3.5)	578 (6.5)	53 (3.5)	508 (6.5)
France	56 (2.8)	493 (4.9)	44 (2.8)	438 (5.1)	75 (2.9)	518 (7.4)	25 (2.9)	481 (10.3)
Germany	x x	x x	x x	x x	x x	x x	x x	x x
Hungary	76 (2.4)	464 (5.3)	24 (2.4)	434 (5.2)	80 (2.7)	492 (5.1)	20 (2.7)	460 (7.2)
Iceland	66 (1.8)	544 (2.5)	34 (1.8)	508 (3.4)	61 (1.5)	595 (3.4)	39 (1.5)	545 (4.5)
Italy	79 (3.7)	468 (6.2)	21 (3.7)	431 (8.3)	83 (2.7)	502 (7.7)	17 (2.7)	473 (9.3)
Lithuania	88 (2.2)	454 (6.2)	12 (2.2)	426 (27.6)	87 (4.8)	487 (7.1)	13 (4.8)	449 (9.6)
Netherlands	50 (4.9)	579 (10.1)	50 (4.9)	485 (5.6)	63 (3.9)	607 (7.7)	37 (3.9)	539 (7.6)
New Zealand	66 (2.3)	538 (5.4)	34 (2.3)	474 (9.0)	70 (2.1)	573 (8.2)	30 (2.1)	482 (10.4)
Norway	34 (3.3)	553 (8.1)	66 (3.3)	496 (4.0)	40 (3.5)	626 (10.8)	60 (3.5)	545 (5.5)
Russian Federation	100 (0.0)	464 (6.7)	0 (0.0)	~ ~	100 (0.1)	511 (5.9)	0 (0.1)	~ ~
Slovenia	85 (3.4)	503 (6.6)	15 (3.4)	460 (8.3)	83 (3.7)	558 (10.7)	17 (3.7)	498 (21.1)
South Africa	92 (1.6)	337 (14.3)	8 (1.6)	354 (15.0)	92 (1.3)	375 (12.6)	8 (1.3)	352 (17.1)
Sweden	35 (2.2)	569 (6.4)	65 (2.2)	518 (3.2)	51 (2.5)	629 (7.8)	49 (2.5)	545 (5.0)
Switzerland	57 (3.4)	537 (10.0)	43 (3.4)	457 (6.8)	44 (3.7)	588 (8.4)	56 (3.7)	509 (7.5)
United States	52 (1.9)	495 (4.7)	48 (1.9)	445 (4.9)	53 (2.3)	520 (5.9)	47 (2.3)	468 (4.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Students were asked which of the following science courses they were currently taking: Biology, Chemistry, Physics, Earth Science, and Other Science. Percent "Yes" based on students reporting taking one or more science courses.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates a 70-84% student response rate.

An "x" indicates data available for <50% students.

A tilde (~) indicates insufficient data to report achievement.

The relationship between choice of program in secondary school and later educational goals may be seen in Table 4.6. Because of the difficulty in establishing consistent definitions of university and vocational/technical programs across countries, Figure 4.2 provides additional information on national adaptations of the educational categories for some countries. In particular, the university category was defined by some countries to include both university and other technically or professionally oriented degree programs at equivalent institutions of higher education, while in other countries it included university only.

More students in countries with well-developed vocational or technical programs in secondary school plan to continue in such programs at a tertiary level, while in countries with more general educational systems greater percentages plan to attend university or an equivalent institution of higher education. Nearly one-fourth or more of final-year students in Austria, the Czech Republic, France, the Netherlands, Norway, the Russian Federation, and Switzerland plan to pursue further education through vocational or technical programs. Countries where the majority of students reported planning to attend university included Australia, Canada, Cyprus, Denmark, France, Iceland, Lithuania, New Zealand, Norway, the Russian Federation, Slovenia, South Africa, Sweden, and the United States. As noted in Figure 4.2, the university category included technical training for some countries. For example, the practically-oriented program (technikon) was included in the university category for South Africa. Although very high percentages of final-year students in most countries reported plans for some form of tertiary education, one-fourth or more of these students in Austria, the Czech Republic, Italy, and Switzerland indicated that they did not intend to continue their education beyond secondary school. In these countries, many vocational programs are offered that provide students with the training needed to enter the workplace directly after completing their upper secondary schooling.

Not surprisingly, in almost all countries, the students planning to attend university had higher average mathematics and science literacy scores than the students with other plans after completing upper secondary schooling.

Table 4.6

Students' Reports on Their Plans for Future Education†
Mathematics and Science Literacy
Final Year of Secondary School*

Country	University [1]		Vocationally Oriented Programs [2]		Other Post Secondary Education [3]		Does Not Intend to Continue Education	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	68 (2.2)	555 (7.3)	15 (2.3)	472 (12.6)	9 (0.9)	476 (9.4)	9 (0.9)	469 (11.3)
Austria	38 (2.2)	562 (6.2)	23 (1.8)	486 (5.2)	12 (1.2)	510 (7.0)	27 (1.5)	498 (7.8)
Canada	63 (1.8)	545 (3.4)	15 (1.0)	504 (5.4)	18 (1.2)	495 (6.8)	4 (0.5)	475 (11.1)
Cyprus	62 (2.0)	473 (3.8)	10 (1.7)	434 (8.6)	11 (1.5)	403 (10.4)	17 (1.5)	398 (6.4)
Czech Republic	31 (5.2)	563 (7.1)	26 (4.3)	443 (8.0)	3 (0.8)	417 (34.7)	40 (2.5)	436 (5.3)
Denmark	r 51 (1.8)	553 (3.5)	21 (2.3)	508 (6.7)	13 (1.4)	496 (6.0)	16 (1.3)	508 (7.4)
France	51 (2.4)	524 (5.5)	28 (2.7)	500 (6.7)	11 (1.1)	498 (7.8)	10 (1.7)	440 (7.5)
Germany	x x	x x	x x	x x	x x	x x	x x	x x
Hungary	36 (1.4)	525 (4.2)	21 (1.1)	446 (3.2)	27 (1.1)	482 (4.5)	17 (1.1)	425 (4.3)
Iceland	65 (0.9)	559 (2.2)	16 (0.7)	528 (4.9)	12 (0.9)	500 (4.1)	7 (0.5)	514 (4.8)
Italy	44 (2.6)	502 (6.8)	8 (1.1)	474 (11.4)	16 (1.8)	460 (9.6)	32 (2.0)	452 (6.1)
Lithuania	51 (2.4)	490 (5.9)	16 (1.0)	444 (7.3)	20 (1.1)	441 (7.3)	13 (1.9)	438 (16.6)
Netherlands	17 (2.8)	645 (10.7)	47 (3.2)	564 (4.0)	14 (1.4)	520 (7.9)	22 (1.7)	508 (6.9)
New Zealand	74 (1.7)	542 (5.2)	13 (1.4)	508 (9.2)	3 (0.5)	486 (12.0)	9 (1.5)	444 (11.6)
Norway	55 (1.7)	557 (4.3)	23 (1.2)	532 (5.4)	11 (0.8)	507 (7.2)	11 (0.9)	486 (8.2)
Russian Federation	60 (2.0)	498 (5.7)	32 (1.9)	448 (6.4)	6 (0.6)	471 (12.2)	1 (0.3)	~ ~
Slovenia	75 (3.5)	538 (7.0)	11 (1.2)	466 (11.1)	2 (0.4)	~ ~	12 (2.6)	438 (17.0)
South Africa	75 (1.8)	357 (10.7)	11 (1.1)	325 (11.6)	8 (0.6)	339 (9.1)	6 (0.9)	390 (14.9)
Sweden	64 (1.8)	590 (4.5)	9 (0.9)	500 (7.2)	12 (0.8)	506 (5.3)	15 (1.1)	494 (5.3)
Switzerland	35 (1.7)	585 (3.7)	24 (2.1)	503 (10.6)	10 (0.7)	513 (8.3)	30 (1.7)	501 (5.1)
United States	69 (1.4)	494 (3.6)	16 (0.9)	425 (4.4)	11 (0.7)	440 (4.1)	4 (0.4)	405 (5.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Educational options were defined by each country to conform to their national system and may not be comparable across countries. See Figure 4.2 for definitions and any national adaptations of the international options in each category.

* See Appendix A for characteristics of the students sampled.

[1] In most countries, defined as at least a 3-year degree program at a university or an equivalent institute of higher education.

[2] Defined in most countries as vocational or technical courses at a tertiary institution not equivalent to a university degree program (e.g., trade or business school, junior or community college, and other shorter vocational programs), but may also include higher-level upper secondary vocational programs in some countries.

[3] Includes other postsecondary education defined in each country. Includes categories such as academic courses at junior or community college, short university or polytechnic courses, and college-preparatory courses.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates a 70-84% student response rate.

An "x" indicates data available for <50% students.

A tilde (~) indicates insufficient data to report achievement.

Figure 4.2

National Adaptations of the Definitions of Educational Levels for Students' Reports on Their Plans for Future Education†

Final Year of Secondary School*

University	
International Version:	*Attend a Four-Year College or University*
Australia:	*University education*
Austria:	*University, higher technical institution, or teacher education at a pedagogical academy or university*
Czech Republic:	*Bachelor or equivalent or higher degree in humanities, business/technical subject or other studies*
Denmark:	*University or other higher educational institution or medium-duration specialized educational (e.g. teacher college, nursing)*
France:	*University study (2-3 years study or 4 years study or more)*
Germany:	*University, technical university, teacher college (PH), or specialized higher vocational education (Fachhochschule)*
Greece:	*University education*
Hungary:	*3-5 year course at university, technical college, economical college, or teacher training college*
Iceland:	*University study (3 years of study or longer)*
Italy:	*University degree program*
Lithuania:	*Attend university*
New Zealand:	*University, teacher college, or academic courses at polytechnic*
Norway:	*University study (up to 3-year course or 4 or more years)*
Russian Federation:	*University or other higher educational institute*
Slovenia:	*University study (4 years or more)*
South Africa:	*University or technikon (3-4 year practically-oriented program)*
Sweden:	*University study (up to 3 years or for 3 years or longer)*
Switzerland:	*University, technical university (ETH), teacher college, or specialized higher vocational education (Fachhochschule)*

Vocationally Oriented Programs	
International Version:	*Vocational or technical courses at a trade or business school or Vocational or technical subjects at a junior or community college*
Australia:	*Apprenticeship or vocational/technical courses at trade/business school*
Austria:	*Apprenticeship (Lehre/Berufsschule) or other occupational training (e.g. health or medical technician, physical therapist)*
Cyprus:	*Vocational/technical training at trade/business school or at higher technical institute*
Czech Republic:	*Extension course*
Denmark:	*Short commercial/technical education*
France:	*Technical institute (BTS, DUT)*
Germany:	*Part-time (Lehre/Berufsschule) or full-time vocational training*
Greece:	*Vocational or teaching courses at a commercial/professional school or at a college (e.g. private or state institute of vocational training)*
Hungary:	*Short vocational training courses*
Iceland:	*Less than 3 years Post secondary vocational study at university, technical school, or technical university, or vocational study in an upper secondary vocational or business school*
Italy:	*Post secondary professional training*
Lithuania:	*Vocational/argicultural high school or vocational/technical courses at trade/business school*
Netherlands:	*Higher Post secondary vocational program (HBO), long senior secondary vocational program (MBO), or short senior secondary vocational program (KMBO).*
New Zealand:	*Vocational/technical study at polytechnic (1-3 year program) or at trade/business school*
Norway:	*Short vocational training or vocational/technical study at vocational school (1-3 year program)*
Russian Federation:	*Vocational/technical courses or short vocational program at college (2 years).*
Slovenia:	*Vocational program at trade/business school or vocational/technical program at a vocational school*
South Africa:	*Vocational/technical courses at trade/business school or technical college*
Sweden:	*Vocationally-oriented courses (up to 1 year)*
Switzerland:	*Postsecondary vocational training or further Upper secondary vocational training (Lehre/Berufsschule)*

Other			
International Version:	*Academic courses at a junior or community college or Other postsecondary education*		
Australia:	*Academic courses at a TAFE (technical and further education) college or other*	Italy:	*Short university course or other*
Austria:	*Other*	Lithuania:	*Attend college or other*
Cyprus:	*Academic courses at college or other*	Netherlands:	*Other*
Czech Republic:	*Other*	New Zealand:	*Other*
Denmark:	*Education for public service or other*	Norway:	*Other*
France:	*Other*	Russian Federation:	*Special courses to prepare for university exam or other*
Germany:	*Other*	Slovenia:	*Other*
Greece:	*Academic courses at a college or other*	Sweden:	*Continuing adult education (komvux, folkhögskola) or other*
Hungary:	*Other*	South Africa:	*Academic courses at private or community college or other*
Iceland:	*Matriculation exam or other*	Switzerland:	*Other*

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Educational options were adapted in each country to conform to their national systems. Countries that used modified response options are indicated to aid in the interpretation of the reporting categories in Tables 4.6, 7.11, and 10.10. Countries not included in figure used translated options considered to be comparable to the internationally-defined options.

* See Appendix A for characteristics of the students sampled.

What Are Students' Attitudes and Perceptions About Mathematics and Science?

Students generally reported positive perceptions about their performance in mathematics and science. Table 4.7 indicates that in all countries, the majority of students agreed that they usually did well in each subject. The highest perceptions of success in mathematics were reported in Australia, Denmark, Italy, and the United States, where 70% or more of the students agreed that they usually did well. Perceptions of doing well in science were generally higher; in 12 countries – Australia, Austria, Canada, the Czech Republic, Denmark, Iceland, Italy, Lithuania, Norway, the Russian Federation, South Africa, and the United States – more than 70% of students agreed that they usually did well.

Students' relative performance in mathematics literacy and science literacy within countries supported their perceptions, with the mean performance of those who agreed that they usually did well exceeding the mean performance of those who did not in almost every country. Students' perceptions of their achievement were less consistent with performance across countries.

Table 4.7

Students' Reports on Their Self-Perceptions About Usually Doing Well in Mathematics and Science – Mathematics Literacy and Science Literacy

Final Year of Secondary School*

Country	Doing Well in Mathematics				Doing Well in Science			
	Agree or Strongly Agree		Disagree or Strongly Disagree		Agree or Strongly Agree		Disagree or Strongly Disagree	
	Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Science Literacy Achievement	Percent of Students	Mean Science Literacy Achievement
Australia	72 (1.8)	544 (7.8)	28 (1.8)	477 (10.6)	73 (2.5)	554 (7.4)	27 (2.5)	470 (8.7)
Austria	59 (1.9)	533 (5.6)	41 (1.9)	501 (6.5)	77 (1.5)	532 (5.4)	23 (1.5)	494 (8.1)
Canada	67 (2.3)	542 (3.1)	33 (2.3)	476 (4.9)	75 (1.5)	548 (3.0)	25 (1.5)	489 (3.4)
Cyprus	68 (2.2)	456 (2.4)	32 (2.2)	425 (6.1)	61 (2.5)	461 (4.0)	39 (2.5)	427 (6.0)
Czech Republic	55 (3.1)	487 (14.9)	45 (3.1)	441 (7.8)	71 (1.7)	500 (9.0)	29 (1.7)	463 (9.1)
Denmark	76 (1.0)	566 (3.4)	24 (1.0)	498 (6.2)	r 72 (1.1)	535 (4.2)	28 (1.1)	469 (5.0)
France	63 (2.3)	543 (5.6)	37 (2.3)	492 (4.5)	50 (1.9)	515 (5.6)	50 (1.9)	461 (5.7)
Germany	x x	x x	x x	x x	x x	x x	x x	x x
Hungary	55 (1.3)	504 (3.8)	45 (1.3)	458 (3.4)	60 (1.2)	488 (3.9)	40 (1.2)	451 (3.0)
Iceland	68 (1.1)	552 (2.3)	32 (1.1)	497 (2.8)	79 (1.2)	564 (1.8)	21 (1.2)	509 (3.4)
Italy	70 (1.9)	485 (5.4)	30 (1.9)	457 (8.4)	86 (1.4)	484 (5.1)	14 (1.4)	433 (9.3)
Lithuania	54 (1.2)	488 (5.8)	46 (1.2)	449 (6.8)	84 (0.9)	464 (5.8)	16 (0.9)	446 (7.0)
Netherlands	63 (1.7)	581 (5.0)	37 (1.7)	527 (5.1)	63 (2.3)	570 (6.3)	37 (2.3)	540 (6.0)
New Zealand	66 (1.8)	557 (4.9)	34 (1.8)	456 (4.5)	68 (1.7)	557 (5.6)	32 (1.7)	471 (6.2)
Norway	57 (1.7)	562 (4.4)	43 (1.7)	485 (4.3)	73 (1.4)	560 (4.2)	27 (1.4)	501 (4.5)
Russian Federation	58 (1.8)	494 (6.8)	42 (1.8)	441 (6.3)	78 (1.4)	489 (6.2)	22 (1.4)	457 (5.8)
Slovenia	62 (2.2)	534 (7.9)	38 (2.2)	482 (9.3)	67 (1.6)	530 (8.5)	33 (1.6)	499 (8.9)
South Africa	58 (2.7)	367 (10.0)	42 (2.7)	353 (8.8)	73 (2.1)	349 (9.9)	27 (2.1)	366 (15.8)
Sweden	62 (1.2)	583 (4.1)	38 (1.2)	507 (4.7)	66 (1.5)	586 (4.7)	34 (1.5)	515 (4.1)
Switzerland	69 (2.1)	560 (4.6)	31 (2.1)	506 (8.7)	66 (1.7)	546 (5.8)	34 (1.7)	489 (6.3)
United States	76 (1.2)	476 (3.7)	24 (1.2)	423 (3.5)	83 (0.9)	491 (3.5)	17 (0.9)	440 (4.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "x" indicates data available for <50% students.

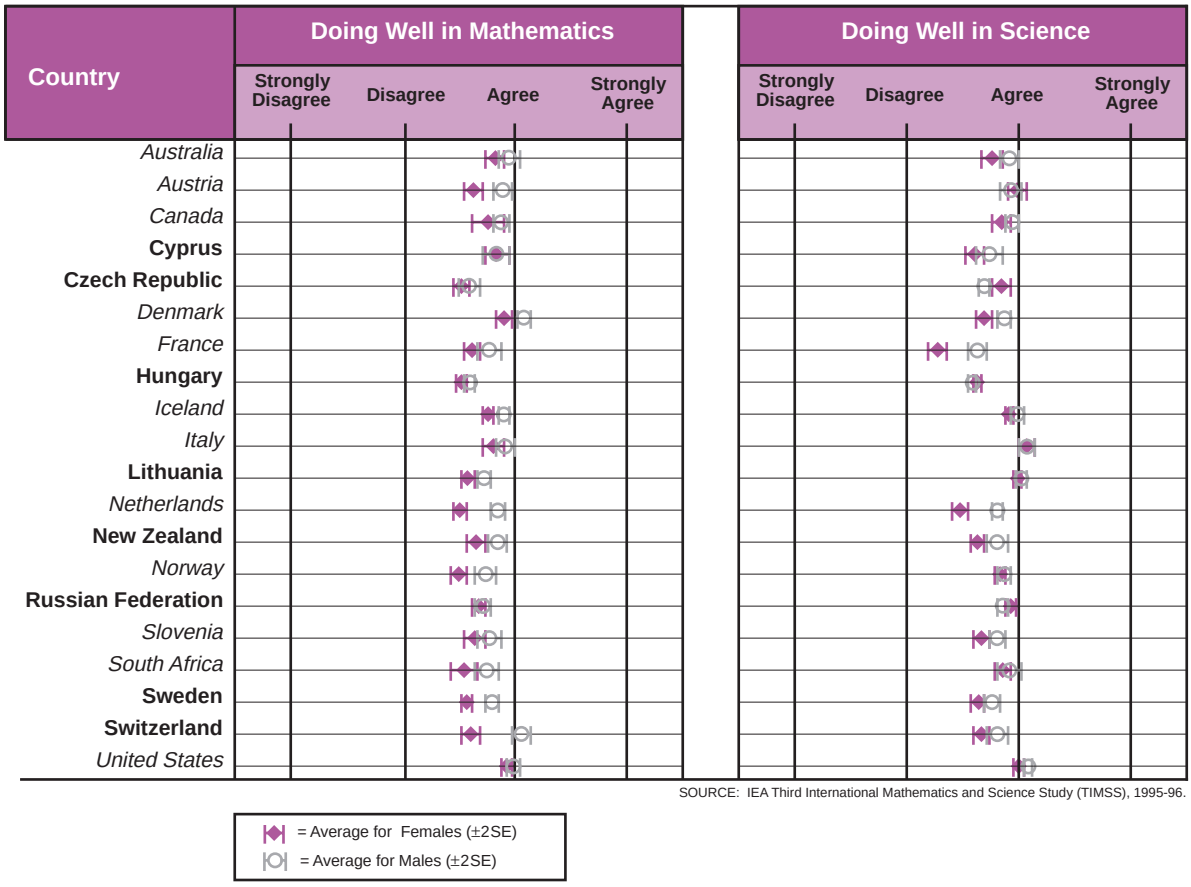
Figure 4.3 depicts gender differences in students' self-perceptions about their performance in mathematics and science. The perceptions of male and female students were quite similar in most countries, although when there were differences, it was generally a greater percentage of males than females who agreed that they were doing well. In Austria, Denmark, Iceland, Lithuania, the Netherlands, New Zealand, Norway, Sweden, and Switzerland, a greater percentage of males than females agreed that they were doing well in mathematics. In Denmark, France, the Netherlands, New Zealand, and Sweden there was a significant gender difference favoring males in self-perceptions about doing well in science. In the Czech Republic, however, females had significantly higher self-perceptions about doing well in science than did males.

To collect information on their attitudes towards mathematics and science, TIMSS asked final-year students how much they liked mathematics and the sciences. Students' liking of these subjects may be considered as both an input and an outcome variable, because it can be related to educational achievement in ways that reinforce higher or lower performance. That is, students who do well in mathematics and science generally have more positive attitudes towards these subjects and thus tend to perform better.

Figure 4.3

Gender Differences in Students' Self-Perceptions About Usually Doing Well in Mathematics and Science

Final Year of Secondary School*



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).
Data are not available for Germany.

Table 4.8 summarizes students' responses to the question about how much they like or dislike mathematics. In almost all countries, the majority of students reported that they liked mathematics to some degree. Only in Austria, the Czech Republic, Hungary, and Lithuania did more than half the students report that they disliked mathematics. In every country, a positive relationship was observed between liking mathematics and mathematics literacy. In every country, the average literacy scores of those who reported liking mathematics a lot were substantially higher than the scores of those who reported disliking it a lot.

The data in Figure 4.4 reveal that, on average, in most of the countries there was no significant difference between males and females in degree of liking for mathematics. However, more male students reported liking mathematics in France, Iceland, Sweden, and Switzerland. In no country did a greater percentage of females report liking mathematics.

Students' reports on how much they liked the sciences are summarized in Table 4.9. There were quite marked differences in the degree of liking for the different disciplines. Students in almost all countries expressed greater liking of biological science and earth science than of chemistry and physics. In almost all countries, 60% or more of the students reported liking biology to some degree. Sixty percent or more of the students reported liking earth science in more than half the countries. Only in South Africa did so many students report liking chemistry and physics.

There were striking differences across the science subjects between males' and females' liking of the sciences (Figure 4.5). Significant differences were rare between males and females in their liking for earth science and in their liking for chemistry. However, in many countries female students reported liking biological science more than did male students. The opposite was found in all countries for physics, where the male students reported liking physics significantly more than did female students. In fact, on average, the female students reported disliking physics to some degree in nearly all countries, while the male students were more neutral in their attitude.

Table 4.8

Students' Reports on How Much They Like Mathematics – Mathematics Literacy
Final Year of Secondary School*

Country	Dislike a Lot		Dislike		Like		Like a Lot	
	Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Mathematics Literacy Achievement
Australia	14 (1.3)	455 (10.4)	25 (1.6)	513 (6.5)	47 (2.2)	538 (10.6)	14 (1.3)	578 (9.5)
Austria	20 (1.4)	490 (7.7)	33 (1.3)	513 (7.1)	33 (1.4)	539 (5.2)	14 (1.3)	550 (7.9)
Canada	17 (1.5)	476 (7.3)	22 (1.2)	501 (5.4)	46 (1.5)	529 (4.4)	15 (1.0)	573 (6.3)
Cyprus	14 (1.7)	405 (7.9)	18 (1.8)	423 (6.2)	47 (2.1)	451 (4.5)	21 (1.4)	480 (6.3)
Czech Republic	19 (1.8)	435 (9.6)	48 (2.1)	447 (12.8)	28 (2.8)	501 (11.7)	5 (0.8)	575 (12.7)
Denmark	7 (0.9)	460 (8.7)	14 (0.9)	506 (6.0)	44 (1.3)	551 (3.4)	34 (1.2)	586 (5.4)
France	10 (1.2)	466 (7.9)	24 (1.7)	500 (5.8)	56 (1.8)	536 (5.0)	10 (1.1)	566 (9.8)
Germany	x x	x x	x x	x x	x x	x x	x x	x x
Hungary	26 (1.1)	444 (3.7)	35 (0.9)	478 (3.4)	33 (0.9)	505 (3.9)	6 (0.5)	568 (6.1)
Iceland	7 (0.7)	472 (8.1)	25 (0.7)	504 (4.2)	47 (1.3)	538 (3.7)	21 (1.3)	587 (3.9)
Italy	17 (1.4)	447 (10.3)	29 (1.6)	472 (7.3)	37 (1.5)	477 (5.5)	17 (1.5)	513 (9.4)
Lithuania	14 (0.9)	439 (9.0)	37 (1.1)	460 (7.1)	41 (1.3)	483 (5.7)	8 (0.5)	510 (7.6)
Netherlands	- -	- -	- -	- -	- -	- -	- -	- -
New Zealand	18 (1.6)	468 (9.6)	29 (1.7)	491 (7.3)	42 (1.5)	547 (5.6)	11 (0.8)	592 (9.7)
Norway	19 (1.1)	463 (4.9)	25 (1.0)	507 (4.8)	41 (1.2)	551 (4.7)	14 (1.0)	595 (7.4)
Russian Federation	6 (0.6)	442 (11.4)	32 (1.6)	449 (6.5)	52 (1.5)	480 (7.3)	10 (0.6)	511 (6.1)
Slovenia	14 (1.6)	453 (15.5)	26 (1.4)	495 (8.4)	48 (1.7)	526 (7.2)	12 (1.8)	576 (12.2)
South Africa	r 8 (1.1)	334 (9.1)	14 (1.4)	363 (11.8)	40 (1.9)	367 (11.4)	38 (2.1)	372 (10.1)
Sweden	13 (0.8)	468 (5.6)	29 (1.1)	521 (4.9)	42 (1.0)	574 (3.9)	16 (0.9)	625 (6.0)
Switzerland	17 (1.6)	486 (9.5)	23 (1.2)	520 (7.0)	42 (1.2)	556 (4.8)	17 (1.3)	587 (8.1)
United States	13 (0.9)	414 (3.7)	21 (0.8)	446 (4.2)	45 (1.1)	465 (3.8)	21 (0.8)	509 (6.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

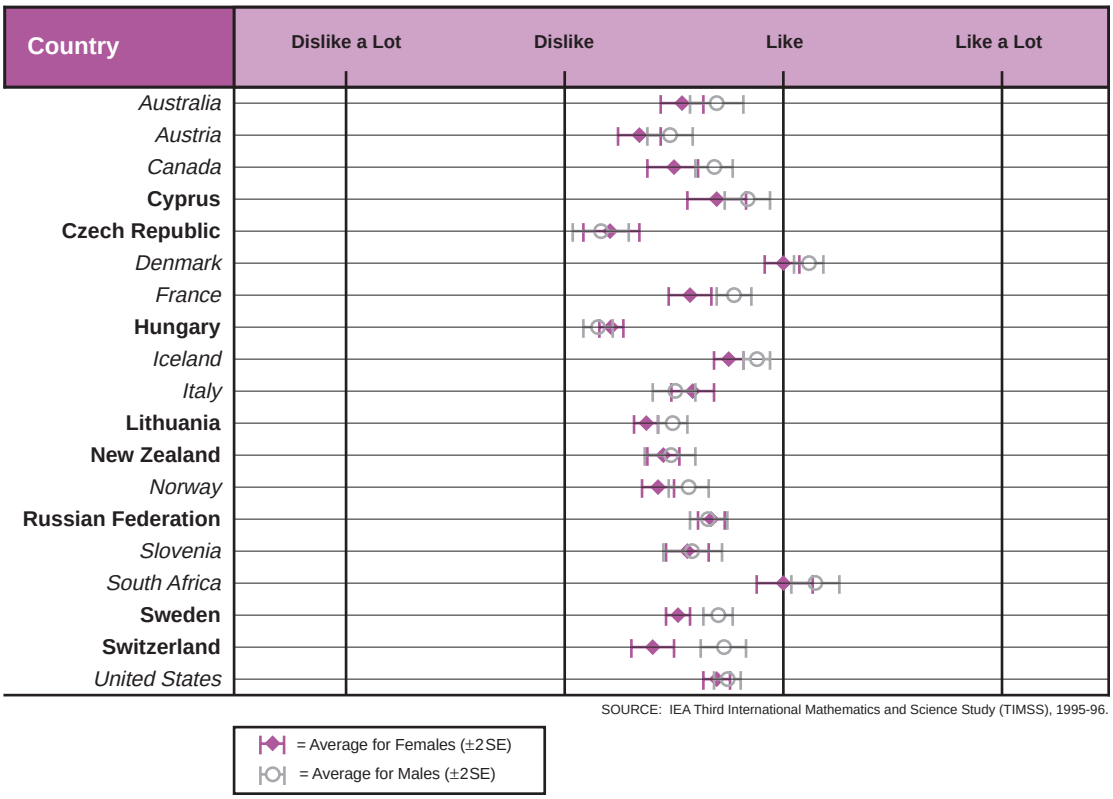
An "r" indicates a 70-84% student response rate.

An "x" indicates data available for <50% students.

A dash (-) indicates data are not available.

Figure 4.4

Gender Differences in Liking Mathematics
Final Year of Secondary School*



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).
Data are not available for Germany.

Table 4.9

Students' Reports on How Much They Like the Sciences
Final Year of Secondary School*

Country	Percent of Students Reporting That They "Like" or "Like a Lot"†			
	Biological Science	Chemistry	Earth Science	Physics
Australia	** 60 (2.6)	** 37 (2.8)	** 53 (2.2)	** 34 (3.3)
Austria	72 (2.4)	** 38 (2.4)	61 (2.3)	** 36 (2.1)
Canada	70 (1.7)	50 (1.4)	** 71 (2.1)	** 44 (2.3)
Cyprus	62 (2.6)	42 (2.1)	** 27 (2.5)	48 (1.9)
Czech Republic	60 (2.0)	29 (2.1)	66 (1.9)	26 (2.6)
Denmark	61 (1.9)	41 (1.5)	59 (1.7)	43 (1.6)
France	62 (2.9)	45 (1.6)	57 (2.5)	43 (2.3)
Germany	x x	x x	x x	x x
Hungary	63 (1.3)	24 (1.1)	61 (1.1)	28 (1.3)
Iceland	86 (1.2)	59 (1.3)	** 65 (1.6)	** 51 (1.3)
Italy	63 (2.1)	42 (2.2)	70 (1.7)	45 (2.0)
Lithuania	66 (1.6)	28 (1.3)	76 (1.2)	33 (1.5)
Netherlands	x x	x x	x x	x x
New Zealand	** 63 (1.9)	** 38 (1.7)	** 55 (2.4)	** 35 (1.7)
Norway	** 61 (1.6)	** 43 (1.5)	58 (1.5)	** 41 (1.7)
Russian Federation	72 (1.3)	45 (2.0)	72 (1.2)	54 (1.7)
Slovenia	54 (2.2)	29 (2.0)	69 (2.4)	35 (2.9)
South Africa	88 (1.3)	** 67 (3.0)	** 68 (2.4)	** 71 (2.7)
Sweden	69 (1.5)	46 (1.3)	72 (1.0)	47 (2.0)
Switzerland	65 (2.3)	46 (1.8)	71 (1.6)	44 (1.5)
United States	67 (0.9)	49 (1.6)	68 (1.1)	** 47 (1.8)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

† Percentages exclude students reporting that they have not studied the science subjects.

** More than 20% of students report that they have not studied the science subject.

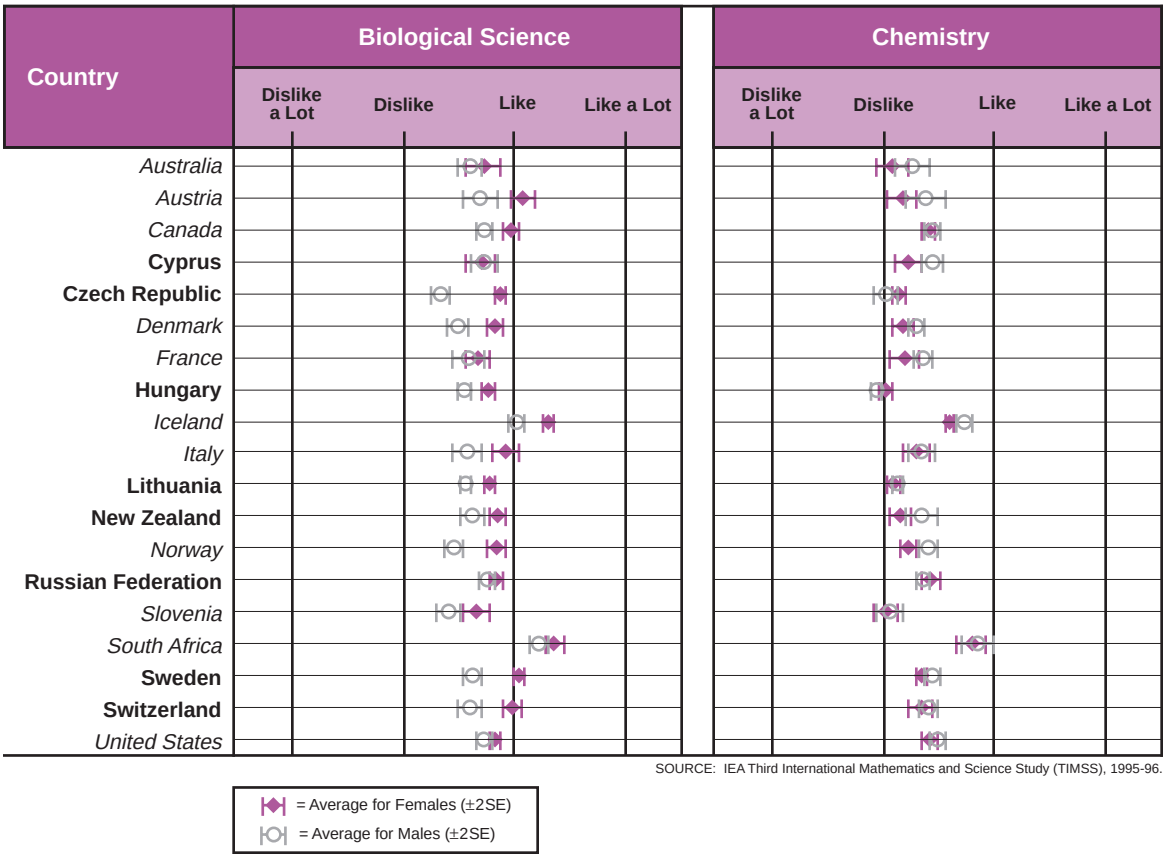
Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "x" indicates data available for <50% students.

Figure 4.5

Gender Differences in Liking the Sciences†
Final Year of Secondary School*



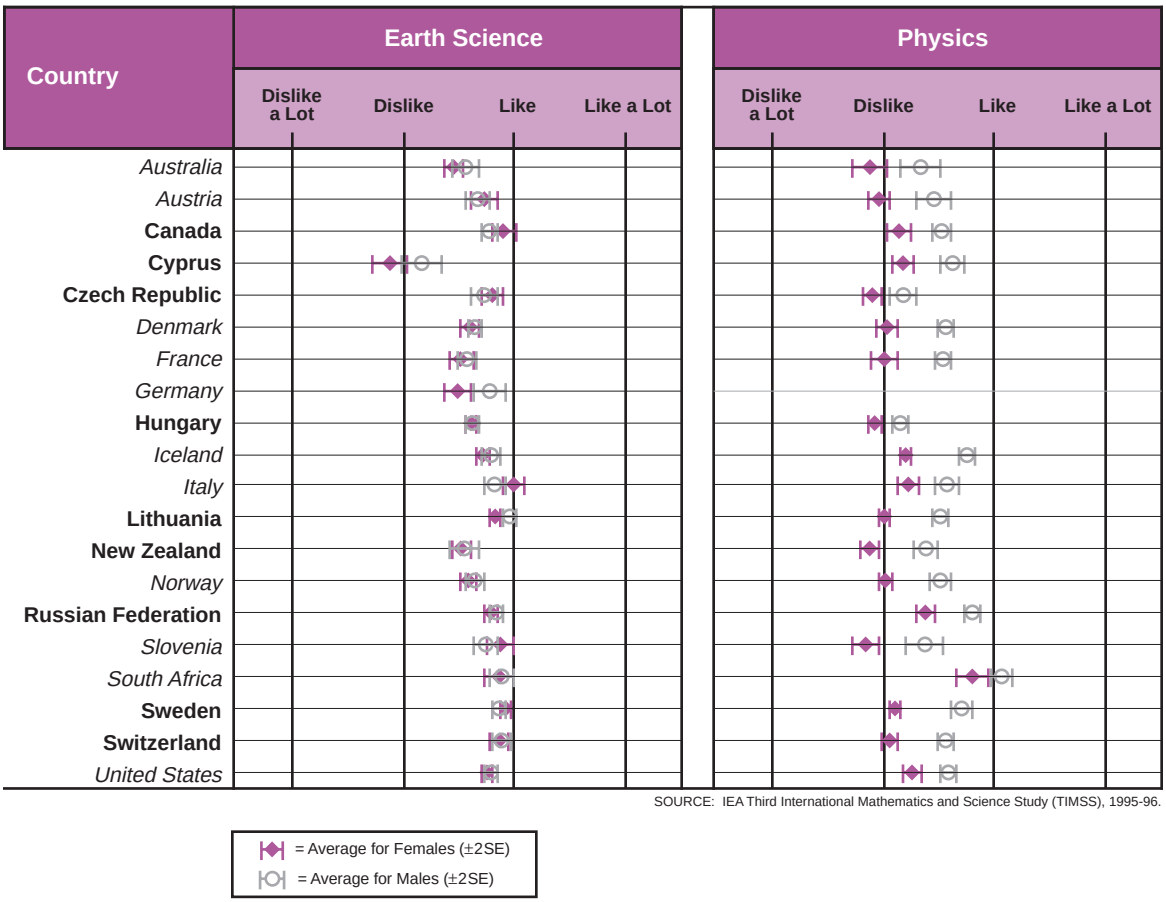
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Averages exclude students reporting that they have not studied the science subjects.

* See Appendix A for characteristics of the students sampled.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).
Data are not available for Germany and the Netherlands.

Figure 4.5 (Continued)

Gender Differences in Liking the Sciences†
Final Year of Secondary School*



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Averages exclude students reporting that they have not studied the science subjects.

* See Appendix A for characteristics of the students sampled.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).
Data are not available for Germany and the Netherlands.

What Educational Resources Do Students Have in Their Homes?

Parental education is a useful indicator of the support for academic endeavor that is often associated with student achievement. Information about their parents' educational levels was gathered by asking students to indicate the highest level of education completed by their fathers and mothers. Table 4.10 presents the relationship between final-year students' mathematics and science literacy and the highest level of education of either parent. Results are presented at three levels: finished university, finished upper secondary school but not university, and finished primary but not upper secondary school. These levels are based on internationally defined categories, which may not be strictly comparable across countries due to differences in national education systems. Although most countries translated and defined the educational categories used in their questionnaires so as to be comparable to the internationally defined levels, some countries used modified response options to conform to their national systems.

Despite the different educational approaches, structures, and organizations across the TIMSS countries, it is clear from Table 4.10 that parents' education is positively related to students' mathematics and science literacy. As was the case for eighth-graders,[1] in every country final-year students whose parents had more education had higher mathematics and science literacy. The percentages of final-year students falling into each of the internationally defined categories agree well with the percentages reported by eighth grade students, although relatively fewer final-year students than eighth-grade students reported that they did not know their parents' educational levels, particularly in Denmark, France, New Zealand, and Sweden. The percentage of students reporting parents' educational levels corresponding to each category varied considerably across countries. More than 30% of students in Canada, Iceland, Lithuania, the Russian Federation, and the United States indicated that at least one parent had finished university, while in contrast, more than 30% of students in Australia, Cyprus, the Czech Republic, France, Italy, and South Africa reported that the highest level attained by either parent was to finish primary but not upper secondary school.

[1] Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College; Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996). *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

Table 4.10

Students' Reports on the Highest Level of Education of Either Parent† Mathematics and Science Literacy

Final Year of Secondary School*

Country	Finished University[1]		Finished Upper Secondary but Not University[2]		Finished Primary but Not Upper Secondary[3]		Do Not Know	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	26 (2.1)	580 (7.9)	39 (2.0)	526 (6.8)	32 (2.3)	497 (9.7)	3 (0.7)	467 (18.5)
Austria	11 (0.9)	559 (8.5)	73 (1.5)	521 (5.2)	12 (0.9)	506 (13.4)	5 (1.0)	465 (12.3)
Canada	44 (1.9)	547 (3.4)	40 (1.4)	519 (4.4)	12 (0.9)	498 (7.0)	4 (0.4)	485 (11.4)
Cyprus	18 (1.5)	492 (8.6)	35 (2.0)	447 (5.2)	41 (2.2)	430 (3.1)	6 (1.2)	426 (9.3)
Czech Republic	18 (1.3)	544 (12.8)	42 (1.6)	494 (9.9)	38 (1.9)	440 (10.2)	3 (0.8)	441 (12.9)
Denmark	21 (1.1)	555 (4.7)	61 (1.4)	529 (4.0)	10 (0.6)	514 (5.6)	8 (0.9)	479 (8.1)
France	16 (2.3)	545 (9.2)	38 (1.4)	517 (4.6)	38 (1.7)	485 (6.7)	8 (0.8)	468 (9.3)
Germany	28 (2.0)	528 (6.3)	67 (2.0)	496 (5.2)	6 (1.2)	409 (15.9)	- -	- -
Hungary	26 (0.9)	521 (5.2)	67 (0.9)	465 (2.9)	7 (0.5)	434 (5.9)	- -	- -
Iceland	31 (1.1)	565 (2.7)	51 (1.5)	536 (2.6)	17 (1.1)	522 (4.1)	1 (0.2)	~ ~
Italy	12 (1.9)	512 (13.5)	43 (1.8)	489 (5.7)	45 (2.2)	456 (6.1)	1 (0.2)	~ ~
Lithuania	41 (2.0)	477 (5.8)	50 (1.7)	460 (6.7)	6 (0.7)	450 (11.7)	3 (0.4)	434 (13.9)
Netherlands	11 (1.5)	598 (12.8)	66 (1.5)	568 (5.0)	10 (0.8)	512 (8.2)	13 (1.1)	528 (7.3)
New Zealand	28 (1.3)	562 (5.0)	39 (1.6)	523 (5.4)	27 (1.6)	510 (6.4)	6 (1.1)	463 (13.6)
Norway	23 (1.5)	569 (5.9)	52 (1.3)	533 (4.8)	14 (0.9)	516 (6.3)	11 (0.8)	506 (7.2)
Russian Federation	41 (2.1)	505 (6.2)	53 (2.1)	460 (5.8)	3 (0.6)	411 (9.2)	2 (0.3)	~ ~
Slovenia	29 (2.7)	548 (9.1)	59 (2.0)	509 (8.2)	12 (1.4)	476 (9.2)	1 (0.2)	~ ~
South Africa	11 (1.9)	418 (26.0)	30 (2.6)	386 (14.8)	44 (3.2)	332 (4.9)	15 (1.2)	314 (3.8)
Sweden	28 (1.3)	590 (4.8)	42 (1.1)	560 (5.3)	17 (0.9)	534 (5.2)	13 (0.8)	520 (8.1)
Switzerland	14 (0.8)	576 (5.5)	69 (1.9)	537 (5.9)	14 (1.5)	479 (11.4)	4 (0.5)	479 (10.7)
United States	35 (1.9)	521 (4.2)	52 (1.4)	462 (3.5)	8 (1.0)	415 (5.7)	4 (0.7)	413 (11.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† The response categories were defined by each country to conform to their own educational system and may not be strictly comparable across countries. See Figure 4.6 for definitions and national adaptations of the international options in each educational category.

* See Appendix A for characteristics of the students sampled.

[1] In most countries, defined as completion of at least a 4-year degree program at a university or an equivalent institute of higher education.

[2] Finished upper secondary school with or without some tertiary education not equivalent to a university degree. In most countries, finished secondary corresponds to completion of an upper secondary track terminating after 11 to 13 years of schooling.

[3] Finished primary or some secondary school not equivalent to completion of upper secondary.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

Figure 4.6 shows the international definitions of the educational categories used for reporting parents' education level and the modifications made to them by some countries to conform to their national education systems. In several countries, the first category – finished primary school but not upper secondary school – included only a single level corresponding to finishing compulsory education (8 to 10 grades) and did not include finishing only primary school. In addition, in Germany, the completion of middle secondary education was considered part of this category, while in Austria, which has an education system similar to Germany's, middle-level vocational education was included with the second category, upper secondary education.

The second reporting category – finished upper secondary school but not university – was complicated because in many countries, particularly in Europe, several upper secondary tracks lead to university or other tertiary institutions as well as to vocational/apprenticeship programs. In most countries, finishing upper secondary school means completion of 11 to 13 years of education. In some systems, however, general secondary education may be completed after 9 or 10 years, followed by 2 to 4 years of full- or part-time vocational/apprenticeship training that may be either included as part of the secondary education system or considered as postsecondary. All of the upper secondary tracks and any upper secondary or postsecondary vocational education programs included as response options are combined in the second reporting category.

Several countries also differed in their interpretation of what is included in the last category – finished university. For example, degrees obtained from technical institutes and other non-university institutions of higher education are considered equivalent to a university degree in some countries but not in others. Completion of a degree at one of these institutions, therefore, may have been included in either the finished university or the finished upper secondary school but not university categories. In countries such as Canada, New Zealand, and the United States, the finished university category includes the completion of the equivalent of a bachelor's degree at a university, college, or polytechnic institute, while in Austria and France, this category corresponds to the equivalent of a master's degree received at a university.

Figure 4.6

National Adaptations of the Definitions of Educational Levels for Parents' Highest Level of Education†

Final Year of Secondary School*

Finished Primary School But Not Upper Secondary School

Internationally-Defined Levels: *Finished Primary School or Finished Some Secondary School*

Countries with Modified Nationally-Defined Levels:

Austria:	*Compulsory (Pfichtschulabschluß; 9 grades)*
Czech Republic:	*Primary or secondary or vocational training without maturita*
Denmark:	*Basic school (Folkeskolen, Realeksamen; 9 or 10 grades)*
France:	*No school, primary, or lower secondary (College, CAP)*
Germany:	*No lower secondary (8 grades); lower secondary (Hauptschulabschluß; 9 or 10 grades) or Medium secondary (Fachoberschulreife, Realschulabschluß or Polytechnische Oberschule; 10 grades)*
Hungary:	*Some or all of general school (8 grades)*
Norway:	*Compulsory (9 grades) or some upper secondary*
Sweden:	*Compulsory (9 grades) or started upper secondary*
Switzerland:	*Compulsory (9 grades)*

Finished Upper Secondary School[1] But Not University

Internationally-Defined Levels: *Finished Secondary School or Some Vocational/Technical Education After Secondary School or Some University*

Countries with Modified Nationally-Defined Levels:

Austria:	*Upper secondary tracks: apprenticeship (Berufsschul-/Lehrabschluß), medium vocational (Handelsschule, Fachschule), higher vocational (HAK, HTL, etc.), or higher academic (Gymnasium, Realgymnasium)*
Cyprus:	*Upper secondary tracks: academic or technical/vocational or Postsecondary: finished college.*
Denmark:	*Upper secondary tracks: academic or general/vocational (gymnasium, hf, htx, hhx) or vocational training (erhvervsfaglig uddannelse) Postsecondary: medium-cycle higher education (mellemlang uddannselse)*
France:	*Upper secondary tracks: BEP (11 grades) or baccalauréat (général, technologique or professionnel; 12 or 13 grades) Postsecondary: 2 or 3 years university study after baccalauréat (BTS, DUT, Licence)*
Germany:	*Upper secondary tracks: general/academic or apprenticeship/vocational training (Lehrabschluß, Berufsfachschule, Berufsaufbauschule) Postsecondary: vocational schools (Fachschulabschluss)*
Greece:	*Upper secondary: general or technical/vocational Lyceum Postsecondary: 4-years at technical institute or some university*
Hungary:	*Upper secondary tracks: apprenticeship (3-year trade school) or final exam in secondary (4-year academic/vocational)*
Italy:	*Upper secondary tracks: completion of secondary with maturita (classical/technical) or vocational training*
Norway:	*Upper secondary tracks: general or vocational programs Postsecondary: vocational training or 1-3 years study at university or technical college*
Sweden:	*Upper secondary tracks: academic or vocational (gymnasieutbildning or yrkesinriktad utbildning) Postsecondary: less than 3 years of university studies*
Switzerland:	*Upper secondary tracks: vocational (Lehre/Berufsschule), academic (gymnasium, kantonsschule, maturität) or teacher training (Lehrer seminar) Postsecondary: Higher vocational/professional school (Fach- and Berufsschule)*

Finished University

Internationally-Defined Levels: *Finished University*

Countries with Modified Nationally-Defined Levels:

Austria:	*University (master's degree)*
Canada:	*University or college*
Cyprus:	*University degree or post-graduate studies*
France:	*4 years university study after baccalauréat*
Germany:	*University, technical university, teacher college or specialized higher vocational degree (Fachhochschulabschluss)*
Hungary:	*University or college diploma*
New Zealand:	*University or teachers' college*
Norway:	*More than 3 years study at university or technical college*
Sweden:	*3 years university studies or more*
Switzerland:	*University or technical university (ETH)*
United States:	*Bachelor's degree at college or university*

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Educational levels were translated and defined in most countries to be comparable to the internationally-defined levels. Countries that used modified response options to conform to their national education systems are indicated to aid in the interpretation of the reporting categories presented in Tables 4.10, 7.10, and 10.9. Countries not included in figure used translated options considered to be comparable to the internationally-defined options.

* See Appendix A for characteristics of the students sampled.

[1] Upper secondary corresponds to ISCED level 3 tracks terminating after 11 to 13 years in most countries. (*Education at a Glance*, OECD, Paris,1996).

The number of books in the home can be an indicator of a home environment that values literacy and the acquisition of knowledge and offers general academic support. Table 4.11 presents final-year students' reports about the number of books in their homes in relation to their achievement on the TIMSS mathematics and science literacy test. In TIMSS reports on fourth and eighth grades,[2] it was noted that in most countries there was a consistent association between students' reports of books in the home and achievement: the more books in the home, the higher students' mathematics and science achievement. This link between books in the home and student achievement is apparent also in the final year of secondary school, with the difference in mean achievement between those reporting most and least books as much as a full standard deviation (100 scale-score points) in several countries.

Although the main purpose of this question was to gain some information about the importance of academic pursuits in students' homes rather than to determine the actual number of books there, students' responses revealed some interesting variations from country to country. Only in South Africa did a large percentage of students report relatively few books in the home, while in Australia, Denmark, Hungary, Iceland, Norway, and Sweden, 40% or more of the students reported more than 200. The number of books in the home reported by final-year students in most countries agreed well with the number reported by their compatriots in fourth and eighth grades.

[2] Mullis, I.V.S., Martin, M.O., Beaton, A.E., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1997). *Mathematics Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College; Martin, M.O., Mullis, I.V.S., Beaton, A.E., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1997). *Science Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College; Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College; Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996). *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College.

Table 4.11

Students' Reports on the Number of Books in the Home – Mathematics and Science Literacy
Final Year of Secondary School*

Country	None or Very Few (0-10 Books)		About One Shelf (11-25 Books)		About One Bookcase (26-100 Books)		About Two Bookcases (101-200 Books)		Three or More Bookcases (More than 200 Books)	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	2 (0.4)	~ ~	7 (1.3)	466 (15.3)	23 (1.6)	499 (9.6)	26 (1.5)	528 (8.1)	43 (2.6)	555 (7.8)
Austria	4 (0.7)	455 (10.5)	11 (1.0)	480 (9.5)	33 (1.5)	507 (6.9)	19 (1.1)	529 (6.7)	33 (2.1)	550 (6.8)
Canada	3 (0.4)	494 (20.7)	10 (0.8)	502 (8.0)	28 (1.2)	513 (6.0)	26 (1.2)	524 (5.1)	33 (1.6)	549 (3.4)
Cyprus	5 (1.1)	417 (14.8)	14 (1.1)	418 (8.3)	38 (2.4)	439 (5.2)	28 (2.2)	459 (5.9)	15 (1.6)	481 (9.1)
Czech Republic	1 (0.4)	~ ~	4 (0.9)	417 (10.4)	28 (1.6)	442 (7.6)	30 (1.2)	479 (14.0)	37 (1.5)	510 (13.3)
Denmark	3 (0.4)	459 (12.3)	5 (0.6)	487 (8.9)	24 (1.0)	509 (6.1)	26 (1.3)	524 (4.5)	41 (1.7)	553 (3.9)
France	3 (0.6)	419 (13.4)	11 (1.2)	465 (7.4)	37 (1.5)	497 (5.0)	24 (1.1)	521 (5.7)	26 (1.5)	529 (7.0)
Germany	6 (0.9)	428 (10.5)	13 (1.2)	440 (10.6)	26 (1.4)	482 (6.0)	20 (1.4)	515 (8.4)	35 (2.4)	532 (7.5)
Hungary	1 (0.2)	~ ~	4 (0.4)	405 (5.9)	18 (0.8)	437 (3.6)	22 (0.6)	469 (3.3)	54 (1.2)	501 (3.7)
Iceland	1 (0.3)	~ ~	5 (0.5)	504 (10.2)	21 (0.8)	520 (5.0)	24 (1.2)	541 (3.6)	49 (1.2)	557 (2.2)
Italy	4 (0.7)	417 (12.4)	19 (1.5)	444 (7.4)	37 (1.8)	476 (6.5)	22 (1.4)	489 (5.6)	18 (1.5)	505 (9.6)
Lithuania	1 (0.2)	~ ~	9 (0.8)	430 (13.0)	30 (1.2)	447 (6.7)	28 (0.9)	469 (6.0)	33 (1.7)	489 (6.2)
Netherlands	6 (0.8)	514 (10.6)	14 (1.1)	536 (10.0)	34 (1.3)	548 (5.5)	21 (1.5)	566 (7.4)	26 (1.9)	589 (11.6)
New Zealand	3 (0.8)	430 (21.6)	6 (0.9)	469 (17.6)	26 (1.6)	508 (5.7)	25 (1.4)	520 (7.7)	39 (1.9)	558 (4.6)
Norway	2 (0.4)	~ ~	7 (0.6)	489 (6.8)	22 (1.0)	509 (4.3)	20 (0.9)	535 (5.6)	49 (1.4)	557 (4.7)
Russian Federation	3 (0.4)	447 (13.1)	9 (1.0)	434 (11.3)	30 (2.0)	457 (6.9)	30 (1.8)	484 (4.6)	29 (1.3)	504 (6.8)
Slovenia	1 (0.4)	~ ~	6 (1.0)	468 (15.5)	35 (2.4)	502 (10.5)	25 (1.8)	522 (9.2)	32 (2.4)	538 (8.4)
South Africa	31 (2.2)	313 (3.0)	26 (1.6)	338 (5.1)	21 (1.8)	372 (12.0)	10 (1.2)	410 (21.2)	12 (1.7)	413 (22.7)
Sweden	2 (0.3)	~ ~	7 (0.6)	506 (8.7)	24 (1.1)	535 (5.0)	23 (1.0)	555 (5.0)	43 (1.2)	580 (5.0)
Switzerland	6 (0.9)	458 (9.3)	11 (1.1)	489 (10.5)	28 (1.7)	522 (6.7)	23 (1.4)	540 (6.4)	32 (1.1)	561 (6.4)
United States	6 (0.7)	402 (7.0)	12 (0.8)	429 (4.7)	29 (1.2)	456 (3.5)	20 (1.0)	484 (4.4)	33 (1.6)	510 (3.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

How Often Do Students Use Calculators and Computers?

Although the issue of how calculators should be deployed by students and teachers so as to maximize students' learning remains a matter of debate, it is clear from Table 4.12 that calculator use is now widespread among final-year students in many countries. In most countries, more than 80% of students reported at least weekly use of calculators, including all activities whether at home, at school, or anywhere else. Only in the Czech Republic, Norway, and the Russian Federation did 20% or more of the students report rarely or never using calculators. The frequent use of calculators was positively related to mathematics and science literacy in all countries, with students who reported using calculators daily performing, on average, well above those who rarely or never used them.

Since calculator use by students in upper secondary school is very common in many countries, final-year students were given the option of using a calculator when completing the TIMSS tests. Table 4.13 summarizes students' reports on how frequently they used a calculator during the testing session. Most students made moderate use (i.e., for up to 10 questions) of a calculator on the mathematics and science test, although in Italy, Lithuania, the Russian Federation, Slovenia, and South Africa, more than 30% reported not using a calculator at all. In general, the students who reported most calculator use were also those who performed best on the test. It is not clear, however, whether calculator use assisted performance on the test, or whether the more able students were also those who chose to use a calculator most.

While calculator use by final-year students was widespread, these students reported using computers much less frequently. As may be seen from Table 4.14, in seven countries, Cyprus, the Czech Republic, Hungary, Italy, Lithuania, Norway, and South Africa, the majority of students reported that they rarely or never use a computer. In contrast, more than one-fourth of the students in Australia, Canada, Denmark, Iceland, the Netherlands, New Zealand, Switzerland, and the United States reported using a computer daily. In about half of the countries, the students who reported using a computer most frequently were also those with the highest performance on mathematics and science literacy, but in the rest the relationship was less regular.

Table 4.12

Students' Reports on How Often They Use a Calculator at School, Home, or Anywhere Else – Mathematics and Science Literacy

Final Year of Secondary School*

Country	Rarely or Never		Monthly		Weekly		Daily	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	6 (0.9)	458 (14.3)	4 (0.6)	461 (13.0)	17 (1.2)	497 (10.1)	73 (1.9)	544 (8.4)
Austria	6 (2.3)	465 (30.7)	5 (0.9)	505 (13.7)	37 (2.3)	516 (5.2)	52 (3.2)	532 (6.7)
Canada	8 (0.8)	482 (6.9)	7 (1.0)	478 (12.3)	23 (1.4)	513 (5.4)	61 (2.2)	543 (2.9)
Cyprus	8 (1.5)	405 (11.2)	7 (1.0)	422 (13.1)	18 (1.7)	437 (6.2)	66 (1.8)	457 (3.6)
Czech Republic	21 (1.9)	428 (8.9)	13 (2.0)	459 (6.1)	43 (2.4)	476 (10.1)	23 (3.3)	533 (11.8)
Denmark	8 (1.1)	482 (3.4)	5 (0.6)	492 (4.7)	19 (1.5)	508 (5.8)	67 (2.2)	543 (4.5)
France	4 (0.8)	471 (14.2)	7 (1.3)	468 (11.3)	25 (1.6)	489 (5.2)	63 (2.4)	519 (5.7)
Germany	x x	x x	x x	x x	x x	x x	x x	x x
Hungary	14 (0.9)	423 (4.0)	2 (0.2)	~ ~	16 (0.8)	453 (4.0)	68 (1.4)	496 (3.4)
Iceland	10 (1.2)	506 (6.0)	6 (0.8)	516 (7.9)	24 (0.8)	530 (3.3)	59 (0.9)	557 (2.5)
Italy	12 (1.4)	436 (11.1)	7 (1.0)	460 (10.4)	36 (2.0)	474 (5.9)	45 (2.3)	491 (7.0)
Lithuania	12 (1.6)	437 (12.4)	6 (0.5)	452 (13.3)	31 (1.3)	455 (5.9)	50 (2.0)	480 (5.7)
Netherlands	10 (1.5)	461 (6.4)	4 (0.7)	467 (9.0)	16 (1.3)	537 (7.4)	69 (2.4)	585 (5.7)
New Zealand	11 (1.1)	465 (8.9)	7 (1.0)	472 (9.5)	20 (1.7)	492 (8.3)	62 (2.1)	554 (4.0)
Norway	31 (2.1)	502 (5.1)	9 (0.8)	519 (7.8)	17 (1.0)	526 (5.1)	44 (2.1)	567 (5.3)
Russian Federation	22 (1.2)	453 (6.0)	8 (0.8)	466 (8.4)	31 (1.6)	480 (6.3)	39 (2.1)	496 (6.2)
Slovenia	5 (1.4)	424 (14.0)	4 (0.9)	472 (21.6)	29 (1.7)	512 (9.3)	62 (2.9)	528 (7.9)
South Africa	14 (1.9)	317 (3.1)	8 (0.7)	314 (5.2)	14 (0.9)	338 (8.7)	63 (2.3)	375 (12.6)
Sweden	13 (1.0)	487 (6.1)	9 (0.7)	508 (5.1)	43 (1.5)	536 (3.7)	35 (1.7)	619 (4.5)
Switzerland	5 (1.6)	471 (11.5)	2 (0.6)	~ ~	42 (2.1)	508 (6.8)	51 (2.1)	559 (4.2)
United States	16 (1.1)	419 (4.5)	8 (0.7)	443 (6.0)	24 (1.1)	464 (4.0)	52 (1.9)	497 (3.8)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "x" indicates data available for <50% of students.

A tilde (~) indicates insufficient data to report achievement.

Table 4.13

Students' Reports on the Frequency of Calculator Use During the TIMSS Test Mathematics and Science Literacy

Final Year of Secondary School*

Country	Did Not Use a Calculator		Used a Calculator Very Little (<5 Questions)		Used a Calculator Somewhat (5-10 Questions)		Used a Calculator Quite a Lot (>10 Questions)	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	13 (2.3)	455 (14.3)	36 (1.7)	531 (9.4)	39 (2.1)	551 (6.4)	12 (1.2)	548 (7.4)
Austria	17 (3.3)	480 (12.4)	35 (1.7)	532 (6.9)	40 (2.3)	531 (5.4)	9 (1.1)	536 (13.1)
Canada	12 (1.1)	464 (7.4)	35 (1.4)	529 (3.9)	39 (1.1)	537 (3.0)	14 (1.1)	553 (7.0)
Cyprus	22 (1.5)	431 (6.7)	48 (2.1)	450 (5.1)	26 (1.9)	456 (6.1)	4 (0.8)	484 (14.4)
Czech Republic	13 (4.8)	448 (24.6)	39 (3.5)	461 (14.9)	41 (2.5)	494 (12.0)	7 (1.0)	512 (15.0)
Denmark	9 (1.3)	488 (6.7)	32 (1.2)	540 (3.8)	44 (1.6)	533 (4.5)	15 (1.0)	550 (5.4)
France	r 13 (1.8)	475 (8.3)	33 (2.0)	514 (5.7)	44 (2.0)	519 (5.0)	10 (1.2)	538 (8.5)
Germany	r 18 (2.9)	448 (14.0)	41 (2.6)	503 (7.0)	31 (2.7)	524 (5.7)	10 (1.4)	538 (14.4)
Hungary	s 20 (1.7)	453 (4.8)	28 (1.2)	485 (5.2)	42 (1.5)	516 (4.2)	10 (0.6)	540 (5.5)
Iceland	24 (1.3)	512 (3.9)	29 (1.1)	537 (3.1)	37 (1.3)	561 (2.7)	10 (0.8)	579 (5.2)
Italy	31 (2.2)	451 (8.7)	31 (1.9)	484 (8.4)	31 (2.0)	490 (6.5)	7 (0.9)	479 (9.9)
Lithuania	r 38 (2.2)	442 (10.7)	25 (1.5)	483 (6.1)	30 (1.5)	497 (6.3)	7 (0.7)	513 (9.4)
Netherlands	11 (1.8)	479 (9.4)	29 (1.7)	560 (5.4)	46 (1.8)	572 (5.9)	14 (1.0)	591 (10.9)
New Zealand	12 (1.7)	436 (8.3)	26 (1.3)	519 (8.5)	48 (1.7)	542 (5.3)	15 (1.5)	562 (5.7)
Norway	21 (2.1)	500 (7.2)	26 (1.3)	529 (5.8)	40 (1.5)	552 (4.2)	13 (0.9)	580 (6.7)
Russian Federation	r 41 (2.7)	467 (7.0)	28 (1.5)	483 (7.1)	24 (1.6)	496 (8.1)	7 (0.9)	509 (12.1)
Slovenia	r 32 (4.4)	495 (15.8)	36 (2.5)	536 (9.8)	27 (2.8)	547 (7.7)	4 (0.7)	528 (19.8)
South Africa	r 55 (4.3)	346 (10.6)	25 (2.5)	362 (10.5)	13 (1.8)	409 (25.7)	8 (1.2)	382 (30.5)
Sweden	8 (1.1)	486 (11.1)	30 (1.1)	554 (6.6)	48 (1.2)	565 (4.6)	15 (0.8)	575 (5.0)
Switzerland	6 (1.0)	491 (11.0)	32 (1.6)	536 (6.6)	47 (1.8)	535 (4.5)	16 (1.4)	546 (10.1)
United States	29 (1.9)	432 (4.7)	35 (1.2)	479 (4.2)	31 (1.3)	498 (4.1)	5 (0.6)	516 (10.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates a 70-84% student response rate. An "s" indicates a 50-69% student report rate.

Table 4.14

Students' Reports on How Often They Use a Computer at School, Home, or Anywhere Else† – Mathematics and Science Literacy

Final Year of Secondary School*

Country	Rarely or Never		Monthly		Weekly		Daily	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	25 (3.5)	498 (9.7)	13 (1.0)	529 (10.2)	28 (1.4)	534 (9.5)	34 (2.9)	544 (9.4)
Austria	34 (3.4)	496 (8.9)	7 (0.7)	525 (8.3)	39 (2.7)	529 (5.7)	20 (2.6)	546 (12.2)
Canada	21 (1.7)	500 (8.2)	16 (0.9)	513 (6.5)	34 (1.3)	535 (3.9)	28 (1.4)	544 (5.1)
Cyprus	65 (2.0)	436 (3.3)	9 (1.3)	461 (9.8)	17 (2.2)	476 (10.6)	9 (1.5)	454 (10.3)
Czech Republic	62 (3.9)	450 (8.5)	9 (1.1)	483 (31.3)	20 (3.5)	524 (9.2)	9 (1.1)	552 (11.4)
Denmark	18 (1.2)	501 (5.3)	14 (1.3)	528 (7.2)	41 (1.6)	529 (4.1)	27 (1.5)	549 (4.5)
France	48 (2.2)	502 (6.0)	17 (1.7)	523 (8.4)	25 (1.4)	503 (5.3)	10 (1.3)	507 (9.5)
Germany	x x	x x	x x	x x	x x	x x	x x	x x
Hungary	r 65 (1.9)	471 (3.1)	4 (0.3)	478 (7.7)	19 (1.3)	500 (5.4)	12 (1.1)	525 (9.3)
Iceland	19 (0.9)	505 (3.7)	15 (0.7)	533 (6.5)	40 (1.0)	551 (3.4)	26 (1.0)	563 (3.4)
Italy	56 (2.2)	465 (5.4)	10 (0.8)	486 (7.9)	23 (1.8)	486 (11.1)	12 (1.3)	509 (12.5)
Lithuania	69 (2.1)	460 (6.7)	8 (0.7)	471 (8.8)	19 (1.9)	481 (8.0)	4 (0.4)	482 (9.7)
Netherlands	26 (1.4)	543 (7.7)	13 (1.0)	563 (10.3)	34 (1.3)	562 (5.5)	26 (1.6)	570 (7.1)
New Zealand	27 (1.8)	511 (8.3)	17 (1.6)	536 (8.2)	27 (1.5)	537 (5.4)	29 (1.7)	522 (7.2)
Norway	54 (1.9)	522 (3.8)	13 (1.1)	527 (7.4)	19 (1.1)	556 (6.4)	14 (1.1)	571 (8.3)
Russian Federation	47 (2.0)	468 (7.9)	9 (0.9)	487 (9.9)	32 (1.4)	483 (5.0)	12 (1.0)	504 (8.0)
Slovenia	38 (2.2)	492 (7.5)	15 (1.1)	511 (9.1)	26 (1.7)	531 (10.2)	21 (1.7)	546 (9.3)
South Africa	81 (2.5)	345 (6.2)	6 (1.1)	415 (27.0)	7 (1.3)	436 (22.5)	6 (0.9)	420 (20.3)
Sweden	32 (1.4)	518 (4.6)	18 (1.1)	549 (4.4)	31 (1.2)	566 (4.4)	19 (2.2)	614 (6.8)
Switzerland	38 (2.2)	501 (7.7)	9 (0.6)	556 (8.4)	24 (1.6)	549 (6.2)	28 (1.9)	550 (6.0)
United States	27 (1.1)	435 (3.9)	16 (1.1)	474 (5.9)	27 (1.2)	485 (4.2)	31 (1.1)	494 (4.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Includes both desktop units and mainframe terminals.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates a 70-84% student response rate.

An "x" indicates data available for <50% students.

How Do Students Spend Their Out-of-School Time During the School Week?

Even though education may be thought to be the dominant activity of students in their final year of secondary school, young people actually spend much more of their time outside of school. Some of this out-of-school time is spent at furthering academic development – for example, in studying or doing homework in school subjects. Table 4.15 presents final-year students' reports about the amount of time they spend in this way on a normal school day. On average, students in most countries reported spending between two to four hours per day on homework. Less than two hours of homework per day was reported by students in the Czech Republic, the Netherlands, Norway, Sweden, and the United States, whereas four hours or more per day, on average, was reported by students in Italy and South Africa. One-fourth or more of the final-year students in Austria, the Czech Republic, the Netherlands, Norway, Sweden, Switzerland, and the United States reported studying for less than one hour per day.

The relationship between time spent doing homework in all subjects and students' average mathematics and science literacy was not consistent across countries. In a few countries, including Australia, Cyprus, Hungary, the Russian Federation, and the United States, the relationship was approximately linear, with students reporting the most time on homework also having the highest scores in mathematics and science literacy. More often, the relationship was curvilinear, the highest achievement being associated with a moderate amount of homework per day (between one and three hours). This pattern suggests that, compared with their higher-achieving counterparts, the lower-performing students may do less homework, whether because they simply do not do it or because their teachers do not assign it, or more homework, perhaps because they need to spend the extra time to keep up academically. Other, more complicated relationships may also be seen in Table 4.15. However, in almost all of the countries, students who reported spending two or more hours studying each day had higher scores in mathematics and science literacy than those spending less than one hour per day.

The amount of time students reported spending on studying or doing homework in mathematics is shown in Table 4.16. Among students taking mathematics in their last year of upper secondary schooling, an average of one-half to one hour of homework was reported in nearly all countries. In only two countries, the Czech Republic and Sweden, did students report an average of less than one-half hour per day, while only in South Africa did they report an average of substantially more than one hour per day. In all countries except South Africa, the majority of students reported spending less than one hour per day on mathematics homework. Fewer than 10% of the students reported spending three hours or more in every country except the Russian Federation and South Africa. In most countries, students spending at least one to two hours per day on mathematics homework had somewhat higher achievement than those spending less, with the largest differences in Australia and Cyprus.

Table 4.15

Students' Reports on the Hours Per Day Spent Studying or Doing Homework† Mathematics and Science Literacy

Final Year of Secondary School*

Country	Less Than One Hour		At Least 1 Hour But Less Than 2 Hours		2-3 Hours		More Than 3 Hours		Average Hours[1]
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	
Australia	13 (1.6)	489 (15.8)	20 (1.5)	527 (12.6)	22 (1.5)	525 (6.5)	44 (2.7)	545 (9.5)	3.3 (0.13)
Austria	31 (2.0)	508 (7.7)	28 (1.4)	533 (6.8)	20 (1.8)	524 (7.9)	20 (1.4)	529 (8.7)	2.0 (0.07)
Canada	18 (1.2)	505 (3.3)	31 (1.7)	527 (5.9)	21 (1.4)	540 (4.7)	30 (2.0)	537 (5.8)	2.7 (0.11)
Cyprus	12 (1.6)	414 (6.4)	20 (1.6)	441 (6.8)	28 (2.1)	444 (5.4)	40 (2.1)	465 (4.0)	3.2 (0.11)
Czech Republic	39 (2.5)	468 (7.7)	31 (1.3)	482 (13.2)	20 (3.0)	498 (9.8)	10 (1.3)	481 (34.2)	1.4 (0.07)
Denmark	r 13 (1.1)	496 (7.1)	31 (1.6)	546 (4.9)	35 (1.6)	543 (4.1)	21 (1.4)	543 (5.1)	r 2.4 (0.06)
France	s 7 (1.1)	498 (11.1)	23 (1.7)	536 (7.9)	19 (1.5)	521 (8.4)	52 (1.9)	523 (6.1)	s 3.4 (0.11)
Germany	- -	- -	- -	- -	- -	- -	- -	- -	- -
Hungary	13 (0.9)	454 (4.4)	26 (0.9)	469 (4.1)	26 (0.9)	482 (4.6)	36 (1.2)	492 (4.2)	2.9 (0.07)
Iceland	21 (1.0)	547 (4.3)	37 (1.2)	552 (3.0)	23 (1.1)	546 (4.3)	19 (1.2)	532 (4.7)	2.1 (0.05)
Italy	8 (1.1)	461 (13.9)	15 (1.6)	472 (7.5)	21 (1.6)	483 (7.2)	56 (2.4)	481 (6.2)	4.0 (0.14)
Lithuania	16 (1.7)	451 (13.7)	21 (1.1)	469 (6.3)	21 (0.9)	473 (6.4)	41 (2.0)	471 (5.5)	3.2 (0.11)
Netherlands	25 (2.2)	527 (8.0)	46 (1.4)	569 (5.2)	16 (1.6)	574 (9.9)	13 (1.3)	572 (12.6)	1.7 (0.06)
New Zealand	20 (2.0)	489 (10.1)	34 (1.9)	539 (7.1)	25 (1.4)	538 (5.2)	22 (1.1)	536 (5.8)	2.2 (0.06)
Norway	27 (1.2)	522 (5.7)	37 (1.0)	547 (5.0)	17 (1.3)	556 (5.8)	19 (1.1)	535 (6.7)	1.9 (0.05)
Russian Federation	10 (0.8)	463 (7.6)	24 (1.4)	467 (6.8)	21 (1.2)	479 (7.0)	45 (1.9)	486 (6.0)	3.5 (0.10)
Slovenia	19 (2.3)	493 (11.7)	36 (3.0)	541 (9.8)	23 (2.1)	508 (7.8)	22 (2.2)	527 (8.7)	2.2 (0.12)
South Africa	r 8 (0.8)	353 (11.9)	13 (1.5)	389 (18.3)	20 (1.5)	370 (15.9)	59 (2.2)	360 (9.2)	r 4.8 (0.17)
Sweden	28 (1.6)	533 (5.5)	34 (1.2)	575 (5.7)	20 (1.2)	565 (5.9)	19 (1.4)	560 (6.7)	1.9 (0.07)
Switzerland	28 (1.9)	520 (6.1)	34 (1.2)	544 (8.0)	21 (1.4)	535 (7.5)	17 (1.1)	545 (7.6)	2.0 (0.06)
United States	34 (1.7)	452 (3.7)	34 (1.1)	481 (4.9)	18 (0.9)	479 (5.9)	15 (1.1)	501 (7.9)	1.7 (0.06)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Study time is defined as the sum of time reported spent studying or doing homework in mathematics, science, and other subjects.

* See Appendix A for characteristics of the students sampled.

[1] Based on sum of responses to three questions about time spent studying or doing homework for mathematics, science, and other subjects. Categorization and average hours based on: No time = 0; Less than 1 hour = .5; 1-2 hours =1.5; 3-5 hours = 4; More than 5 hours = 7.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates a 70-84% student response rate. An "s" indicates a 50-69% student response rate.

A dash (-) indicates data are not available.

Table 4.16

Students' Reports on the Hours Per Day Studying or Doing Mathematics Homework Mathematics Literacy

Final Year of Secondary School*

Country	Percent Not Taking Mathematics	Hours Per Day Studying or Doing Mathematics Homework[1]						
		Less than One Hour		One to Two Hours		Three or More Hours		Average Hours[2]
		Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Mathematics Literacy Achievement	Percent of Students	Mean Mathematics Literacy Achievement	
Australia	13 (2.2)	59 (2.2)	521 (8.3)	36 (2.2)	557 (10.2)	5 (0.8)	534 (13.4)	1.0 (0.04)
Austria	26 (3.6)	77 (1.7)	526 (5.8)	19 (1.6)	533 (9.4)	4 (0.8)	502 (13.7)	0.6 (0.04)
Canada	46 (2.6)	56 (2.1)	539 (5.1)	38 (1.9)	547 (5.0)	7 (1.0)	526 (14.6)	1.1 (0.05)
Cyprus	0 (0.0)	63 (2.1)	435 (4.3)	29 (1.8)	471 (4.8)	8 (1.3)	451 (9.0)	1.0 (0.05)
Czech Republic	5 (2.1)	92 (1.5)	464 (13.8)	8 (1.4)	482 (17.8)	0 (0.2)	~ ~	0.4 (0.03)
Denmark	22 (2.4)	68 (2.0)	571 (4.9)	28 (1.6)	563 (4.7)	4 (0.7)	562 (11.9)	0.9 (0.04)
France	0 (0.0)	59 (2.3)	517 (5.1)	35 (2.3)	539 (6.7)	5 (0.7)	505 (14.7)	1.0 (0.04)
Germany	- -	- -	- -	- -	- -	- -	- -	- -
Hungary	0 (0.0)	74 (0.9)	480 (3.2)	24 (0.8)	496 (5.5)	2 (0.2)	~ ~	0.7 (0.02)
Iceland	35 (1.0)	79 (1.1)	553 (3.2)	19 (1.1)	542 (7.0)	2 (0.4)	~ ~	0.7 (0.02)
Italy	12 (3.3)	55 (2.6)	479 (6.3)	40 (2.2)	486 (7.2)	5 (0.9)	477 (11.2)	1.0 (0.05)
Lithuania	10 (2.1)	67 (1.8)	472 (5.8)	29 (1.7)	480 (5.2)	4 (0.5)	484 (11.5)	0.8 (0.03)
Netherlands	40 (2.6)	82 (1.7)	606 (6.2)	16 (1.6)	581 (11.1)	1 (0.3)	~ ~	0.7 (0.03)
New Zealand	27 (1.8)	75 (1.4)	544 (6.1)	23 (1.4)	552 (5.9)	2 (0.3)	~ ~	0.7 (0.03)
Norway	32 (2.5)	85 (1.4)	541 (5.1)	14 (1.3)	558 (9.5)	1 (0.3)	~ ~	0.5 (0.03)
Russian Federation	0 (0.1)	56 (2.0)	463 (5.9)	33 (1.4)	484 (7.5)	11 (1.2)	494 (8.1)	1.2 (0.06)
Slovenia	5 (2.7)	72 (2.7)	521 (9.4)	25 (2.6)	518 (9.5)	2 (0.6)	~ ~	0.7 (0.05)
South Africa	31 (2.9)	33 (1.8)	394 (17.1)	51 (1.8)	375 (10.9)	17 (1.2)	344 (7.2)	1.7 (0.05)
Sweden	30 (2.0)	90 (0.9)	579 (5.4)	9 (0.9)	580 (7.8)	1 (0.2)	~ ~	0.4 (0.02)
Switzerland	39 (3.2)	67 (1.6)	569 (4.9)	28 (1.3)	550 (5.6)	5 (0.9)	522 (10.6)	0.9 (0.04)
United States	34 (1.9)	76 (1.5)	475 (3.8)	22 (1.5)	486 (5.9)	2 (0.2)	~ ~	0.7 (0.02)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

[1] Percentages based on those students reporting currently taking mathematics.

[2] Average hours computed based on: No time = 0; Less than 1 hour = .5; 1-2 hours =1.5; 3-5 hours = 4; More than 5 hours = 7.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

Students' reports about doing science homework (Table 4.17) show a similar pattern to mathematics with respect to both the amount of homework and the relationship to science literacy achievement. Although the average amount of science homework reported by students taking at least one science course is somewhat less than what was reported by mathematics students, it is still between one-half and one hour in most countries. The highest level of science homework was again reported by South African students, with an average of one and one-half hours. As was found for mathematics, most students in all countries except South Africa reported spending less than one hour, and only a small percentage reported spending three hours or more. In many countries, the average science literacy achievement was highest for students studying science between one and two hours per day.

The students were also asked about other ways they could spend their time out of school: watching television, playing computer games, spending time with friends, doing jobs at home, working at a paid job, playing sports, and reading books for enjoyment. Their reports are summarized in Table 4.18. Socializing is clearly an important activity for final-year students, with students in many countries devoting up to about two and one-half hours each day to spending time with friends – about as much time as they devote to their studies. Watching television or videos is the next most popular pastime, although final-year students report spending less time at this than fourth or eighth graders. Playing computer games is much less popular, although students in about half of the countries report spending between 20 and 30 minutes daily on average on this pastime. Sports also occupy an important role in students' lives, with students in most countries reporting more than one hour each day, but this is less than the time eighth graders reported spending on sports, perhaps reflecting final-year students' increased involvement in paid employment. The time spent on leisure activities is not additive, because students do many of these activities simultaneously (e.g., talk with friends, watch television).

Whereas students in most countries reported about one hour each day, on average, doing jobs at home, many also reported significant time working at a paid job. There was a wide range across countries in this respect, from the Russian Federation, where students reported very little working time, to the United States, where they reported spending more than three hours a day on average in paid employment. Table 4.19 presents further details, including the average mathematics and science literacy of students reporting working for different amounts of time. In about half the countries, most final-year students (more than 80%) reported working at a paid job for less than one hour each day. However, in Australia, Canada, Iceland, the Netherlands, New Zealand, Norway, and the United States, at least one-fourth of students reported working for three hours or more each day.

Table 4.17

Students' Reports on the Hours Per Day Studying or Doing Science Homework
Science Literacy
Final Year of Secondary School*

Country		Percent Not Taking Science	Hours Per Day Studying or Doing Science Homework[1]						Average Hours[2]
			Less than One Hour		One to Two Hours		Three or More Hours		
			Percent of Students	Mean Science Literacy Achievement	Percent of Students	Mean Science Literacy Achievement	Percent of Students	Mean Science Literacy Achievement	
Australia		27 (3.6)	58 (1.8)	540 (9.5)	35 (1.7)	575 (6.9)	7 (1.0)	588 (33.0)	1.0 (0.04)
Austria		12 (1.7)	87 (1.4)	529 (6.0)	11 (1.4)	526 (13.8)	1 (0.3)	~ ~	0.4 (0.03)
Canada		45 (2.2)	57 (2.1)	554 (4.2)	35 (1.8)	567 (6.8)	8 (0.9)	537 (18.0)	1.1 (0.05)
Cyprus		0 (0.0)	80 (1.1)	436 (3.7)	16 (0.9)	483 (10.7)	4 (0.6)	552 (11.8)	0.5 (0.03)
Czech Republic		66 (5.7)	84 (2.6)	520 (11.6)	14 (2.3)	571 (11.5)	3 (0.5)	583 (13.6)	0.5 (0.05)
Denmark	r	58 (2.3)	73 (1.8)	555 (4.7)	25 (1.6)	570 (6.1)	3 (0.6)	565 (15.0)	0.7 (0.03)
France	s	35 (2.4)	59 (2.0)	497 (5.7)	35 (1.8)	525 (7.0)	6 (0.8)	515 (9.1)	1.0 (0.04)
Germany		- -	- -	- -	- -	- -	- -	- -	- -
Hungary		22 (1.9)	67 (1.2)	475 (3.9)	27 (0.9)	486 (4.9)	6 (0.6)	497 (11.5)	0.9 (0.03)
Iceland		37 (1.2)	87 (1.0)	566 (2.5)	12 (1.0)	575 (4.6)	1 (0.3)	~ ~	0.4 (0.01)
Italy		19 (2.8)	70 (2.8)	487 (6.3)	25 (2.5)	482 (9.7)	5 (1.2)	462 (13.9)	0.8 (0.06)
Lithuania		12 (2.4)	69 (1.5)	465 (5.5)	26 (1.3)	469 (6.5)	5 (0.6)	470 (11.4)	0.8 (0.03)
Netherlands		43 (3.3)	78 (2.8)	593 (6.4)	20 (2.9)	605 (16.9)	1 (0.4)	~ ~	0.7 (0.03)
New Zealand		32 (1.6)	80 (1.1)	551 (6.3)	18 (1.1)	581 (6.6)	3 (0.5)	553 (15.3)	0.6 (0.02)
Norway		63 (2.7)	74 (2.4)	592 (7.1)	23 (2.2)	598 (10.8)	3 (0.7)	583 (23.8)	0.7 (0.05)
Russian Federation		0 (0.1)	61 (1.6)	478 (6.0)	30 (1.3)	488 (7.0)	10 (0.8)	501 (8.0)	1.1 (0.04)
Slovenia		16 (2.8)	85 (2.0)	528 (8.1)	13 (1.9)	548 (8.9)	2 (0.6)	~ ~	0.5 (0.04)
South Africa	r	8 (1.1)	47 (1.6)	373 (15.5)	35 (1.3)	367 (12.2)	18 (1.4)	326 (7.3)	1.5 (0.05)
Sweden		57 (2.0)	81 (1.9)	599 (7.4)	17 (1.8)	632 (10.1)	2 (0.5)	~ ~	0.6 (0.03)
Switzerland		50 (2.6)	76 (2.3)	564 (6.6)	21 (2.3)	564 (10.9)	3 (0.9)	508 (29.0)	0.7 (0.04)
United States		47 (1.7)	76 (2.1)	505 (4.3)	21 (2.1)	517 (5.7)	2 (0.4)	~ ~	0.7 (0.04)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

[1] Percentages based on those students reporting currently taking at least one science course (biology, chemistry, physics, earth science, or other science).

[2] Average hours based on: No time = 0; Less than 1 hour = .5; 1-2 hours =1.5; 3-5 hours = 4; More than 5 hours = 7.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates a 70-84% student response rate. An "s" indicates a 50-69% student response rate.

A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

Table 4.18

Students' Reports on How They Spend Their Leisure Time on a Normal School Day† Mathematics and Science Literacy

Final Year of Secondary School*

Country	Average Hours Watching Television or Videos	Average Hours Playing Computer Games	Average Hours Spending Time with Friends Outside of School	Average Hours Doing Jobs at Home	Average Hours Working at a Paid Job	Average Hours Playing Sports	Average Hours Reading a Book for Enjoyment
Australia	1.8 (0.06)	0.3 (0.03)	1.3 (0.06)	0.8 (0.03)	1.4 (0.09)	1.1 (0.07)	0.6 (0.04)
Austria	1.5 (0.06)	0.2 (0.02)	2.3 (0.08)	0.9 (0.05)	0.5 (0.04)	1.0 (0.04)	0.8 (0.02)
Canada	1.6 (0.04)	0.2 (0.01)	2.0 (0.04)	1.4 (0.11)	2.2 (0.06)	1.1 (0.03)	0.7 (0.03)
Cyprus	1.6 (0.06)	0.2 (0.04)	1.4 (0.07)	0.7 (0.05)	0.6 (0.11)	0.8 (0.06)	0.4 (0.03)
Czech Republic	2.1 (0.07)	0.3 (0.03)	2.7 (0.14)	1.1 (0.07)	1.2 (0.13)	1.3 (0.06)	0.9 (0.05)
Denmark	1.7 (0.03)	0.3 (0.02)	1.9 (0.04)	0.9 (0.06)	1.5 (0.08)	1.3 (0.06)	0.5 (0.02)
France	1.3 (0.06)	0.2 (0.01)	1.4 (0.06)	0.9 (0.07)	0.6 (0.06)	1.0 (0.04)	0.8 (0.04)
Germany	x x	x x	x x	x x	x x	x x	x x
Hungary	2.0 (0.04)	0.4 (0.02)	2.3 (0.05)	1.5 (0.04)	- -	1.2 (0.03)	1.1 (0.03)
Iceland	1.6 (0.04)	0.2 (0.01)	2.4 (0.04)	0.9 (0.05)	1.8 (0.07)	1.1 (0.04)	0.6 (0.02)
Italy	1.5 (0.04)	0.2 (0.02)	2.3 (0.09)	1.0 (0.04)	0.6 (0.08)	0.9 (0.05)	0.7 (0.03)
Lithuania	2.2 (0.07)	0.3 (0.02)	2.4 (0.09)	1.0 (0.03)	0.8 (0.06)	0.9 (0.05)	1.1 (0.03)
Netherlands	2.2 (0.07)	0.3 (0.02)	2.4 (0.07)	0.8 (0.03)	1.8 (0.08)	1.3 (0.05)	0.6 (0.04)
New Zealand	2.1 (0.08)	0.2 (0.02)	1.5 (0.08)	0.9 (0.03)	1.7 (0.07)	1.2 (0.06)	0.7 (0.03)
Norway	1.7 (0.04)	0.2 (0.02)	2.5 (0.07)	0.8 (0.03)	s 1.8 (0.10)	1.2 (0.05)	0.5 (0.02)
Russian Federation	2.5 (0.06)	0.4 (0.03)	2.8 (0.07)	1.6 (0.06)	0.2 (0.04)	0.9 (0.04)	1.4 (0.05)
Slovenia	1.4 (0.07)	0.3 (0.03)	1.7 (0.10)	1.1 (0.09)	0.5 (0.06)	1.0 (0.06)	0.6 (0.03)
South Africa	1.2 (0.06)	r 0.2 (0.03)	1.1 (0.06)	2.2 (0.11)	r 0.9 (0.07)	1.3 (0.06)	1.3 (0.05)
Sweden	1.6 (0.03)	0.2 (0.02)	1.9 (0.05)	0.9 (0.03)	0.5 (0.04)	1.2 (0.04)	0.6 (0.02)
Switzerland	1.2 (0.05)	0.2 (0.02)	2.3 (0.08)	1.1 (0.05)	0.6 (0.06)	1.2 (0.04)	0.6 (0.03)
United States	1.7 (0.05)	0.3 (0.01)	2.3 (0.06)	1.1 (0.04)	3.1 (0.07)	1.3 (0.05)	0.6 (0.03)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

† Average hours based on: No time = 0; Less than 1 hour = .5; 1-2 hours =1.5; 3-5 hours = 4; More than 5 hours = 7.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates a 70-84% student response rate. An "s" indicates a 50-69% student report rate.

An "x" indicates data available for <50% students.

A dash (-) indicates data are not available.

Table 4.19

Students' Reports on the Hours Per Day Spent Working at a Paid Job Mathematics and Science Literacy

Final Year of Secondary School*

Country	Less Than One Hour		1-2 Hours		3-5 Hours		More Than 5 Hours	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	68 (2.0)	536 (9.1)	8 (1.1)	532 (8.4)	15 (1.4)	516 (11.3)	10 (1.3)	487 (10.0)
Austria	86 (1.5)	523 (5.3)	8 (1.3)	534 (16.8)	3 (0.4)	504 (13.2)	4 (0.5)	481 (13.2)
Canada	50 (1.3)	535 (3.7)	11 (0.9)	549 (6.5)	23 (1.2)	517 (5.8)	16 (1.0)	498 (4.4)
Cyprus	88 (1.8)	451 (3.1)	3 (0.6)	411 (18.8)	2 (0.8)	~ ~	6 (1.6)	408 (11.9)
Czech Republic	72 (2.3)	486 (11.4)	9 (0.7)	481 (9.6)	8 (1.3)	451 (9.9)	10 (1.4)	439 (4.6)
Denmark	59 (1.8)	538 (3.6)	18 (1.2)	536 (4.3)	13 (0.9)	513 (6.3)	10 (1.1)	487 (7.8)
France	83 (1.4)	512 (5.0)	10 (1.1)	488 (5.7)	4 (0.6)	474 (14.5)	3 (0.7)	463 (8.8)
Germany	x x	x x	x x	x x	x x	x x	x x	x x
Hungary	- -	- -	- -	- -	- -	- -	- -	- -
Iceland	55 (1.3)	554 (2.5)	18 (0.9)	544 (3.8)	13 (0.9)	528 (6.1)	13 (0.8)	510 (4.7)
Italy	84 (1.6)	483 (5.5)	7 (0.8)	453 (11.4)	4 (0.5)	456 (10.4)	5 (1.0)	433 (11.9)
Lithuania	83 (1.2)	470 (5.2)	5 (0.4)	469 (12.1)	4 (0.5)	456 (13.2)	8 (0.7)	442 (12.6)
Netherlands	60 (1.6)	571 (6.5)	13 (1.1)	563 (6.4)	10 (0.9)	542 (6.6)	16 (1.0)	526 (7.0)
New Zealand	53 (1.8)	530 (6.0)	20 (1.6)	536 (7.8)	16 (1.2)	521 (10.3)	11 (0.9)	492 (9.3)
Norway	s 61 (2.1)	552 (5.0)	12 (1.0)	544 (8.4)	11 (1.1)	517 (6.6)	16 (1.3)	515 (7.0)
Russian Federation	93 (1.2)	480 (5.8)	4 (0.9)	473 (17.1)	2 (0.3)	~ ~	1 (0.3)	~ ~
Slovenia	89 (1.3)	521 (7.6)	5 (0.7)	508 (14.5)	3 (0.5)	487 (13.3)	4 (0.7)	444 (11.1)
South Africa	r 82 (1.5)	366 (11.0)	4 (0.5)	351 (16.4)	6 (0.8)	337 (10.7)	7 (0.7)	340 (11.9)
Sweden	84 (1.0)	563 (4.2)	8 (0.6)	541 (6.7)	5 (0.5)	511 (9.6)	3 (0.3)	497 (16.6)
Switzerland	83 (1.3)	537 (5.8)	9 (0.9)	532 (10.9)	4 (0.6)	505 (12.0)	4 (0.7)	463 (14.0)
United States	39 (1.3)	484 (5.0)	7 (0.5)	506 (6.8)	27 (1.1)	474 (4.6)	28 (1.1)	448 (4.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates a 70-84% student response rate. An "s" indicates a 50-69% student report rate.

An "x" indicates data available for <50% students.

A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

Average mathematics and science literacy was highest among students reporting a low to moderate amount of time daily (two hours or less) working at a paid job. In almost every country, average mathematics and science literacy was lowest among those who reported working for more than five hours each day. This could reflect the fact that students working many hours have less time available for homework, but since mathematics and science literacy as assessed by TIMSS is probably acquired over many years, it also may be that less academically inclined students are choosing to place less emphasis on their studies in favor of an early start in the workplace.

Although final-year students seem to watch television less than do younger students, it still absorbs a significant part of their leisure time (Table 4.20). In many countries, about one-third of students reported watching television for less than one hour each day, and about two-thirds reported between one and five hours. Only in South Africa and Switzerland did a majority of students report watching television for less than one hour each day. In almost every country, there was a negative relationship between achievement in mathematics and science literacy and the amount of time spent watching television, with average achievement being highest among those who reported watching television for less than one hour each day. One notable exception to this pattern is South Africa, where students watching one to five hours of television per day had the highest average literacy achievement. This may reflect the generally higher socio-economic level of students able to watch television, since 57% of the students in South Africa reported watching very little television. Although only about 5% of final-year students in each country reported watching television for more than five hours each day, these were also the students with the lowest average mathematics and science literacy.

Table 4.20

Students' Reports on the Hours Per Day Spent Watching Television or Videos Mathematics and Science Literacy

Final Year of Secondary School*

Country	Less Than One Hour		1-2 Hours		3-5 Hours		More Than 5 Hours	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	34 (2.1)	532 (11.0)	44 (2.2)	530 (8.9)	17 (1.5)	527 (7.3)	5 (0.6)	476 (10.5)
Austria	37 (2.2)	532 (8.2)	47 (1.8)	518 (5.0)	14 (1.0)	507 (6.8)	2 (0.4)	~ ~
Canada	38 (1.1)	531 (3.3)	44 (1.4)	528 (3.7)	15 (1.3)	512 (5.7)	3 (0.5)	502 (12.2)
Cyprus	38 (1.9)	451 (5.5)	43 (2.3)	447 (4.2)	16 (1.6)	434 (6.7)	2 (0.7)	~ ~
Czech Republic	21 (2.3)	512 (11.1)	51 (2.7)	479 (10.6)	22 (1.6)	450 (11.6)	5 (1.0)	429 (5.9)
Denmark	32 (1.4)	541 (4.4)	51 (1.3)	526 (3.5)	15 (1.1)	519 (5.9)	2 (0.3)	~ ~
France	49 (2.1)	512 (5.0)	41 (1.7)	503 (6.6)	8 (0.8)	491 (9.4)	2 (0.4)	~ ~
Germany	x x	x x	x x	x x	x x	x x	x x	x x
Hungary	31 (0.9)	505 (4.4)	44 (0.9)	475 (3.4)	19 (0.7)	451 (4.3)	6 (0.5)	426 (5.0)
Iceland	38 (1.1)	555 (4.0)	47 (1.4)	536 (2.9)	14 (1.0)	528 (4.3)	2 (0.3)	~ ~
Italy	36 (1.4)	477 (6.8)	50 (1.6)	477 (6.3)	12 (0.9)	473 (6.9)	2 (0.4)	~ ~
Lithuania	21 (1.0)	473 (6.5)	50 (1.3)	469 (5.3)	24 (1.3)	459 (7.5)	6 (0.7)	439 (12.5)
Netherlands	19 (1.4)	569 (10.4)	49 (1.6)	567 (5.0)	27 (1.7)	547 (5.9)	4 (0.7)	503 (14.0)
New Zealand	28 (1.4)	537 (6.1)	45 (1.6)	527 (4.9)	20 (1.4)	511 (9.7)	7 (1.4)	506 (12.5)
Norway	32 (1.5)	549 (5.0)	50 (1.2)	540 (4.5)	16 (1.0)	505 (5.3)	2 (0.4)	~ ~
Russian Federation	15 (1.2)	490 (8.9)	46 (1.4)	482 (6.4)	31 (1.4)	469 (6.5)	7 (0.8)	451 (8.9)
Slovenia	44 (2.6)	520 (9.2)	44 (2.3)	520 (8.2)	10 (1.1)	486 (14.4)	3 (0.6)	484 (19.0)
South Africa	57 (2.3)	345 (8.9)	29 (2.0)	377 (12.4)	11 (1.1)	389 (17.3)	3 (0.5)	342 (15.5)
Sweden	33 (1.1)	576 (5.3)	51 (1.0)	554 (4.5)	15 (0.7)	526 (7.2)	1 (0.2)	~ ~
Switzerland	55 (2.1)	545 (4.8)	36 (1.7)	521 (7.8)	8 (0.9)	505 (9.3)	2 (0.4)	~ ~
United States	40 (1.5)	483 (4.2)	39 (1.1)	473 (4.1)	15 (0.9)	458 (4.5)	5 (0.4)	424 (7.9)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "x" indicates data available for <50% students.

A tilde (~) indicates insufficient data to report achievement.

What Are Students' Negative School Experiences?

Although it is reasonable to expect schools to provide a secure and supportive environment in which students can devote their full attention to their studies, for some students school can be a threatening or worrisome place. Students' reports on how often they had negative experiences during their last month in school before the TIMSS testing are summarized in Table 4.21. In almost all countries, more than 80% of final-year students reported never having something stolen. However, more than one-fifth of the students in New Zealand, South Africa, and the United States reported having something stolen at least once during that month.

Similarly, students reported that threats from another student are not common in upper secondary schools around the world. In almost all countries, more than 80% of final-year students reported that they were never threatened by another student. The exception was South Africa, where about one-fourth of the students reported being threatened at least once during the past month.

Table 4.21

Students' Reports on How Often They Had Negative Experiences During the Past Month in School – Mathematics and Science Literacy

Final Year of Secondary School*

Country	Percent of Students					
	Had Something Stolen			Was Threatened by Another Student		
	Never	Once or Twice	Three times or more	Never	Once or Twice	Three times or more
Australia	83 (1.4)	16 (1.2)	2 (0.4)	92 (0.8)	6 (0.7)	2 (0.6)
Austria	91 (1.2)	8 (1.0)	1 (0.3)	96 (0.5)	3 (0.4)	1 (0.3)
Canada	85 (1.0)	14 (1.0)	1 (0.3)	94 (0.6)	5 (0.6)	1 (0.2)
Cyprus	86 (1.9)	13 (1.8)	1 (0.5)	87 (1.8)	10 (1.7)	2 (0.6)
Czech Republic	82 (1.4)	16 (1.1)	2 (0.5)	93 (1.5)	5 (1.2)	2 (0.5)
Denmark	94 (0.9)	5 (0.8)	1 (0.3)	87 (1.0)	10 (0.8)	3 (0.6)
France	- -	- -	- -	- -	- -	- -
Germany	x x	x x	x x	x x	x x	x x
Hungary	83 (0.8)	15 (0.7)	2 (0.3)	- -	- -	- -
Iceland	97 (0.4)	3 (0.4)	0 (0.1)	98 (0.3)	1 (0.1)	1 (0.3)
Italy	87 (1.1)	11 (0.9)	2 (0.5)	97 (0.5)	2 (0.5)	1 (0.3)
Lithuania	94 (0.5)	5 (0.4)	1 (0.2)	93 (0.7)	5 (0.6)	2 (0.3)
Netherlands	- -	- -	- -	- -	- -	- -
New Zealand	78 (1.6)	20 (1.5)	2 (0.3)	92 (0.8)	7 (0.8)	1 (0.3)
Norway	92 (0.7)	8 (0.7)	0 (0.1)	97 (0.5)	3 (0.4)	1 (0.2)
Russian Federation	94 (0.8)	6 (0.7)	1 (0.2)	94 (0.6)	5 (0.6)	1 (0.2)
Slovenia	94 (1.0)	6 (0.9)	0 (0.2)	93 (1.0)	5 (0.7)	2 (0.4)
South Africa	62 (2.4)	29 (1.7)	8 (1.1)	77 (1.4)	18 (1.1)	6 (0.7)
Sweden	97 (0.3)	3 (0.3)	0 (0.1)	99 (0.2)	1 (0.2)	0 (0.1)
Switzerland	92 (0.8)	8 (0.8)	0 (0.2)	98 (0.4)	1 (0.3)	0 (0.2)
United States	76 (0.9)	21 (0.9)	3 (0.3)	89 (0.8)	8 (0.7)	2 (0.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.

* See Appendix A for characteristics of the students sampled.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.4).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "x" indicates data available for <50% students.

A dash (-) indicates data are not available.