Chapter 5

International Student Achievement in Advanced Mathematics

Chapters 5 to 7 present the results for the advanced mathematics test given in the participating countries to the final-year students who had taken advanced mathematics courses. The definition of advanced mathematics courses was left to each country, and it varied (see Appendix A). However, as a point of reference, the students involved had generally taken calculus, trigonometry, higher levels of algebra or geometry, or other advanced mathematics courses. The test questions covered primarily the content areas of equations and functions, calculus, and geometry. Students were permitted to use a calculator if they wished (see Chapter 7 for student reports on calculator use).

Chapter 5 summarizes achievement on the TIMSS advanced mathematics test overall and by gender. Different percentages of students had taken advanced mathematics courses across the participating countries, and coverage of the entire school-leaving population varied by country, as discussed in the introduction. We therefore also examine achievement in advanced mathematics in relation to the percentages of students in the school-leaving age cohort covered by the sample in each country, and provide performance estimates for the top 10% and top 5% of the entire school-leaving age cohort.

How Does Performance Compare for the Students Tested in Advanced Mathematics?

Table 5.1 presents the mean achievement in advanced mathematics for 16 countries participating in this portion of the testing for students in the final year of secondary school.[1] Countries with triangles pointing up next to their mean achievement performed significantly above the international average: France, the Russian Federation, Switzerland, Cyprus, Lithuania, and Denmark. Countries with triangles pointing down had mean achievement significantly below the international average: the Czech Republic, Germany, Austria, and the United States.

The upper part of the table shows, in decreasing order of mean achievement, the 10 countries that were judged to have met the TIMSS requirements for testing a representative sample of the students having taken advanced mathematics, in accordance with their national definitions. While some countries had more success in locating these advanced students and encouraging them to participate in the testing than they had for the entire school-leaving population, others encountered resistance from schools and students and failed to reach the overall participation rates of 75% or higher (for schools and students combined) specified in the TIMSS

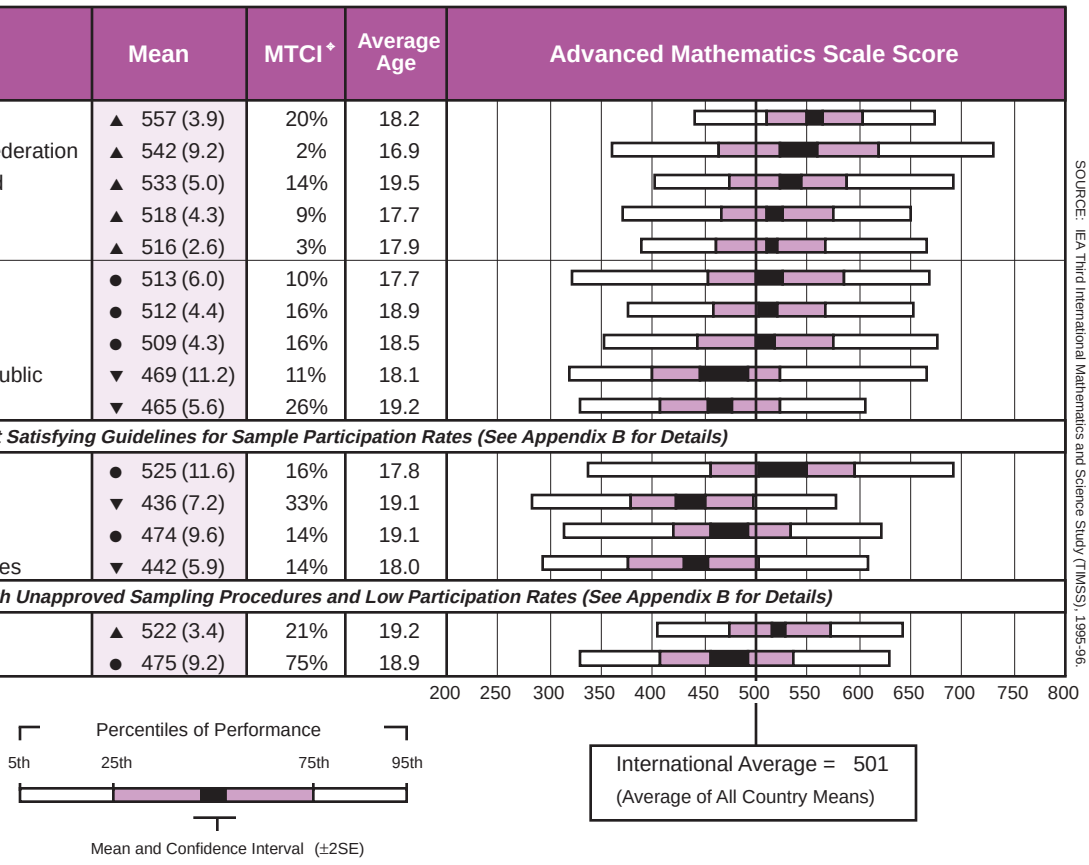
[1] The achievement results for advanced mathematics were derived from all of the advanced mathematics items scaled together. Chapter 6 contains scaled results for the three major content areas within advanced mathematics. For more detailed information about the scaling methods used, see the "IRT Scaling and Data Analysis" section of Appendix B.

Table 5.1

Distributions of Advanced Mathematics Achievement for Students Having Taken Advanced Mathematics

Final Year of Secondary School*

Country	Mean	MTCI✦	Average Age
France	▲ 557 (3.9)	20%	18.2
[2] Russian Federation	▲ 542 (9.2)	2%	16.9
Switzerland	▲ 533 (5.0)	14%	19.5
[2] Cyprus	▲ 518 (4.3)	9%	17.7
[1] Lithuania	▲ 516 (2.6)	3%	17.9
[†] Greece	● 513 (6.0)	10%	17.7
Sweden	● 512 (4.4)	16%	18.9
Canada	● 509 (4.3)	16%	18.5
Czech Republic	▼ 469 (11.2)	11%	18.1
[†] Germany	▼ 465 (5.6)	26%	19.2
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)			
Australia	● 525 (11.6)	16%	17.8
[2] Austria	▼ 436 (7.2)	33%	19.1
[1] Italy	● 474 (9.6)	14%	19.1
United States	▼ 442 (5.9)	14%	18.0
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)			
Denmark	▲ 522 (3.4)	21%	19.2
Slovenia	● 475 (9.2)	75%	18.9



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 Mathematics TIMSS Coverage Index (MTCI) is an estimate of the percentage of the school-leaving age cohort covered by the TIMSS final-year advanced mathematics 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 5.1

Multiple Comparisons of Advanced Mathematics Achievement for Students Having Taken Advanced Mathematics – 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	France	Russian Federation	Switzerland	*Australia*	*Denmark*	Cyprus	Lithuania	Greece	Sweden	Canada	*Slovenia*	*Italy*	Czech Republic	Germany	*United States*	*Austria*
France		●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Russian Federation	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲
Switzerland	▼	●		●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲
Australia	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲
Denmark	▼	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲
Cyprus	▼	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲
Lithuania	▼	●	▼	●	●	●		●	●	●	▲	▲	▲	▲	▲	▲
Greece	▼	●	●	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲
Sweden	▼	▼	▼	●	●	●	●	●		●	▲	▲	▲	▲	▲	▲
Canada	▼	▼	▼	●	●	●	●	●	●		▲	▲	▲	▲	▲	▲
Slovenia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		●	●	●	▲	▲
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	●	●	▲
Czech Republic	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	●
Germany	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	▲
United States	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●
Austria	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	

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.5).

guidelines (i.e., Australia, Austria, Italy, and the United States). Denmark and Slovenia also had some difficulties in implementing the prescribed sampling methods. Because clear sampling documentation was not available for Israel, Appendix D contains its unweighted results. Appendix B provides detailed information about the sampling for the advanced mathematics test in each country.

As explained in the Introduction, the Mathematics TIMSS Coverage Index (MTCI) reflects the percentage of the entire school-leaving age cohort covered by the student samples for the advanced mathematics testing. The MTCI shows the differing levels of overall sample coverage of this cohort in each country, including omissions of students who have left the educational system (e.g., by dropping out) and sampling exclusions in the three countries so footnoted (the Russian Federation, Cyprus, and Austria). In addition, the MTCI reflects the fact that a relatively small subset of the final-year students in each country have taken the advanced mathematics courses necessary to participate in this portion of the testing, and that the percentage of these students also varies across countries. In general, most participating countries tested 20% or fewer of their school-leaving age cohort in advanced mathematics. Countries with a MTCI below 10% were the Russian Federation (2%), Cyprus (9%), and Lithuania (3%). Countries with a MTCI above 30% were Slovenia (75%) and Austria (33%).

The average age of students gives some idea of the years of formal schooling in the participating countries. Students of similar age, however, have not necessarily had the same number of years of formal schooling, because of different policies regarding the age for starting school and for retention. Further, the students in the TIMSS countries have not studied the same curriculum. The reader is encouraged to consult Appendix A, which provides further detail about the students included in the advanced mathematics testing.

The results in Table 5.1, especially the visual representations of the performance distributions within each country, suggest some similarity in average performance among many of the countries, although there is variation from the top- to the bottom-performing ones. In contrast to the overlapping performance across a number of the countries in their mean achievement (shown by the dark boxes at the distribution midpoints representing the 95% confidence intervals around the means), the range in within-country performance usually was substantial (shown by the 5th and 95th percentiles, representing the extremes of lower and higher achievement).[2]

Figure 5.1 provides a method for comparing countries in terms of mean achievement in advanced mathematics. It shows whether or not the differences in mean achievement between pairs of countries are statistically significant.[3] 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 in performance, and a triangle pointing down indicates significantly lower performance.

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

[3] The significance tests in Figure 5.1 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 that of another country.

The figure shows that there were essentially two groupings of countries by average performance. The top group, led by France, also included the Russian Federation, Switzerland, Australia, Denmark, Cyprus, Lithuania, Greece, Sweden, and Canada. Among these countries, the Russian Federation (2%) and Lithuania (3%) tested a rather small percentage of their school-leaving age cohort in advanced mathematics, and Australia and Denmark did not meet the TIMSS sampling guidelines. The second group of countries included Slovenia, Italy, the Czech Republic, Germany, the United States, and Austria. Here it should be noted that Slovenia tested three-fourths of its school-leaving age cohort, and Austria (33%) also had a comparatively higher MTCI than the other participants, as did Germany (26%).

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

Figure 5.2 shows the relationship between average performance and the MTCI.[4] The figure reveals that the two countries testing the highest percentages of their school-leaving age cohort (Slovenia and Austria) had lower than average performance in advanced mathematics, but then so did some countries testing smaller percentages of this cohort. Among those countries that performed above the international average, many are clustered in the upper left corner of the graph. However, the MTCI for these countries varied from 2% (the Russian Federation) to 21% (Denmark), and there appears to be little relationship between the MTCI and performance. For example, France, with the highest performance, also had one of the higher coverage indices, testing 20% of its entire school-leaving age cohort in advanced mathematics.

Table 5.2 provides a way of comparing performance in advanced mathematics for the top 10% of the school-leaving age cohort. For the 12 countries where the students tested in advanced mathematics covered more than 10% of the school-leaving age cohort, TIMSS computed the 90th percentile of performance. The 90th percentile is the point on the advanced mathematics scale that divides the higher-performing 10% of the students from the lower-performing 90%. It is used in this table because it can be reliably estimated even when scores from some members of the population are not available (that is, all of the students in the school-leaving age cohort that were not tested in advanced mathematics, including those not attending school). To compute the 90th percentile, TIMSS assumed that those students not tested in advanced mathematics would have scored below the 90th percentile, primarily because they had not taken courses in advanced mathematics. These percentages of students were added to the lower tail of the performance distribution before calculating the 90th percentile using the modified distribution. After calculating the 90th percentile, TIMSS then computed the mean achievement of the top 10% of the students. Because the students tested in Greece only covered 10% of the school-leaving age cohort, the data reflect the mean performance of all the students tested.

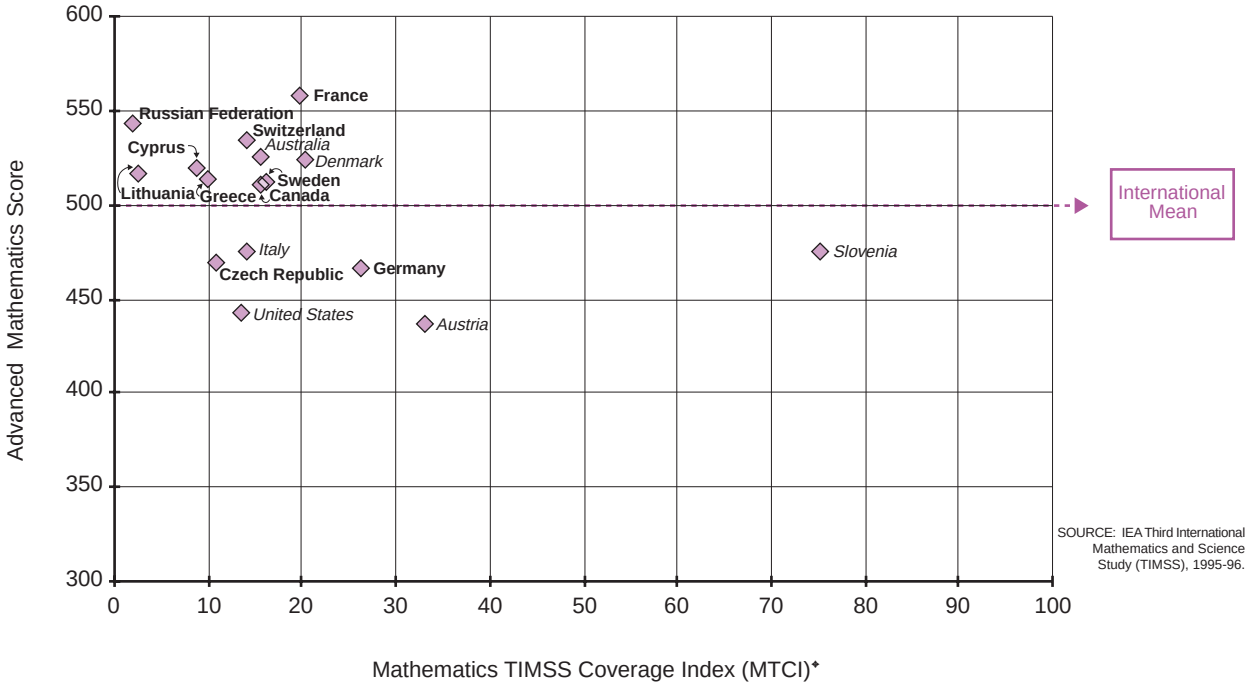
Figure 5.3 provides the country comparison information for the mean performance of the top 10% of the students in the school-leaving age cohort. Selecting a country of interest and reading across the table, a triangle pointing up indicates significantly higher performance than the country listed across the top, a dot indicates no significant difference, and a triangle pointing down indicates significantly lower performance. As shown in the figure, Slovenia and France had significantly higher performance in advanced mathematics for the top 10% of their students than other participating countries. In particular, this analysis offers an interesting view of performance for Slovenia, the country that educates three-fourths of its entire school-leaving age cohort in advanced mathematics. Even though Slovenia had difficulties in implementing the sampling guidelines, the results suggest high performance for the top end of the distribution. Similarly, France followed all of the sampling guidelines

[4] The relationship between advanced mathematics achievement and the MTCI has a correlation coefficient of – 0.37.

Figure 5.2

Mean Advanced Mathematics Achievement by TIMSS Coverage Index for Students Having Taken Advanced Mathematics

Final Year of Secondary School*



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

* See Appendix A for characteristics of students sampled.

◆ The Mathematics TIMSS Coverage Index (MTCI) is an estimate of the percentage of the school-leaving age cohort covered by the TIMSS final-year advanced mathematics 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.5).

Table 5.2

Advanced Mathematics Achievement for the Top 10 Percent@ of All Students in the School-Leaving Age Cohort*

Country	90th Percentile	Mean Achievement of the Top 10% of Students (Above 90th Percentile)	Mathematics TCI
France	558 (5.5)	612 (2.3)	20%
Switzerland	483 (7.6)	575 (3.9)	14%
Canada	473 (3.9)	567 (4.0)	16%
Sweden	487 (6.0)	564 (3.2)	16%
† Germany	489 (5.5)	550 (2.4)	26%
† Greece	- -	513 (6.0)	10%
Czech Republic	343 (11.3)	485 (9.9)	11%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)			
Australia	496 (11.6)	589 (5.9)	16%
2 Austria	487 (3.8)	537 (4.1)	33%
1 Italy	432 (7.7)	520 (7.0)	14%
United States	383 (6.8)	485 (6.1)	14%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)			
Denmark	526 (7.0)	582 (2.4)	21%
Slovenia	577 (8.3)	629 (6.0)	75%
International Average	478 (2.0)	554 (1.5)	

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

@To compute the 90th percentile, TIMSS assumed that the students in the school-leaving age cohort not tested would have scored below the 90th 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.

A dash (-) indicates data are not available. Because the students tested in Greece covered 10% of the school-leaving age cohort, the 90th percentile could not be estimated with precision.

Less than 10% of the students in the Russian Federation, Lithuania, and Cyprus took the advanced mathematics test.

Figure 5.3

Multiple Comparisons of Advanced Mathematics Achievement of the Top 10 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	*Slovenia*	**France**	*Australia*	*Denmark*	**Switzerland**	**Canada**	**Sweden**	**Germany**	*Austria*	*Italy*	**Greece**	*United States*	**Czech Republic**
Slovenia		●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
France	●		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	▼	▼		●	●	▲	▲	▲	▲	▲	▲	▲	▲
Denmark	▼	▼	●		●	▲	▲	▲	▲	▲	▲	▲	▲
Switzerland	▼	▼	●	●		●	●	▲	▲	▲	▲	▲	▲
Canada	▼	▼	▼	▼	●		●	▲	▲	▲	▲	▲	▲
Sweden	▼	▼	▼	▼	●	●		▲	▲	▲	▲	▲	▲
Germany	▼	▼	▼	▼	▼	▼	▼		●	▲	▲	▲	▲
Austria	▼	▼	▼	▼	▼	▼	▼	●		●	▲	▲	▲
Italy	▼	▼	▼	▼	▼	▼	▼	▼	●		●	▲	▲
Greece	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		▲	●
United States	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		●
Czech Republic	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	

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

@ To compute the 90th percentile, TIMSS assumed that the students in the school-leaving age cohort not tested would have scored below the 90th percentile and added them to the lower tail of the distribution.

* See Appendix A for characteristics of 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.5).

Less than 10% of the students in the Russian Federation, Lithuania, and Cyprus took the advanced mathematics test.

and also has a relatively high MTCI (20%). It appears that having higher percentages of students enrolled in advanced mathematics courses need not have a negative impact on the performance of the top students in that group.

Australia, Denmark, and Switzerland performed similarly to each other, and Australia and Denmark performed better than all of the other participating countries except Slovenia and France. However, Australia and Denmark had some difficulties in achieving high participation rates. Canada and Sweden performed about the same as Switzerland. The top 10% of the school-leaving age cohort in Germany and Austria performed similarly, but below Canada, Sweden, and Switzerland. For Germany and Austria, which had comparatively large coverage indices, this represents an improvement in relative position from the results presented in Figure 5.1 for the full samples of final-year advanced mathematics students. The students in Italy performed about the same as those in Austria, and in turn, the students in Greece performed about the same as those in Italy. The United States and the Czech Republic performed below the other countries; however, a large sampling error in the Czech Republic resulted in no significant difference between its performance and that of Greece.

Table 5.3 and Figure 5.4 present the corresponding information for the 14 countries where the students tested in advanced mathematics covered 5% of the school-leaving age cohort (all except the Russian Federation and Lithuania). Figure 5.4 reveals that performance rankings by mean achievement of the top 5% of the students tended to be similar, but not identical, to those found for the top 10%. Interestingly, from the top-performing countries on down through the list of participants, the differences from one country to the next were often quite negligible. For the top 5%, Slovenia, France, and Australia had the best performance, with Switzerland performing at a level similar to that of France and Australia. Next, Canada and Denmark performed similarly to Switzerland, and in turn, Sweden performed similarly to Canada and Denmark. Greece had the next highest level of performance, followed by Germany and Cyprus, who performed similarly to Greece, and then by Austria, Italy, and the Czech Republic, who all performed similarly to Germany and Cyprus as well as to each other. The United States had significantly lower mean achievement than the other participating countries except Italy and the Czech Republic.

Despite the small difference from one country to the next, however, spanning across all the participating TIMSS countries, the performance difference from the top-performing to the bottom-performing countries was substantial (approximately 100 points, or one standard deviation on the TIMSS advanced mathematics scale). It is also interesting to note that the mean achievement internationally for the top 10% of the advanced mathematics students was 554, which increased to 601 for the top 5%. For the lower-performing countries, mean achievement in advanced mathematics for the top 5% of the final-year students more closely resembled the international mean at the 10% level.

Table 5.3

Advanced Mathematics Achievement for the Top 5 Percent@ of All Students in the School-Leaving Age Cohort*

Country	95th Percentile	Mean Achievement of the Top 5% of Students (Above 95th Percentile)	Mathematics TCI
France	603 (6.3)	645 (3.0)	20%
Switzerland	559 (7.1)	629 (4.7)	14%
Canada	554 (4.0)	620 (4.0)	16%
Sweden	553 (5.1)	608 (4.0)	16%
† Greece	521 (6.7)	592 (4.2)	10%
† Germany	540 (5.9)	586 (2.6)	26%
2 Cyprus	508 (7.5)	577 (3.9)	9%
Czech Republic	466 (15.5)	558 (10.8)	11%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)			
Australia	576 (12.0)	643 (6.0)	16%
2 Austria	527 (7.0)	570 (5.2)	33%
1 Italy	507 (9.1)	569 (8.3)	14%
United States	470 (7.4)	543 (3.7)	14%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)			
Denmark	574 (7.3)	616 (3.3)	21%
Slovenia	618 (8.6)	664 (6.5)	75%
International Average	541 (2.2)	601 (1.5)	

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

@To compute the 95th percentile, TIMSS assumed that the students in the school-leaving age cohort not tested would have scored below the 95th 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.

Less than 5% of the students in the Russian Federation and Lithuania took the advanced mathematics test.

Figure 5.4

Multiple Comparisons of Advanced Mathematics Achievement of the Top 5 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	*Slovenia*	**France**	*Australia*	**Switzerland**	**Canada**	*Denmark*	**Sweden**	**Greece**	**Germany**	**Cyprus**	*Austria*	*Italy*	**Czech Republic**	*United States*
Slovenia		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
France	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	●	●		●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Switzerland	▼	●	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲
Canada	▼	▼	▼	●		●	●	▲	▲	▲	▲	▲	▲	▲
Denmark	▼	▼	▼	●	●		●	▲	▲	▲	▲	▲	▲	▲
Sweden	▼	▼	▼	▼	●	●		●	▲	▲	▲	▲	▲	▲
Greece	▼	▼	▼	▼	▼	▼	●		●	●	▲	●	▲	▲
Germany	▼	▼	▼	▼	▼	▼	▼	●		●	●	●	●	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	●	▲
Austria	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	▲
Italy	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●
Czech Republic	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●
United States	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	

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

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

@ To compute the 95th percentile, TIMSS assumed that the students in the school-leaving age cohort not tested would have scored below the 95th percentile and added them to the lower tail of the distribution.

* See Appendix A for characteristics of 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.5).

Less than 5% of the students in the Russian Federation and Lithuania took the advanced mathematics test.

How Does Performance in Advanced Mathematics Compare by Gender?

Table 5.4 presents the differences in achievement by gender. The table shows mean achievement in advanced mathematics separately for males and females for each country, as well as the difference between the means. The graphic representation of the gender difference, shown by the bar for each country, shows that the direction of the difference favored males in every country, and that the difference usually was statistically significant (indicated by a darkened bar). The gender differences were not statistically significant in Greece, Cyprus, Australia, Italy, and Slovenia. Especially large gender differences in relation to the international average difference of 37 scale-score points were found in the Czech Republic and Austria (80 points or more).

Table 5.4 also shows, by gender, the percentages of upper secondary school students who have taken advanced mathematics courses. The results reveal that many more (at least 20%) males than females have taken advanced mathematics in Greece, Cyprus, Sweden, France, Italy, and Denmark. More males than females have also taken advanced mathematics in several other countries, although the differences are not as large (Australia 10%, Switzerland 8%, and Canada 6%). The percentages are nearly identical in Lithuania, the Russian Federation, the United States, and Slovenia. In contrast, more females than males have taken advanced mathematics courses in three of the participating countries – Germany (14%), the Czech Republic (18%), and Austria (24%).

The TIMSS data on gender differences in taking advanced mathematics courses raise several serious questions. For example, why do so many more males than females take advanced mathematics in some countries? Even when females have taken advanced mathematics, why is their achievement significantly lower than that of males? The question of why males have higher achievement than females even when they have taken the same mathematics courses has been investigated to some extent, with one finding being that teachers seem to provide more encouragement to males.[5] For example, teachers tend to call on male students more frequently and praise them more for their responses. The TIMSS data suggest that, internationally, we need more encouragement for females to take advanced mathematics courses in some countries, and more support for them in all countries once they are taking these courses.

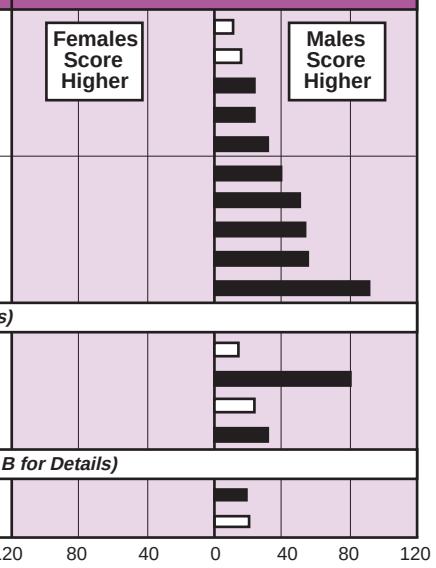
[5] Fennema, E. and Leder, G.C. (Eds.). (1990). *Mathematics and Gender.* New York: Teachers College Press.

Table 5.4

Gender Differences in Advanced Mathematics Achievement for Students Having Taken Advanced Mathematics

Final Year of Secondary School*

Country	Males		Females		Difference	MTCI	Gender Difference
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement			
† Greece	69 (2.1)	516 (6.6)	31 (2.1)	505 (10.2)	11 (12.1)	10%	
² Cyprus	61 (1.6)	524 (4.4)	39 (1.6)	509 (6.4)	15 (7.8)	9%	
Sweden	69 (3.4)	519 (5.9)	31 (3.4)	496 (5.2)	23 (7.9)	16%	
France	63 (2.0)	567 (5.1)	37 (2.0)	543 (5.1)	23 (7.2)	20%	
† Germany	43 (2.4)	484 (6.5)	57 (2.4)	452 (6.6)	32 (9.2)	26%	
Canada	53 (1.6)	528 (6.4)	47 (1.6)	489 (4.4)	39 (7.7)	16%	
¹ Lithuania	51 (1.9)	542 (3.7)	49 (1.9)	490 (5.6)	51 (6.7)	3%	
² Russian Federation	52 (2.4)	568 (9.7)	48 (2.4)	515 (10.2)	53 (14.1)	2%	
Switzerland	54 (2.4)	559 (5.6)	46 (2.4)	503 (5.7)	56 (8.0)	14%	
Czech Republic	41 (2.5)	524 (13.0)	59 (2.5)	432 (8.9)	92 (15.7)	11%	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)							
Australia	55 (5.5)	531 (11.4)	45 (5.5)	517 (15.1)	14 (18.9)	16%	
² Austria	38 (4.1)	486 (7.3)	62 (4.1)	406 (8.6)	80 (11.2)	33%	
¹ Italy	61 (3.8)	484 (10.6)	39 (3.8)	460 (14.1)	24 (17.7)	14%	
United States	51 (2.6)	457 (7.8)	49 (2.6)	426 (7.1)	31 (10.5)	14%	
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)							
Denmark	63 (1.8)	529 (4.4)	37 (1.8)	510 (4.6)	19 (6.3)	21%	
Slovenia	50 (4.2)	484 (11.5)	50 (4.2)	464 (11.0)	20 (15.9)	75%	



International Averages

Males	Females	Difference
519	482	37

(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 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 Well Did Students Having Taken Advanced Mathematics Perform in Mathematics and Science Literacy?

Table 5.5 contains the results on the mathematics and science literacy portion of the testing for students who had taken advanced mathematics. Because the students tested in literacy represented all students in their final year of secondary school, students who had taken advanced mathematics courses were necessarily included as part of the overall population. In 13 of the countries that participated in the literacy testing, it was possible to identify the students eligible for participation in the advanced mathematics testing and compute their literacy achievement.[6]

The results show that in every country students having taken advanced mathematics courses outperformed the overall population of final-year students in mathematics and science literacy. Interestingly, across the participating countries, the average difference was 70 points on the combined mathematics and science literacy test and also 70 points for the mathematics portion of the literacy test. Particularly large differences (more than 100 points, or a standard deviation on the literacy scales) were found in the Czech Republic and Sweden for both the composite mathematics and science literacy scale and the mathematics literacy scale. Understandably, the smallest differences were found in Slovenia, where a large percentage of the final-year student population has taken advanced mathematics.

[6] In addition, some students who had taken both advanced mathematics and physics courses were tested on part of the mathematics and science literacy test. Thus, it was also possible to estimate mathematics literacy, science literacy, and a composite mathematics and science literacy score for these students.

Table 5.5

Comparison Between All Students in Their Final Year of Secondary School and Final-Year Students Having Taken Advanced Mathematics in Mathematics and Science Literacy

Country	Mean Achievement				Overall TCI	Mathematics TCI
	Mathematics and Science Literacy		Mathematics Literacy			
	All Students	Advanced Mathematics Students	All Students	Advanced Mathematics Students		
Canada	526 (2.6)	587 (3.7)	519 (2.8)	588 (3.3)	70%	16%
[2] Cyprus	447 (2.5)	521 (6.1)	446 (2.5)	516 (6.5)	48%	9%
Czech Republic	476 (10.5)	582 (7.2)	466 (12.3)	573 (7.8)	78%	11%
France	505 (4.9)	572 (5.0)	523 (5.1)	592 (5.6)	84%	20%
[†] Germany	496 (5.4)	565 (4.1)	495 (5.9)	562 (4.4)	75%	26%
Sweden	555 (4.3)	664 (3.7)	552 (4.3)	661 (3.8)	71%	16%
Switzerland	531 (5.4)	618 (4.2)	540 (5.8)	619 (4.5)	82%	14%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)						
Australia	525 (9.5)	604 (8.1)	522 (9.3)	606 (7.6)	68%	16%
[2] Austria	519 (5.4)	567 (5.9)	518 (5.3)	564 (6.1)	76%	33%
[1] Italy	475 (5.3)	521 (9.5)	476 (5.5)	519 (10.4)	52%	14%
United States	471 (3.1)	554 (5.2)	461 (3.2)	551 (5.1)	63%	14%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)						
Denmark	528 (3.2)	594 (2.9)	547 (3.3)	613 (3.0)	58%	21%
Slovenia	514 (8.2)	531 (7.1)	512 (8.3)	530 (6.7)	88%	75%
International Average	505 (1.6)	575 (1.6)	506 (1.7)	576 (1.7)		

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

[†] 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.

The procedures used by Lithuania, the Russian Federation, and Denmark do not permit estimating literacy achievement for students taking advanced mathematics. Greece did not test the population of all students in their final year of secondary school.

Chapter 6

Achievement in Advanced Mathematics Content Areas

Recognizing that important curricular differences exist between and within countries is an important aspect of IEA studies, and TIMSS sought to measure achievement in different areas of advanced mathematics, which would be useful in relating achievement to curriculum. After much deliberation, the advanced mathematics test was designed to enable reporting by three content areas.[1] These three content areas are:

- Numbers, equations, and functions
- Calculus
- Geometry

The advanced mathematics test also included several items dealing with probability and statistics and several in the area of validation and structure. The results for these items were included in the scaling of the overall results, but there were too few items in these two categories to develop separate subscales.[2] The latter part of this chapter contains further information about the types of items within the advanced mathematics test, including six example items and the percentage of correct responses on those items for each of the participating TIMSS countries.

How Does Performance Compare Across Content Areas?

As discussed in Chapter 5, there were differences in achievement among the participating countries on the TIMSS advanced mathematics test. Given that the test was designed to include items from different curricular areas, it is important to examine whether the participating countries have particular strengths and weaknesses in their achievement in these areas.

Table 6.1 provides the subscale scores for the three major content areas in the advanced mathematics test. As indicated, the international averages for each of the subscales were arbitrarily set to be 500.[3] However, within those constraints the performance of each country was allowed to vary above or below the mean. Sometimes countries that did well on the overall advanced mathematics test generally did well in the three content areas for which there are separate results, and those that did poorly overall also tended to do so in each of the content areas. For example, the French students who performed above the international average overall also

[1] See the "Test Development" section of Appendix B for more information about the process used to develop the TIMSS tests. Appendix C provides an analysis of the match between the test and curriculum in the TIMSS countries and the effect of this match on the results.

[2] See the "IRT Scaling and Data Analysis" section of Appendix B for more details about the procedures used to obtain the subscales for the advanced mathematics content areas. However, the results for the three content area scales within advanced mathematics were the result of a separate multidimensional scaling effort.

[3] Final revisions of the data resulted in international averages of 501 for some of the advanced mathematics scales.

Table 6.1

Achievement in Advanced Mathematics Content Areas for Students Having Taken Advanced Mathematics

Final Year of Secondary School*

Country	MTCI	Advanced Mathematics Content Areas Mean Achievement Scale Scores		
		Numbers and Equations (17 items)	Calculus (15 items)	Geometry (23 items)
Canada	16%	● 512 (3.9)	● 503 (3.6)	● 499 (3.8)
[2] Cyprus	9%	● 510 (5.7)	▲ 561 (5.2)	▲ 517 (4.9)
Czech Republic	11%	▼ 460 (11.7)	▼ 446 (9.7)	● 494 (9.8)
France	20%	▲ 548 (4.1)	▲ 560 (3.0)	▲ 544 (3.8)
[†] Germany	26%	▼ 457 (5.0)	▼ 454 (4.4)	● 487 (5.5)
[†] Greece	10%	▲ 539 (7.2)	▲ 538 (7.3)	● 498 (8.7)
[1] Lithuania	3%	▲ 547 (2.8)	● 498 (2.5)	▲ 515 (2.8)
[2] Russian Federation	2%	▲ 555 (8.8)	▲ 537 (9.1)	▲ 548 (9.2)
Sweden	16%	▲ 523 (4.7)	▼ 480 (4.4)	● 492 (4.4)
Switzerland	14%	● 514 (5.2)	● 512 (5.7)	▲ 547 (4.2)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)				
Australia	16%	● 517 (9.4)	● 530 (11.7)	● 496 (12.5)
[2] Austria	33%	▼ 412 (7.4)	▼ 439 (6.5)	▼ 462 (7.9)
[1] Italy	14%	▼ 460 (9.2)	● 520 (10.4)	● 480 (9.5)
United States	14%	▼ 459 (5.3)	▼ 450 (4.1)	▼ 424 (5.1)
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)				
Denmark	21%	● 504 (2.7)	● 508 (3.3)	▲ 527 (3.1)
Slovenia	75%	● 491 (9.9)	▼ 471 (6.6)	▼ 476 (7.6)
International Average		501 (1.7)	501 (1.7)	500 (1.8)

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

▲ = Country average significantly higher than the international average for the scale

● = No significant difference between country average and international average for the scale

▼ = Country average significantly lower than the international average for the scale

* 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.

performed above the international average in each of the three content areas. Most countries, however, showed particular strengths or weaknesses. Sweden performed above the international average in numbers and equations, below the international average in calculus, and about at the international average in geometry. Switzerland performed above the international average in geometry, but only at the international average in numbers and equations and in calculus.

Figure 6.1 presents a visual profile of performance in the advanced mathematics content areas in each country. In this profile, the comparison is with the country's overall mean achievement, so that regardless of the performance of the country relative to that of other participants, particular strengths and weaknesses within the country can be identified. The horizontal line indicates each country's overall average achievement in advanced mathematics, and the three darkened boxes indicate the 95% confidence intervals around the mean achievement in each of the three major content areas. If the darkened box is below the line, then the country performed significantly less well in that content area than it did overall. Similarly, if the darkened box is above the line, then the country performed significantly better in that content area than it did overall.

The results in Figure 6.1 reveal that students in Cyprus performed relatively less well in numbers and equations and relatively better in calculus than they did on the advanced mathematics test as a whole. Students in the Czech Republic performed better in geometry than overall, and those in France had a relative strength in calculus. Students in Germany did relatively better in geometry and relatively worse in calculus than they did overall. Whereas the Greek students had a relative weakness in geometry, the Swiss students were particularly strong in that area. Students in both Lithuania and Sweden showed relative strength in numbers and equations, but had more difficulty in calculus than they did overall. Achievement in both Austria and Denmark was relatively lower in numbers and equations, and relatively higher in geometry. Students in Italy had relatively lower achievement in numbers and equations, and relatively higher achievement in calculus. Compared to their overall mean achievement, students in the United States performed better in numbers and equations and worse in geometry. For Australia, Canada, the Russian Federation, and Slovenia, performance in the individual content areas was not significantly different from their overall advanced mathematics scores.

Table 6.2 shows a number of statistically significant gender differences in achievement by content areas, all favoring males rather than females. Five countries, however, showed no significant differences – Cyprus, Greece, Australia, Italy, and Slovenia. Countries showing no significant gender differences in achievement in one or two content areas included France, Sweden, the United States, and Denmark in numbers and equations, Sweden and the United States in calculus, and Germany and Denmark in geometry.

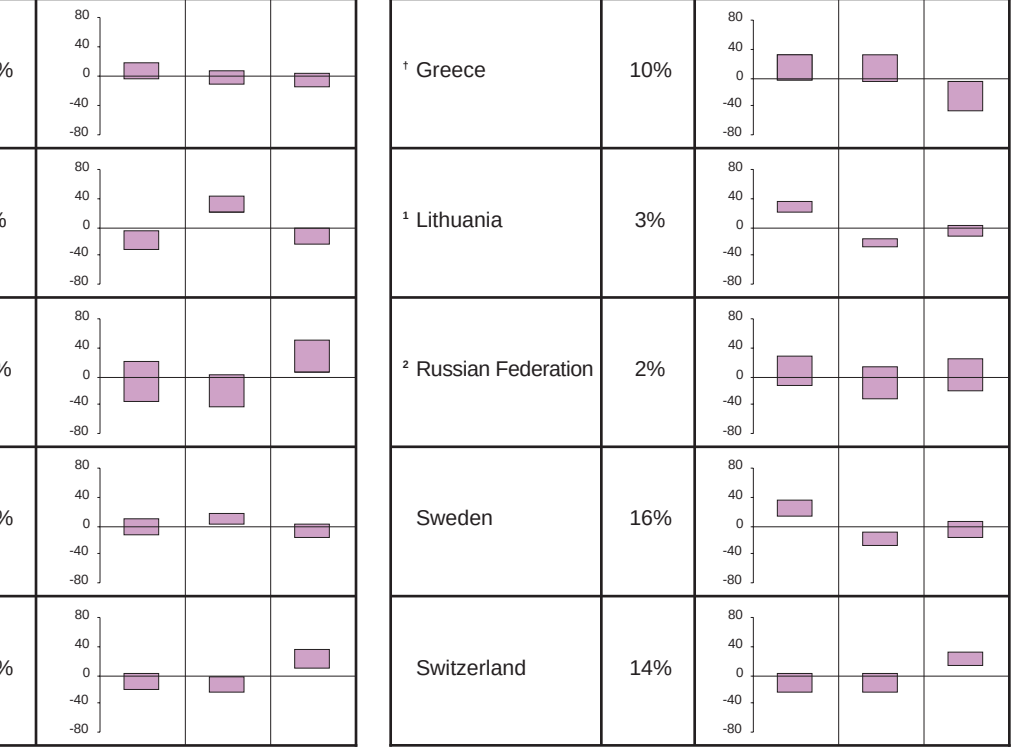
Considering the eighth-grade TIMSS results where the gender differences that did exist tended to favor boys, some of the gender differences in advanced mathematics for the final-year students might have been anticipated. Still, the eighth-grade results indicated few statistically significant differences by content area. For example, the gender differences in achievement were minimal in fractions and number sense as

Figure 6.1

Profiles of Performance in Advanced Mathematics Content Areas for Students Having Taken Advanced Mathematics

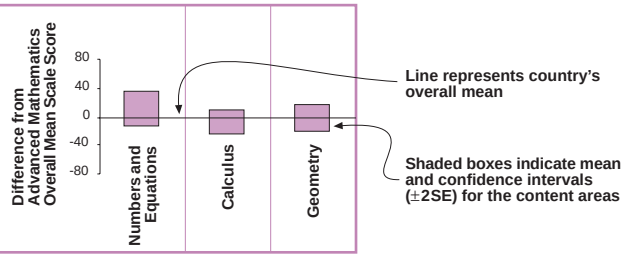
Final Year of Secondary School*

Country	MTCI	Numbers and Equations	Calculus	Geometry
Canada	16%			
[2] Cyprus	9%			
Czech Republic	11%			
France	20%			
[†] Germany	26%			
[†] Greece	10%			
[1] Lithuania	3%			
[2] Russian Federation	2%			
Sweden	16%			
Switzerland	14%			



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

Legend:



* 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).

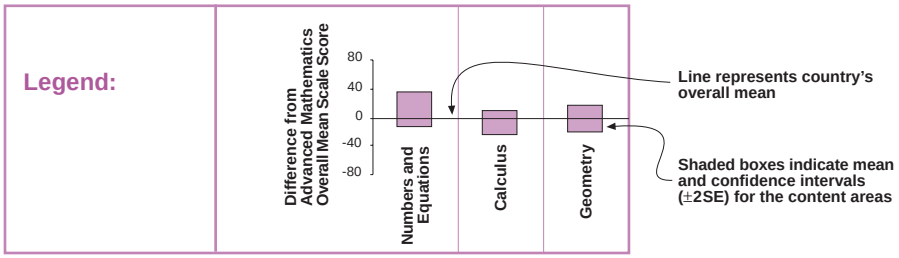
Figure 6.1 (Continued)

Profiles of Performance in Advanced Mathematics Content Areas for Students Having Taken Advanced Mathematics

Final Year of Secondary School*

Country	MTCI	Numbers and Equations	Calculus	Geometry
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):				
Australia	16%			
[2] Austria	33%			
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B):				
Denmark	21%			
[1] Italy	14%			
United States	14%			
Slovenia	75%			

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).

Table 6.2

Achievement in Advanced Mathematics Content Areas by Gender for Students Having Taken Advanced Mathematics

Final Year of Secondary School*

Country	MTCI	Advanced Mathematics Content Areas Mean Achievement Scale Scores					
		Numbers and Equations (17 items)		Calculus (15 items)		Geometry (23 items)	
		Females	Males	Females	Males	Females	Males
Canada	16%	496 (4.5)	▲ 526 (5.6)	484 (4.9)	▲ 521 (5.5)	482 (4.6)	▲ 516 (5.3)
[2] Cyprus	9%	497 (7.0)	518 (6.5)	562 (8.0)	559 (5.0)	512 (8.5)	520 (5.2)
Czech Republic	11%	427 (10.5)	▲ 510 (11.3)	417 (8.3)	▲ 488 (11.0)	461 (7.2)	▲ 543 (12.1)
France	20%	544 (3.9)	551 (5.4)	544 (4.1)	▲ 569 (4.3)	529 (4.8)	▲ 555 (5.7)
[†] Germany	26%	446 (5.1)	▲ 475 (6.2)	442 (5.2)	▲ 471 (5.6)	480 (5.6)	498 (7.0)
[†] Greece	10%	537 (10.4)	540 (9.1)	536 (12.0)	540 (8.2)	485 (15.4)	505 (7.5)
[1] Lithuania	3%	526 (5.4)	▲ 568 (3.0)	478 (4.8)	▲ 518 (4.3)	491 (5.8)	▲ 539 (3.6)
[2] Russian Federation	2%	533 (9.8)	▲ 576 (9.6)	512 (10.9)	▲ 560 (8.9)	525 (10.5)	▲ 570 (8.9)
Sweden	16%	511 (5.6)	529 (6.4)	472 (4.9)	484 (6.0)	476 (5.1)	▲ 500 (5.5)
Switzerland	14%	488 (5.7)	▲ 536 (5.7)	486 (6.2)	▲ 536 (6.8)	522 (5.9)	▲ 569 (3.8)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)							
Australia	16%	511 (11.2)	523 (9.9)	525 (12.2)	533 (13.6)	485 (13.8)	505 (14.1)
[2] Austria	33%	385 (9.3)	▲ 455 (6.2)	412 (7.3)	▲ 486 (6.9)	433 (9.6)	▲ 509 (7.7)
[1] Italy	14%	441 (14.1)	472 (10.6)	521 (13.5)	520 (11.4)	472 (14.5)	485 (10.4)
United States	14%	447 (6.9)	470 (6.1)	439 (6.1)	460 (5.3)	408 (7.0)	▲ 439 (5.8)
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)							
Denmark	21%	498 (3.5)	507 (3.6)	491 (5.4)	▲ 517 (4.3)	519 (4.0)	531 (4.2)
Slovenia	75%	480 (10.8)	503 (13.0)	463 (7.9)	479 (8.2)	469 (8.9)	482 (9.6)
International Average		485 (2.1)	▲ 516 (2.0)	487 (2.0)	▲ 515 (1.9)	484 (2.2)	▲ 517 (2.0)

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

▲ = Difference from other gender statistically significant at .05 level, adjusted for multiple comparisons

* 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.

well as in geometry. In algebra, while no differences in performance by gender were statistically significant, if anything girls may have had a slight edge. At the eighth grade, the greatest differences in performance by gender were found in measurement, where boys had higher achievement than girls in a number of countries.[4]

What Are Some Examples of Performance in Advanced Mathematics?

This section presents six example items from the advanced mathematics test, two from each of the three content areas. The performance results on each item are presented for each of the TIMSS countries, and the average across countries is also provided. The example items were chosen to illustrate the topics covered within each content area, the range of item formats used, and the range of difficulty.

Example Item 1, presented in Table 6.3, involves solving an algebraic inequality. On average across countries, almost three-fourths (73%) of the students having taken courses in advanced mathematics selected the correct answer. More than 80% of students in Cyprus, the Czech Republic, France, Greece, Lithuania, and the Russian Federation answered this question correctly.

Example Item 2 is a geometry item involving coordinates and geometric properties. There are several approaches to solving this problem. For example, students could have determined that the slopes of lines PQ and QR are negative reciprocals, and therefore are perpendicular lines creating a right angle at PQR. Students also may have plotted the triangle and either applied the Pythagorean theorem to determine the answer or simply looked at their plots. The results in Table 6.4 reveal substantial variation in performance across countries. For example, 70% or more of the students answered correctly in Lithuania, the Russian Federation, and Denmark. In contrast, fewer than half answered correctly in the Czech Republic, Greece, Australia, and the United States.

Even greater differences in performance across countries were found on Example Item 3, assessing students' understanding of combinations. Essentially, students needed to recognize that the problem involved determining how many combinations would occur from 11 examination questions taken 9 at a time, and that the choice involving the first two questions meant that the entire set of combinations for the remaining questions would occur twice. As shown in Table 6.5, 78% of the students in France answered this question correctly, compared with fewer than 40% in Germany, the Russian Federation, Italy, the United States, and Denmark.

In Example Item 4, students needed to understand that the first derivative is used to tell whether a function is increasing or decreasing, and the second derivative is used to indicate the concavity of a function. On average, 45% of the students across participating countries selected the function for which the first derivative is positive when

[4] 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.

x = 0 and negative when x = 1, and for which the graph of the function is always concave down (second derivative always negative). Students in Sweden had the best performance (61% correct).

Example Item 5, in which students needed to demonstrate their understanding of the integral, proved to be even more difficult. To answer the item correctly, students had to understand that if a curve lies above the x-axis, the integral represents the area under the curve, and if the curve lies below the x-axis, the integral represents the negative of the area between the curve and the x-axis. Thirty-five percent of students internationally selected the correct response, on average. The highest percentage correct was in Cyprus (51%), followed by Sweden (48%).

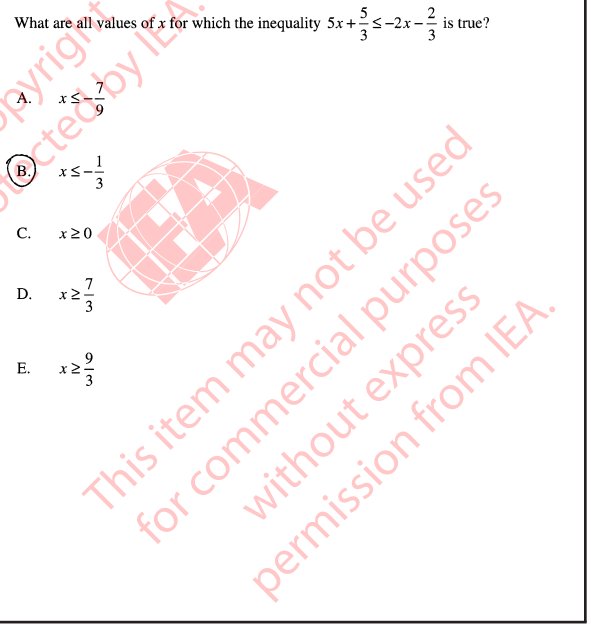
To solve Example Item 6, students had to use their visualization skills to recognize an application of the Pythagorean theorem. Essentially, as shown in the example response, students needed to represent the surface of the rod as a rectangle, draw the congruent segments indicating the string, calculate the length of one string segment using the Pythagorean theorem, and multiply that result by 4 for each of the segments. Most of the students responding correctly used this approach, although a handful used variations (e.g., half of surface represented as a rectangle using eight congruent segments). Students receiving partial credit used the general approach, but made numerical errors in calculating the length of string. Students in all participating countries found this problem very difficult. Only 10%, on average, provided a fully correct response, with another 2%, on average, receiving partial credit. Swedish students had the best performance, with 24% providing fully correct responses.

Figure 6.2 is a graphic representation of the relationship between performance on the TIMSS international mathematics scale and on the six example items from the advanced mathematics test.[5] Achievement on each example item is indicated both by the average percentage of fully correct responses across all countries and by the international advanced mathematics scale value, or item difficulty level. Since the scale was based on the performance of students in all countries, the international scale values apply to all countries. As can be seen, the advanced mathematics test was quite difficult for students in a number of countries. Students achieving below the international average were unlikely to provide fully correct responses to many of the example items. Still, a less difficult test would have been too easy for the top 5% of the students in some countries. For example, average achievement for the top 5% of the students in Australia, France, and Slovenia ranged from 643 to 664. These students were likely to have answered all but the most difficult items correctly.

[5] 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 6.3 Advanced Mathematics

Percent Correct for Example Item 1 for Students Having Taken Advanced Mathematics Final Year of Secondary School*

Country	Percent Correct	MTCI	Example 1 Values of X for an inequality. Content Category: Numbers, Equations and Functions
Canada	68 (2.4)	16%	
[2] Cyprus	81 (3.4)	9%	
Czech Republic	84 (4.4)	11%	
France	85 (2.1)	20%	
[†] Germany	56 (2.6)	26%	
[†] Greece	83 (4.0)	10%	
[1] Lithuania	96 (0.7)	3%	
[2] Russian Federation	86 (2.9)	2%	
Sweden	58 (3.8)	16%	
Switzerland	69 (3.7)	14%	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	68 (5.3)	16%	
[2] Austria	43 (4.1)	33%	
[1] Italy	73 (5.7)	14%	
United States	68 (2.3)	14%	
Countries with Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	78 (2.4)	21%	
Slovenia	71 (3.9)	75%	
International Average Percent Correct	73 (0.9)		

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 totals may appear inconsistent.

Table 6.4 Advanced Mathematics

Percent Correct for Example Item 2 for Students Having Taken Advanced Mathematics Final Year of Secondary School*

Country	Percent Correct	MTCI	Example 2 Vertices right angle triangle. Content Category: Geometry
Canada	52 (2.0)	16%	The vertices of the triangle PQR are the points P(1, 2), Q(4, 6) and R(− 4, 12). Which one of the following statements about triangle PQR is true? A. PQR is a right triangle with the right angle ∠P. B. PQR is a right triangle with the right angle ∠Q. C. PQR is a right triangle with the right angle ∠R. D. PQR is not a right triangle.
[2] Cyprus	51 (4.3)	9%	
Czech Republic	48 (3.5)	11%	
France	64 (2.9)	20%	
[†] Germany	51 (2.8)	26%	
[†] Greece	36 (4.2)	10%	
[1] Lithuania	70 (3.3)	3%	
[2] Russian Federation	70 (3.9)	2%	
Sweden	60 (2.8)	16%	
Switzerland	62 (3.2)	14%	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	46 (4.1)	16%	
[2] Austria	52 (4.2)	33%	
[1] Italy	55 (6.7)	14%	
United States	47 (4.6)	14%	
Countries with Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	71 (2.5)	21%	
Slovenia	54 (3.1)	75%	
International Average Percent Correct	55 (0.9)		

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 totals may appear inconsistent.

Table 6.5 Advanced Mathematics

Percent Correct for Example Item 3 for Students Having Taken Advanced Mathematics Final Year of Secondary School*

Country	Percent Correct	MTCI	Example 3 Contributions of examination question choices. Content Category: Numbers, Equations and Functions
Canada	50 (2.7)	16%	
[2] Cyprus	63 (4.7)	9%	
Czech Republic	42 (3.5)	11%	
France	78 (3.7)	20%	
† Germany	35 (2.8)	26%	
† Greece	46 (3.7)	10%	
[1] Lithuania	47 (2.9)	3%	
[2] Russian Federation	32 (3.1)	2%	
Sweden	46 (3.6)	16%	
Switzerland	57 (3.5)	14%	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	70 (4.8)	16%	
[2] Austria	40 (3.7)	33%	
[1] Italy	27 (5.3)	14%	
United States	36 (2.6)	14%	
Countries with Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	39 (2.9)	21%	
Slovenia	51 (3.6)	75%	
International Average Percent Correct	47 (0.9)		

An examination consists of 13 questions. A student must answer only one of the first two questions and only nine of the remaining ones. How many choices of questions does the student have?

A. $^{13}C_{10} = 286$

B. $^{11}C_{8} = 165$

C. $2 \times {}^{11}C_{9} = 110$

D. $2 \times {}^{11}P_{2} = 220$

E. some other number

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).

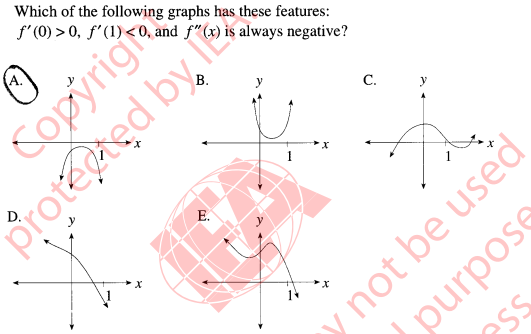
[1] National Desired Population does not cover all of International Desired Population (see Table B.4).

[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 totals may appear inconsistent.

Table 6.6 Advanced Mathematics

Percent Correct for Example Item 4 for Students Having Taken Advanced Mathematics Final Year of Secondary School*

Country	Percent Correct	MTCI	Example 4 Derivatives. Content Category: Calculus
Canada	47 (3.1)	16%	
[2] Cyprus	36 (5.0)	9%	
Czech Republic	39 (3.5)	11%	
France	52 (2.7)	20%	
† Germany	38 (2.5)	26%	
† Greece	37 (5.2)	10%	
[1] Lithuania	43 (2.9)	3%	
[2] Russian Federation	48 (4.0)	2%	
Sweden	61 (4.8)	16%	
Switzerland	45 (4.0)	14%	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	52 (4.0)	16%	
[2] Austria	42 (4.2)	33%	
[1] Italy	42 (7.6)	14%	
United States	47 (4.5)	14%	
Countries with Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	49 (3.0)	21%	
Slovenia	39 (3.7)	75%	
International Average Percent Correct	45 (1.1)		

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).

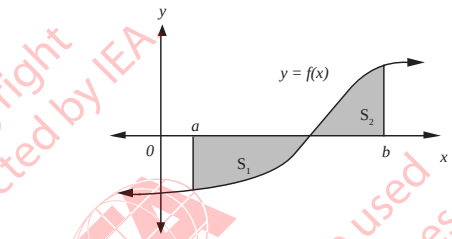
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

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

Table 6.7 Advanced Mathematics

Percent Correct for Example Item 5 for Students Having Taken Advanced Mathematics Final Year of Secondary School*

Country	Percent Correct	MTCI	Example 5 Graph of y = f(x). Content Category: Calculus
Canada	28 (2.8)	16%	
[2] Cyprus	51 (4.3)	9%	
Czech Republic	25 (4.0)	11%	
France	39 (2.8)	20%	
[†] Germany	26 (2.7)	26%	
[†] Greece	32 (6.0)	10%	
[1] Lithuania	31 (2.6)	3%	
[2] Russian Federation	43 (3.8)	2%	
Sweden	48 (3.4)	16%	
Switzerland	44 (4.1)	14%	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	35 (3.4)	16%	
[2] Austria	19 (3.0)	33%	
[1] Italy	42 (7.6)	14%	
United States	27 (2.1)	14%	
Countries with Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	39 (2.9)	21%	
Slovenia	25 (3.6)	75%	
International Average Percent Correct	35 (1.0)		



This figure shows the graph of $y = f(x)$.
S_1 is the area enclosed by the x- axis, $x = a$ and $y = f(x)$;
S_2 is the area enclosed by the x- axis, $x = b$ and $y = f(x)$;
where $a < b$ and $0 < S_2 < S_1$.

The value of $\int_a^b f(x)dx$ is

A. $S_1 + S_2$

B. $S_1 - S_2$

C. $S_2 - S_1$

D. $|S_1 - S_2|$

E. $\frac{1}{2}(S_1 + S_2)$

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 totals may appear inconsistent.

Table 6.8 Advanced Mathematics

Percent Correct for Example Item 6 for Students Having Taken Advanced Mathematics Final Year of Secondary School*

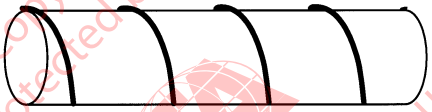
Country	Percent Partially Correct	Percent Fully Correct	MTCI
Canada	1 (0.3)	12 (1.6)	16%
[2] Cyprus	2 (1.3)	0 (0.0)	9%
Czech Republic	4 (1.3)	8 (2.0)	11%
France	2 (1.0)	4 (1.6)	20%
[†] Germany	1 (0.5)	8 (1.9)	26%
[†] Greece	1 (0.9)	5 (2.0)	10%
[1] Lithuania	1 (0.6)	18 (2.3)	3%
[2] Russian Federation	2 (1.1)	12 (2.7)	2%
Sweden	1 (0.5)	24 (4.0)	16%
Switzerland	1 (0.6)	17 (3.7)	14%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	1 (0.9)	14 (3.1)	16%
[2] Austria	2 (1.2)	9 (2.6)	33%
[1] Italy	3 (2.3)	6 (3.5)	14%
United States	0 (0.2)	4 (0.9)	14%
Countries with Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	2 (0.8)	11 (2.1)	21%
Slovenia	1 (0.6)	5 (1.3)	75%
International Average Percent Correct	2 (0.3)	10 (0.6)	

Example 6

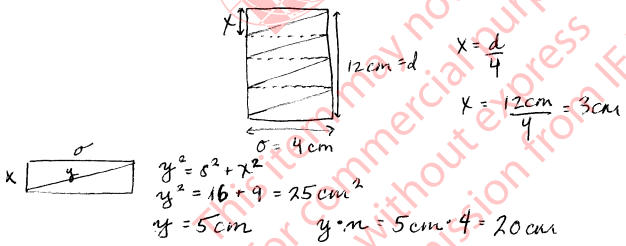
Length of string around rod.

Content Category: Geometry

A string is wound symmetrically around a circular rod. The string goes exactly 4 times around the rod. The circumference of the rod is 4 cm and its length is 12 cm.



Find the length of the string. Show all your work.



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).

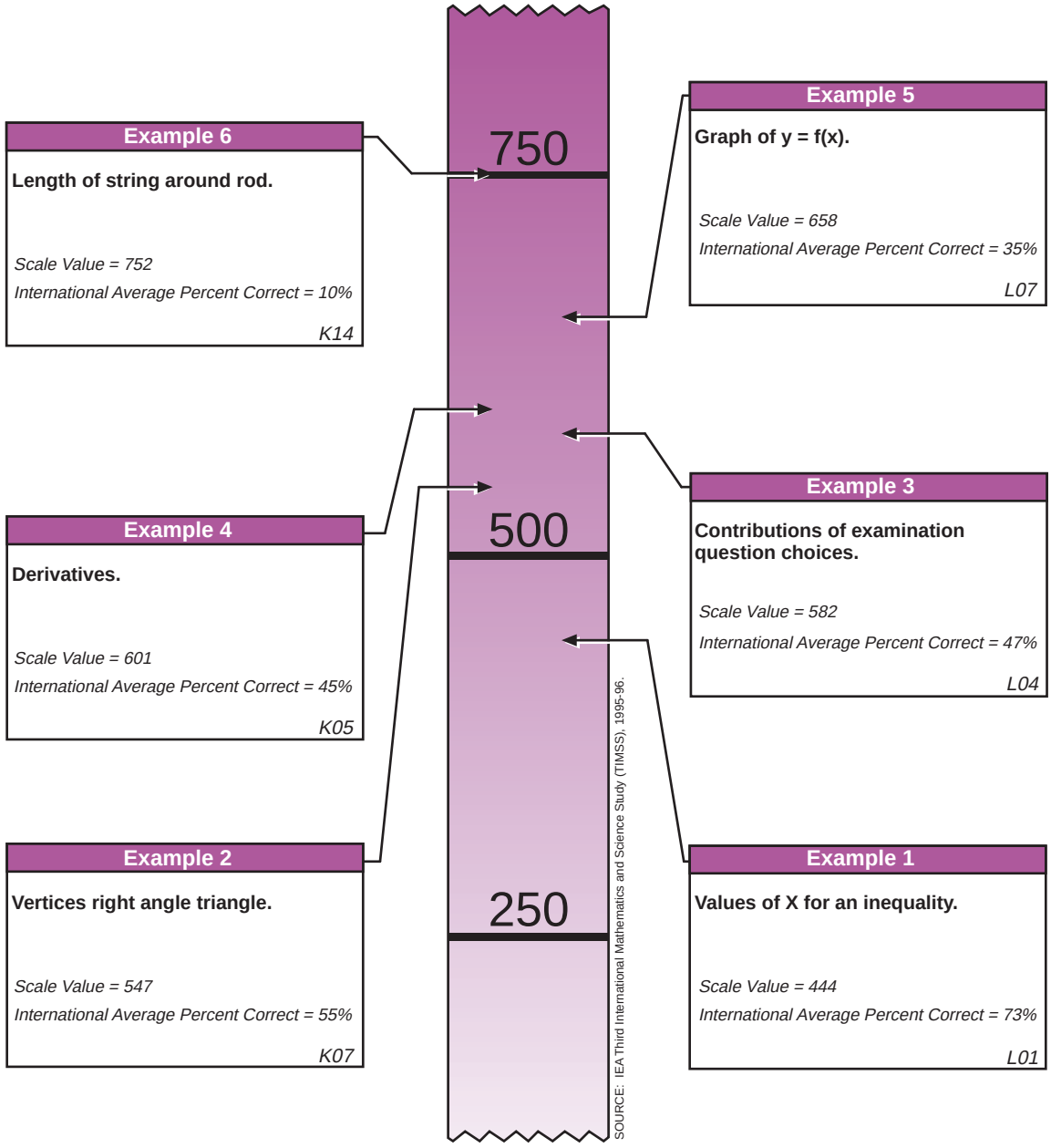
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table B.4).

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

Figure 6.2

International Difficulty Map for Advanced Mathematics Example Items for Students Having Taken Advanced Mathematics

Final Year of Secondary School*



* See Appendix A for characteristics of students sampled.

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

Chapter 7

Contexts for Advanced Mathematics Achievement

This chapter focuses on the instructional experiences of students having taken advanced mathematics: the amount of mathematics instruction and homework they receive each week, the kinds of activities in which they engage in mathematics class, and their use of calculators and computers. This chapter also presents advanced mathematics students' reports on the educational level of their parents, and describes students' own plans for future study and employment.

What Are the Instructional Practices in Advanced Mathematics Classes?

As shown in Table 7.1, the amount of instructional time per week reported by students taking advanced mathematics in their final year varied considerably across countries. Although the majority of students in many TIMSS countries reported receiving from three to five hours of mathematics instruction each week, in Austria and Sweden more than 60% of the students had less than three hours each week, and in Australia, Canada, Cyprus, France, Greece, and the Russian Federation, the majority of students had five hours or more. In some countries, courses are scheduled by semesters rather than full years, so some students who had studied advanced mathematics prior to their final year or during the first semester might not have been taking a mathematics class at the time they completed the TIMSS questionnaire. About 20% of the students in Austria and Canada as well as 8% in the United States reported that they were not currently taking mathematics.

For students taking mathematics, there was considerable variation across countries in the relationship between mathematics achievement and amount of weekly instruction. Although the most common was a curvilinear relationship, with the highest achievement associated with the middle amounts of instruction reported by students, sometimes the students receiving five hours or more of weekly mathematics instruction were those with the highest average achievement.

Table 7.2 reveals that the amount of homework assigned to final-year students taking advanced mathematics also varies considerably from country to country. At one extreme, more than 40% of the students in the Czech Republic and Sweden reported that they were assigned mathematics homework less than once a week, while at the other extreme, more than 80% of the students in Australia, Canada, Cyprus, Greece, Lithuania, the Russian Federation, and the United States reported having homework assigned three or more times a week. Although the relationship between amount of homework assigned and mathematics achievement was not consistent across countries, in about half of them average achievement was highest among students who reported that mathematics homework was assigned three or more times a week.

Table 7.1

Advanced Mathematics Students' Reports on the Amount of Mathematics Instruction They Are Currently Receiving Each Week – Advanced Mathematics

Final Year of Secondary School*

Country	Not Currently Taking Mathematics		Amount of Mathematics Instruction Per Week[1]							
			Less Than 3 Hours		3 to Less Than 4 Hours		4 to Less Than 5 Hours		5 Hours or More	
	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	0 (0.1)	~ ~	1 (0.4)	~ ~	16 (3.3)	455 (17.3)	17 (2.4)	469 (24.5)	66 (3.8)	557 (9.7)
Austria	21 (3.2)	405 (18.6)	73 (3.7)	437 (8.6)	6 (2.8)	488 (32.7)	7 (2.3)	490 (19.6)	14 (2.5)	438 (12.9)
Canada	19 (1.4)	491 (10.0)	4 (0.9)	497 (18.3)	14 (2.1)	481 (6.7)	15 (2.3)	539 (10.9)	67 (2.6)	516 (4.6)
Cyprus	0 (0.0)	~ ~	1 (0.6)	~ ~	1 (0.5)	~ ~	1 (0.4)	~ ~	97 (0.9)	520 (4.5)
Czech Republic	0 (0.0)	~ ~	48 (5.2)	416 (8.4)	37 (4.3)	485 (8.6)	10 (2.0)	565 (22.9)	5 (1.8)	648 (31.4)
[2] *Denmark*	1 (0.3)	~ ~	0 (0.0)	~ ~	100 (0.0)	523 (3.5)	0 (0.0)	~ ~	0 (0.0)	~ ~
France	0 (0.0)	~ ~	1 (0.4)	~ ~	1 (0.3)	~ ~	2 (0.6)	~ ~	97 (0.7)	559 (3.9)
Germany	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Greece	0 (0.0)	~ ~	0 (0.0)	~ ~	0 (0.0)	~ ~	0 (0.0)	~ ~	100 (0.0)	515 (5.9)
Italy	0 (0.0)	~ ~	46 (6.1)	475 (17.8)	29 (7.8)	473 (15.9)	19 (7.4)	475 (9.4)	5 (1.7)	465 (30.4)
Lithuania	0 (0.2)	~ ~	0 (0.1)	~ ~	15 (1.3)	528 (5.2)	64 (1.5)	523 (4.1)	20 (1.3)	488 (6.3)
Russian Federation	0 (0.1)	~ ~	14 (3.1)	448 (19.8)	8 (2.1)	505 (17.6)	24 (4.4)	537 (14.9)	54 (4.4)	573 (10.1)
Slovenia	0 (0.0)	~ ~	20 (3.2)	390 (8.9)	77 (3.3)	498 (8.7)	3 (1.1)	465 (30.6)	0 (0.2)	~ ~
Sweden	2 (1.2)	~ ~	64 (5.7)	513 (4.8)	29 (5.1)	522 (9.3)	6 (1.3)	503 (17.5)	1 (0.4)	~ ~
Switzerland	1 (0.4)	~ ~	16 (4.2)	504 (11.6)	63 (4.3)	520 (6.3)	8 (1.4)	594 (8.1)	12 (1.6)	607 (11.6)
United States	8 (1.3)	390 (16.5)	7 (0.8)	413 (12.9)	36 (4.4)	460 (9.5)	46 (4.2)	447 (8.1)	12 (1.1)	445 (8.4)

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

* See Appendix A for characteristics of the students sampled.

[1] Percentages based only on those students reporting that they are currently taking mathematics. Hours of instruction computed from lessons per week and minutes per lesson.

[2] Data for Denmark obtained from ministry.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.5).

( ) 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 7.2

Advanced Mathematics Students' Reports on How Often They Are Assigned Mathematics Homework – Advanced Mathematics

Final Year of Secondary School*

Country	Not Currently Taking Mathematics		How Often Mathematics Homework Is Assigned[1]					
			Less Than Once a Week		Once or Twice a Week		3 or More Times a Week	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	0 (0.1)	~ ~	5 (1.4)	525 (25.1)	8 (1.1)	529 (21.8)	87 (2.0)	525 (12.4)
Austria	21 (3.2)	405 (18.6)	11 (2.7)	415 (27.9)	47 (3.8)	442 (7.1)	41 (4.1)	464 (8.3)
Canada	19 (1.4)	491 (10.0)	5 (1.1)	562 (28.5)	11 (1.7)	522 (13.0)	84 (2.6)	510 (4.4)
Cyprus	0 (0.0)	~ ~	1 (0.5)	~ ~	1 (0.5)	~ ~	98 (0.8)	519 (4.2)
Czech Republic	0 (0.0)	~ ~	41 (5.0)	455 (15.3)	37 (3.3)	472 (13.3)	21 (3.4)	491 (15.2)
Denmark	1 (0.3)	~ ~	3 (0.6)	507 (22.8)	32 (2.4)	520 (5.5)	65 (2.6)	526 (4.1)
France	0 (0.0)	~ ~	16 (2.2)	568 (7.4)	23 (2.2)	547 (5.6)	61 (2.4)	559 (3.8)
Germany	- -	- -	- -	- -	- -	- -	- -	- -
Greece	0 (0.0)	~ ~	7 (2.0)	505 (39.3)	6 (1.5)	527 (23.0)	87 (2.6)	515 (6.9)
Italy	0 (0.0)	~ ~	10 (2.4)	468 (18.7)	21 (2.8)	465 (15.6)	69 (4.3)	478 (9.7)
Lithuania	0 (0.2)	~ ~	8 (0.7)	554 (12.0)	9 (1.4)	524 (10.7)	83 (1.5)	512 (3.7)
Russian Federation	0 (0.1)	~ ~	2 (1.0)	~ ~	9 (1.9)	528 (32.2)	89 (2.2)	541 (8.1)
Slovenia	0 (0.0)	~ ~	20 (3.2)	451 (17.6)	23 (2.7)	446 (14.6)	57 (4.7)	495 (8.9)
Sweden	2 (1.2)	~ ~	46 (4.2)	521 (7.4)	51 (4.3)	507 (6.0)	4 (0.8)	488 (11.5)
Switzerland	1 (0.4)	~ ~	17 (3.2)	533 (10.0)	44 (3.3)	529 (5.7)	40 (4.2)	541 (9.4)
United States	8 (1.3)	390 (16.5)	3 (0.7)	410 (34.0)	7 (1.2)	409 (13.3)	90 (1.5)	453 (5.8)

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

* See Appendix A for characteristics of the students sampled.

[1] Percentages based only on those students reporting that they are currently taking mathematics.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.5).

( ) 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.

To examine instructional activities in their classrooms, advanced mathematics students were asked how often they are asked to do reasoning tasks, apply mathematics to everyday problems, solve equations, apply models to data, and use computers to do exercises or solve problems. Reasoning tasks appear to be universally required in mathematics class (see Table 7.3), with almost all students in all countries reporting such tasks in at least some lessons. In almost every country, the students with the highest achievement were those that reported engaging in reasoning tasks most frequently.

Applying mathematics to everyday problems happens less frequently in mathematics classes in most of the TIMSS countries (see Table 7.4). One-third or more of the students in Austria, the Czech Republic, France, Germany, Greece, Italy, Lithuania, Sweden, and Switzerland reported that they are never or almost never asked to do this. However, more than one-third of the students in Australia, Canada, and the United States reported that they apply mathematics to everyday problems in most or all lessons. In almost every country, the relationship between mathematics achievement and frequency of applying mathematics to everyday problems was curvilinear, with the highest average achievement occurring among those applying mathematics to everyday problems in some or most lessons. This may reflect a tendency by instructors to spend more time on concrete applications with the less advanced students.

Algebra is an essential component of mathematics in upper secondary school, and students in every country reported that they are often asked to solve equations in mathematics class (see Table 7.5). Countries where this activity was reported to be most frequent included Australia, Canada, Cyprus, Germany, and the United States. In these countries, 50% or more of the advanced mathematics students reported being asked to solve equations in every lesson. Spending time working on equations is also an indicator of high achievement in mathematics; in almost every country, the final-year students with the highest average achievement were those who reported spending the most time solving equations.

In contrast, students in most countries reported that they are asked to apply models to data only in some lessons, or never (Table 7.6). This activity was reportedly least common in Austria, the Czech Republic, and Denmark. Countries where mathematics classes were reported to include modeling data most frequently included Cyprus, France, Greece, Italy, Sweden, and the United States, where upwards of 30% of students reported this activity in most or all lessons. There was no consistent relationship between mathematics achievement and reported frequency of applying models to data.

Final-year advanced mathematics students reported that the use of computers to do exercises or solve problems in mathematics class is comparatively rare. In eight countries, Austria, Canada, the Czech Republic, France, Germany, Lithuania, the Russian Federation, and Switzerland, 80% or more of the students reported never or almost never using computers in mathematics classes (see Table 7.7). Only in Cyprus and Slovenia did more than 20% of students report using a computer in most or all mathematics lessons. There was no consistent relationship between computer use in mathematics class and mathematics achievement.

Table 7.3

Advanced Mathematics Students' Reports on How Often They Are Asked to Do Reasoning Tasks in Their Mathematics Lessons[1] – Advanced Mathematics

Final Year of Secondary School*

Country	Never or Almost Never		Some Lessons		Most Lessons		Every Lesson	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	1 (0.6)	~ ~	15 (2.4)	511 (15.2)	51 (2.5)	517 (12.5)	34 (3.5)	544 (14.4)
Austria	r 4 (0.7)	405 (30.0)	30 (2.8)	440 (10.9)	49 (2.7)	452 (7.9)	17 (1.9)	444 (10.1)
Canada	0 (0.1)	~ ~	15 (0.8)	490 (8.8)	53 (1.4)	506 (4.7)	32 (1.3)	525 (7.3)
Cyprus	1 (0.0)	~ ~	8 (1.4)	490 (16.0)	40 (2.2)	509 (6.0)	52 (2.0)	531 (6.0)
Czech Republic	0 (0.0)	~ ~	11 (1.3)	422 (10.3)	56 (2.5)	465 (8.2)	34 (2.7)	491 (20.1)
Denmark	2 (0.5)	~ ~	17 (1.4)	508 (6.9)	59 (1.3)	524 (4.6)	23 (1.2)	531 (5.8)
France	0 (0.2)	~ ~	10 (1.0)	542 (7.3)	56 (1.5)	561 (5.4)	33 (1.4)	558 (4.5)
Germany	1 (0.3)	~ ~	18 (1.4)	459 (11.3)	49 (1.9)	467 (5.4)	31 (1.2)	470 (6.3)
Greece	0 (0.3)	~ ~	4 (1.1)	477 (33.8)	37 (1.9)	481 (10.5)	59 (2.3)	540 (6.5)
Italy	2 (0.6)	~ ~	19 (2.3)	442 (13.1)	47 (3.6)	470 (11.3)	33 (4.0)	501 (12.8)
Lithuania	1 (0.3)	~ ~	18 (1.6)	494 (6.8)	60 (1.8)	518 (4.7)	21 (1.7)	531 (7.9)
Russian Federation	1 (0.4)	~ ~	23 (2.1)	486 (7.8)	48 (1.6)	544 (10.6)	27 (2.2)	590 (9.8)
Slovenia	5 (0.8)	391 (15.2)	42 (1.9)	459 (8.7)	43 (1.9)	490 (9.7)	10 (1.3)	520 (17.3)
Sweden	0 (0.0)	~ ~	12 (1.1)	498 (12.8)	51 (2.3)	507 (4.5)	37 (2.2)	523 (6.8)
Switzerland	0 (0.1)	~ ~	13 (1.3)	495 (5.1)	55 (1.3)	533 (5.4)	32 (1.4)	549 (8.3)
United States	0 (0.1)	~ ~	11 (0.9)	403 (12.4)	46 (1.5)	435 (5.6)	43 (1.7)	464 (6.3)

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

[1] Based on most frequent response for: explain reasoning behind an idea; represent and analyze relationship using tables, charts, or graphs; work on problems for which there is no immediately obvious method solution; and write equations to represent relationships.

* 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.5).

( ) 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.

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

Table 7.4

Advanced Mathematics Students' Reports on How Often They Are Asked to Apply Mathematics to Everyday Problems in Their Mathematics Lessons – Advanced Mathematics Final Year of Secondary School*

Country	Never or Almost Never		Some Lessons		Most Lessons		Every Lesson	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	11 (1.6)	508 (20.0)	42 (2.3)	532 (12.9)	35 (2.5)	523 (11.7)	12 (1.7)	524 (19.5)
Austria	r 33 (3.4)	426 (9.3)	46 (3.0)	456 (8.2)	16 (1.6)	463 (9.9)	5 (1.3)	403 (30.7)
Canada	14 (1.0)	484 (10.5)	48 (1.1)	513 (4.9)	26 (1.1)	522 (5.9)	11 (0.8)	492 (8.2)
Cyprus	28 (2.7)	515 (6.5)	52 (2.4)	525 (6.8)	15 (2.0)	510 (12.5)	5 (1.2)	498 (15.2)
Czech Republic	38 (3.0)	449 (14.3)	54 (2.9)	483 (9.2)	8 (0.8)	462 (16.2)	0 (0.2)	~ ~
Denmark	27 (1.8)	513 (5.3)	52 (1.6)	529 (4.6)	20 (1.5)	525 (6.5)	2 (0.4)	~ ~
France	34 (1.7)	556 (4.9)	50 (1.4)	564 (5.5)	10 (1.1)	546 (9.4)	6 (0.7)	536 (10.7)
Germany	45 (2.8)	451 (6.6)	44 (2.5)	482 (5.7)	9 (1.2)	473 (7.7)	2 (0.5)	~ ~
Greece	34 (2.5)	512 (8.9)	54 (2.0)	520 (7.3)	9 (1.3)	513 (19.3)	3 (0.8)	469 (27.5)
Italy	67 (3.5)	472 (7.9)	26 (2.9)	483 (16.7)	5 (1.2)	465 (21.1)	3 (0.7)	417 (17.7)
Lithuania	46 (1.8)	511 (4.2)	40 (1.7)	521 (5.8)	11 (1.1)	525 (8.6)	3 (0.8)	529 (17.9)
Russian Federation	23 (1.3)	531 (9.8)	58 (1.4)	549 (9.9)	15 (1.1)	538 (11.2)	4 (0.5)	531 (37.4)
Slovenia	25 (1.8)	448 (9.2)	56 (2.4)	487 (9.9)	16 (1.2)	478 (11.6)	3 (0.5)	472 (12.6)
Sweden	36 (2.7)	498 (6.5)	53 (2.5)	524 (6.5)	10 (1.2)	503 (14.1)	1 (0.4)	~ ~
Switzerland	43 (2.4)	514 (6.5)	49 (2.3)	545 (6.3)	7 (0.9)	573 (13.2)	1 (0.4)	~ ~
United States	15 (1.4)	438 (13.1)	42 (1.3)	449 (7.6)	27 (1.4)	447 (5.3)	16 (1.1)	427 (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.5).

( ) 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.

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

Table 7.5

Advanced Mathematics Students' Reports on How Often They Are Asked to Solve Equations in Their Mathematics Lessons – Advanced Mathematics

Final Year of Secondary School*

Country	Never or Almost Never		Some Lessons		Most Lessons		Every Lesson	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	2 (0.8)	~ ~	9 (1.1)	488 (16.6)	39 (3.1)	529 (14.8)	50 (2.9)	530 (12.8)
Austria	r 7 (1.7)	371 (15.2)	26 (2.6)	438 (7.5)	50 (3.5)	449 (9.1)	17 (2.1)	475 (11.5)
Canada	1 (0.2)	~ ~	9 (0.7)	490 (8.2)	37 (1.5)	506 (5.5)	53 (1.3)	517 (5.8)
Cyprus	2 (0.5)	~ ~	10 (1.4)	491 (14.9)	38 (1.9)	509 (8.1)	50 (2.2)	534 (7.2)
Czech Republic	0 (0.2)	~ ~	36 (1.8)	456 (10.4)	46 (1.8)	475 (11.3)	17 (1.8)	482 (23.0)
Denmark	2 (0.6)	~ ~	17 (1.5)	511 (7.7)	58 (1.8)	524 (4.1)	23 (1.5)	531 (5.6)
France	1 (0.4)	~ ~	21 (1.4)	549 (5.5)	52 (1.7)	560 (4.7)	25 (1.3)	559 (5.0)
Germany	1 (0.2)	~ ~	12 (1.5)	458 (6.8)	37 (1.5)	463 (6.3)	51 (2.3)	472 (6.2)
Greece	1 (0.5)	~ ~	14 (1.9)	467 (17.5)	40 (2.4)	514 (8.0)	46 (2.8)	533 (7.6)
Italy	2 (0.6)	~ ~	20 (2.6)	451 (11.5)	38 (2.9)	464 (11.0)	40 (3.3)	500 (13.6)
Lithuania	1 (0.2)	~ ~	10 (1.4)	499 (12.7)	57 (1.9)	512 (6.0)	33 (1.8)	528 (5.8)
Russian Federation	0 (0.2)	~ ~	10 (1.4)	484 (13.7)	49 (1.8)	530 (9.2)	41 (2.6)	570 (9.5)
Slovenia	2 (0.4)	~ ~	26 (1.9)	446 (12.7)	49 (2.0)	480 (9.2)	24 (1.9)	502 (10.4)
Sweden	0 (0.2)	~ ~	13 (1.4)	494 (11.1)	52 (1.4)	505 (5.1)	35 (1.9)	531 (6.5)
Switzerland	2 (0.6)	~ ~	18 (1.5)	510 (5.4)	54 (1.9)	529 (5.8)	26 (1.6)	561 (10.2)
United States	0 (0.1)	~ ~	6 (0.8)	415 (12.8)	28 (1.2)	437 (6.2)	66 (1.2)	450 (5.8)

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.5).

( ) 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.

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

Table 7.6

Advanced Mathematics Students' Reports on How Often They Are Asked to Apply Models to Data in Their Mathematics Lessons – Advanced Mathematics
Final Year of Secondary School*

Country	Never or Almost Never		Some Lessons		Most Lessons		Every Lesson	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	24 (3.2)	514 (15.8)	51 (3.4)	529 (10.9)	22 (3.2)	532 (20.2)	3 (0.9)	513 (34.0)
Austria	r 60 (2.5)	441 (8.2)	29 (2.5)	449 (9.6)	9 (1.1)	473 (12.4)	2 (0.7)	~ ~
Canada	30 (1.7)	488 (5.7)	43 (1.7)	513 (5.4)	20 (1.5)	524 (6.0)	7 (0.6)	543 (15.6)
Cyprus	18 (1.7)	515 (10.9)	41 (2.3)	519 (8.1)	25 (1.9)	521 (9.7)	16 (2.0)	522 (10.6)
Czech Republic	76 (2.1)	468 (12.8)	22 (1.9)	475 (10.6)	2 (0.5)	~ ~	0 (0.2)	~ ~
Denmark	56 (2.5)	519 (4.2)	38 (2.4)	531 (4.8)	5 (0.9)	512 (12.5)	1 (0.3)	~ ~
France	10 (1.0)	561 (9.7)	39 (1.7)	555 (5.1)	37 (1.9)	563 (5.8)	14 (1.6)	547 (6.7)
Germany	43 (1.3)	455 (6.6)	38 (1.3)	475 (6.1)	14 (1.2)	480 (6.2)	5 (0.6)	466 (9.4)
Greece	23 (3.0)	507 (11.1)	42 (2.3)	513 (9.5)	25 (2.3)	522 (10.0)	10 (1.7)	525 (16.8)
Italy	28 (2.4)	461 (10.7)	42 (2.5)	466 (12.3)	20 (2.2)	497 (13.9)	10 (1.7)	506 (30.1)
Lithuania	30 (2.5)	518 (8.8)	42 (2.6)	516 (5.6)	22 (1.4)	523 (8.2)	6 (0.9)	497 (7.2)
Russian Federation	25 (1.3)	547 (11.8)	52 (1.9)	543 (9.0)	20 (1.7)	535 (16.3)	4 (0.5)	539 (16.0)
Slovenia	36 (2.1)	443 (9.3)	48 (2.0)	492 (9.2)	13 (1.6)	504 (16.5)	3 (0.5)	492 (19.5)
Sweden	27 (1.9)	502 (10.0)	44 (2.0)	519 (5.6)	23 (1.5)	508 (7.4)	7 (1.3)	525 (11.2)
Switzerland	33 (1.8)	513 (5.5)	41 (1.7)	547 (7.3)	21 (1.6)	536 (12.5)	5 (0.7)	544 (19.1)
United States	23 (1.3)	424 (9.8)	45 (1.5)	450 (7.1)	24 (1.2)	448 (5.0)	8 (0.8)	447 (9.8)

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.5).

( ) 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.

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

Table 7.7

Advanced Mathematics Students' Reports on How Often in Mathematics Lessons They Are Asked to Use Computers to Solve Exercises or Problems – Advanced Mathematics
Final Year of Secondary School*

Country	Never or Almost Never		Some Lessons		Most Lessons		Every Lesson	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	72 (3.4)	531 (10.8)	20 (3.6)	490 (20.5)	3 (1.3)	544 (16.8)	5 (1.9)	574 (31.4)
Austria	r 84 (3.2)	442 (7.3)	14 (3.2)	466 (15.0)	1 (0.3)	~ ~	1 (0.4)	~ ~
Canada	80 (1.6)	511 (4.7)	17 (1.6)	504 (7.5)	2 (0.4)	~ ~	2 (0.4)	~ ~
Cyprus	54 (2.2)	522 (6.0)	16 (1.7)	506 (10.2)	20 (1.9)	518 (8.9)	11 (1.3)	516 (14.4)
Czech Republic	97 (0.9)	468 (11.3)	2 (0.9)	~ ~	0 (0.2)	~ ~	0 (0.1)	~ ~
Denmark	67 (2.4)	519 (4.6)	30 (2.3)	534 (5.6)	2 (0.4)	~ ~	0 (0.2)	~ ~
France	88 (1.1)	560 (3.9)	7 (0.8)	546 (10.7)	3 (0.6)	537 (13.8)	2 (0.6)	~ ~
Germany	89 (1.4)	465 (5.3)	8 (1.2)	491 (15.3)	2 (0.3)	~ ~	2 (0.5)	~ ~
Greece	68 (2.1)	522 (7.1)	23 (2.4)	504 (15.0)	6 (1.3)	494 (17.5)	3 (0.9)	487 (36.4)
Italy	44 (4.3)	481 (7.7)	37 (3.5)	477 (14.6)	11 (1.8)	447 (22.7)	8 (2.3)	463 (20.7)
Lithuania	86 (1.2)	510 (3.5)	11 (0.9)	557 (9.3)	2 (0.4)	~ ~	2 (0.5)	~ ~
Russian Federation	83 (1.4)	537 (8.7)	14 (1.4)	559 (13.4)	2 (0.6)	~ ~	1 (0.3)	~ ~
Slovenia	13 (1.4)	504 (16.0)	34 (2.1)	474 (9.5)	38 (1.9)	471 (10.3)	15 (1.5)	462 (12.6)
Sweden	79 (4.0)	505 (5.2)	20 (3.8)	538 (7.8)	1 (0.4)	~ ~	1 (0.3)	~ ~
Switzerland	84 (2.6)	525 (5.2)	14 (2.1)	577 (11.1)	2 (0.7)	~ ~	1 (0.4)	~ ~
United States	66 (1.9)	443 (5.8)	23 (1.7)	446 (9.4)	7 (0.5)	451 (11.5)	4 (0.5)	434 (13.8)

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.5).

( ) 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.

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

As noted in Chapter 4, final-year students in general reported frequent calculator use at school, home, or anywhere else. Final-year students taking advanced mathematics used calculators even more extensively, as shown in Table 7.8. In Australia, Canada, Cyprus, Denmark, Sweden, and the United States, more than 80% of students reported using a calculator at least daily, and in several other countries more than half of the students reported this level of use. The lowest levels of calculator use among advanced mathematics students were reported in the Czech Republic and Greece, where about one-fourth of the students reported using a calculator once a month or less. Similar to final-year students in general, the advanced mathematics students with the highest average achievement were those who reported the highest level of calculator use. In almost every country, students who reported daily calculator use performed better on the TIMSS mathematics assessment than those who reported less frequent use.

Since students use calculators so frequently in many countries, final-year students were given the option of using a calculator when doing the TIMSS tests. Table 7.9 summarizes students' reports on how frequently they used a calculator during the testing session. Like final-year students in general, most of the advanced mathematics students made moderate use (for up to 10 questions) of a calculator on the TIMSS test; smaller percentages reported using a calculator quite a lot. In Greece, Italy, Lithuania, and the Russian Federation, more than one-third of the students reported not using a calculator at all. In general, the students who reported that they did not use a calculator on the test did not do as well as those who reported using one, although the extent of calculator use was not consistently related to achievement in every country.

Table 7.8

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

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	0 (0.1)	~ ~	0 (0.3)	~ ~	7 (1.6)	496 (36.9)	93 (1.8)	527 (11.3)
Austria	4 (1.4)	389 (32.3)	3 (0.7)	391 (30.4)	33 (2.5)	427 (10.0)	60 (2.6)	447 (7.6)
Canada	1 (0.4)	~ ~	1 (0.2)	~ ~	11 (1.2)	487 (10.3)	87 (1.5)	513 (4.2)
Cyprus	2 (0.7)	~ ~	1 (0.4)	~ ~	9 (1.4)	502 (11.9)	88 (1.5)	522 (5.0)
Czech Republic	11 (2.6)	414 (13.3)	14 (2.5)	430 (21.4)	44 (2.7)	456 (8.1)	31 (3.3)	525 (13.0)
Denmark	0 (0.2)	~ ~	0 (0.2)	~ ~	10 (1.1)	510 (10.8)	89 (1.2)	525 (3.4)
France	1 (0.4)	~ ~	2 (0.5)	~ ~	19 (1.4)	545 (6.7)	77 (1.3)	562 (3.9)
Germany	5 (0.6)	399 (9.4)	4 (0.6)	396 (12.0)	33 (1.8)	451 (7.0)	57 (2.1)	486 (5.9)
Greece	22 (1.9)	482 (17.8)	6 (1.3)	505 (22.9)	28 (2.3)	508 (11.7)	44 (2.9)	538 (7.6)
Italy	6 (2.1)	432 (23.3)	4 (1.2)	432 (19.7)	37 (3.1)	473 (14.0)	53 (3.1)	483 (9.6)
Lithuania	3 (0.6)	476 (18.6)	2 (0.6)	~ ~	19 (1.1)	494 (5.8)	75 (1.2)	525 (4.1)
Russian Federation	9 (0.8)	512 (12.6)	6 (1.0)	521 (18.6)	28 (1.6)	538 (14.1)	57 (1.9)	551 (8.1)
Slovenia	2 (0.4)	~ ~	3 (0.7)	468 (26.3)	28 (2.0)	466 (10.0)	67 (2.4)	480 (10.2)
Sweden	0 (0.2)	~ ~	0 (0.2)	~ ~	10 (1.5)	499 (16.4)	89 (1.6)	514 (4.2)
Switzerland	1 (0.3)	~ ~	1 (0.3)	~ ~	27 (1.8)	508 (8.9)	72 (1.9)	544 (4.4)
United States	3 (0.4)	381 (17.4)	2 (0.5)	~ ~	13 (1.0)	418 (10.7)	82 (1.5)	452 (6.0)

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.5).

( ) 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.

Table 7.9

Advanced Mathematics Students' Reports on the Frequency of Calculator Use During the TIMSS Test – Advanced Mathematics

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	10 (1.8)	488 (25.0)	55 (2.2)	533 (15.4)	28 (1.8)	526 (12.7)	6 (1.2)	527 (17.5)
Austria	20 (2.7)	391 (16.1)	47 (2.3)	447 (9.8)	29 (2.7)	451 (6.0)	4 (0.8)	426 (14.5)
Canada	7 (0.7)	478 (12.8)	59 (1.6)	515 (5.4)	29 (1.5)	505 (5.6)	5 (0.8)	520 (12.7)
Cyprus	30 (2.1)	504 (8.4)	58 (2.4)	525 (6.0)	10 (1.8)	512 (17.2)	1 (0.4)	~ ~
Czech Republic	13 (1.6)	452 (16.1)	64 (1.7)	473 (11.8)	21 (1.3)	472 (15.1)	1 (0.4)	~ ~
Denmark	7 (0.9)	475 (9.9)	55 (1.4)	529 (3.7)	33 (1.5)	525 (5.0)	6 (0.7)	519 (9.2)
France	13 (1.6)	547 (8.5)	56 (2.4)	561 (4.2)	25 (1.7)	557 (6.8)	5 (0.7)	571 (12.6)
Germany	15 (1.6)	414 (8.0)	58 (1.7)	479 (6.0)	23 (1.0)	478 (6.3)	4 (0.6)	457 (14.2)
Greece	86 (2.2)	509 (6.6)	13 (2.0)	539 (14.6)	1 (0.4)	~ ~	0 (0.2)	~ ~
Italy	38 (5.1)	468 (18.9)	47 (3.6)	485 (9.6)	13 (2.8)	466 (11.2)	2 (0.5)	~ ~
Lithuania	r 40 (1.7)	516 (4.5)	50 (2.1)	524 (7.1)	8 (1.3)	539 (24.2)	1 (0.5)	~ ~
Russian Federation	r 50 (2.4)	551 (12.2)	41 (2.0)	556 (9.3)	8 (1.0)	506 (9.9)	1 (0.3)	~ ~
Slovenia	26 (2.4)	435 (10.1)	64 (2.4)	492 (9.8)	10 (1.3)	479 (12.1)	1 (0.4)	~ ~
Sweden	3 (0.7)	474 (21.0)	39 (2.0)	509 (7.3)	46 (2.1)	515 (4.9)	11 (1.2)	526 (10.1)
Switzerland	7 (0.9)	484 (12.3)	57 (1.6)	546 (5.8)	32 (1.3)	524 (5.8)	4 (0.5)	532 (18.2)
United States	14 (1.6)	388 (10.6)	55 (2.0)	443 (6.1)	26 (1.8)	459 (9.8)	5 (0.8)	497 (18.0)

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.5).

( ) 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.

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

What Are Secondary School Students' Educational Resources and Plans?

Chapter 4 describes the strong relationship between parental education and mathematics and science literacy among final-year students in each country. Table 7.10 presents similar information for final-year students taking advanced mathematics. Results are presented for the same three educational levels: finished university, finished upper secondary school but not university, and finished primary school but not upper secondary. The modifications that were made by some countries are those described in Figure 4.6. The clear positive relationship between parents' education and mathematics and science literacy for final-year students in general (see Table 4.6) is also apparent in Table 7.10 for students taking advanced mathematics. The major difference is that the advanced mathematics students reported much higher levels of parental education. Whereas in only five countries did as many as 30% of final-year students in general indicate that at least one parent had finished university, among advanced mathematics students this figure was reached in all but two countries (Austria and Italy). More than half the advanced mathematics students in Canada, Lithuania, the Russian Federation, and the United States reported that at least one parent had completed university.

It is clear from the discussion in Chapter 4 that although many final-year students were planning a university career, there were also many who planned to follow a vocational, technical, or other postsecondary course, or to continue no further with their education. Among final-year students taking advanced mathematics, however, the majority in every country reported that they plan to attend university, and in ten countries – Australia, Canada, Cyprus, the Czech Republic, Greece, Lithuania, the Russian Federation, Sweden, Switzerland, and the United States – the percentage planning a university career exceeded 80% (see Table 7.11). Countries where 10% or more of the students planned to choose a vocationally oriented program included Austria, France, Germany, the Russian Federation, and Slovenia. Very few of the advanced mathematics students reported that they planned not to continue their education. Only in Austria, Denmark, and Italy did more than 10% of students state that intention. In most countries, the students planning to attend university had higher average mathematics achievement than the other groups.

Students who have studied advanced mathematics in upper secondary school have many areas for further study available to them. Table 7.12 presents students' reports of their choices for further study, including mathematics, computer or information sciences, engineering, business, health sciences or related occupations, and the sciences. An "other" category was provided for students whose preferred area of study was not included. It is noteworthy that in almost half of the countries, more students indicated that they planned to study some area other than the choices provided.

The most popular areas were business, health sciences or related occupations, and engineering. Of the specific choices available, business was the area chosen most often by advanced mathematics students in Austria, the Czech Republic, Denmark, Germany, Lithuania, the Russian Federation, and Slovenia, and was one of the two most popular in Australia and Switzerland. Health sciences and related occupations

Table 7.10

Advanced Mathematics Students' Reports on the Highest Level of Education of Either Parent† – Advanced Mathematics

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	47 (4.0)	551 (9.8)	31 (3.5)	512 (16.4)	19 (2.8)	480 (17.2)	4 (0.9)	541 (39.8)
Austria	21 (1.7)	465 (10.1)	68 (2.5)	429 (8.5)	9 (1.3)	433 (14.4)	2 (0.8)	~ ~
Canada	53 (2.1)	527 (5.4)	37 (1.6)	490 (4.9)	8 (0.9)	487 (10.1)	3 (0.7)	508 (17.0)
Cyprus	43 (2.1)	534 (6.3)	37 (1.5)	511 (8.4)	18 (1.8)	498 (15.1)	2 (0.8)	~ ~
Czech Republic	49 (1.8)	493 (15.5)	39 (1.6)	452 (10.2)	11 (0.9)	432 (7.0)	0 (0.1)	~ ~
Denmark	36 (1.9)	531 (5.0)	55 (2.1)	520 (4.4)	7 (0.9)	510 (10.0)	3 (0.5)	519 (13.1)
France	31 (3.3)	573 (5.0)	44 (2.5)	557 (4.1)	22 (2.5)	541 (7.1)	3 (0.6)	540 (10.6)
Germany	50 (2.0)	479 (6.3)	47 (1.8)	455 (5.3)	2 (0.4)	~ ~	- -	- -
Greece	34 (3.1)	537 (8.2)	44 (2.5)	512 (9.1)	20 (2.6)	490 (14.6)	2 (0.8)	~ ~
Italy	16 (3.3)	531 (19.0)	52 (2.1)	474 (9.7)	31 (4.0)	448 (10.9)	1 (0.6)	~ ~
Lithuania	67 (1.3)	531 (3.4)	30 (1.4)	486 (5.7)	2 (0.4)	~ ~	1 (0.5)	~ ~
Russian Federation	65 (2.4)	566 (7.9)	33 (2.5)	500 (12.4)	1 (0.4)	~ ~	1 (0.2)	~ ~
Slovenia	30 (2.2)	510 (11.6)	59 (2.1)	462 (9.5)	10 (1.0)	450 (10.0)	1 (0.3)	~ ~
Sweden	43 (2.1)	523 (7.1)	40 (2.4)	512 (9.5)	7 (1.0)	492 (12.3)	10 (1.1)	489 (11.1)
Switzerland	34 (1.7)	539 (5.7)	61 (1.6)	531 (5.6)	4 (0.7)	528 (15.0)	2 (0.4)	~ ~
United States	58 (2.0)	472 (6.3)	37 (1.5)	411 (5.8)	4 (0.8)	390 (7.6)	1 (0.3)	~ ~

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 country modifications to the definitions of educational levels.

* 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.5).

( ) 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 7.11

Advanced Mathematics Students' Reports on Their Plans for Future Education† – Advanced Mathematics

Final Year of Secondary School*

Country	University[1]		Vocationally Oriented Programs[2]		Other Postsecondary 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	94 (1.2)	528 (11.3)	2 (0.5)	~ ~	2 (0.8)	~ ~	1 (0.8)	~ ~
Austria	66 (2.2)	454 (7.6)	13 (1.7)	372 (17.2)	5 (0.9)	412 (13.4)	15 (1.9)	429 (10.9)
Canada	84 (1.3)	515 (3.9)	4 (0.4)	425 (8.4)	11 (1.4)	502 (13.7)	1 (0.2)	~ ~
Cyprus	91 (1.4)	522 (4.7)	5 (1.0)	466 (25.8)	4 (1.0)	498 (21.1)	1 (0.5)	~ ~
Czech Republic	93 (0.7)	475 (11.5)	5 (0.7)	375 (12.2)	1 (0.3)	~ ~	1 (0.4)	~ ~
Denmark	r 67 (1.6)	537 (4.6)	8 (0.9)	493 (8.5)	11 (1.0)	501 (9.8)	14 (1.5)	512 (8.1)
France	76 (1.8)	564 (3.9)	13 (1.6)	540 (8.1)	10 (1.2)	544 (10.5)	1 (0.3)	~ ~
Germany	72 (2.5)	474 (6.0)	21 (2.1)	440 (5.8)	3 (0.6)	486 (19.6)	4 (0.6)	448 (17.0)
Greece	85 (1.6)	534 (5.6)	7 (1.1)	400 (27.3)	7 (1.2)	427 (26.3)	2 (0.6)	~ ~
Italy	73 (3.1)	489 (11.0)	3 (0.8)	451 (9.9)	11 (2.6)	445 (14.6)	13 (1.9)	417 (17.5)
Lithuania	90 (1.3)	523 (2.9)	3 (0.8)	445 (17.2)	7 (1.1)	464 (11.6)	0 (0.2)	~ ~
Russian Federation	86 (1.7)	555 (8.1)	10 (1.4)	460 (16.9)	3 (0.5)	489 (13.6)	1 (0.4)	~ ~
Slovenia	80 (2.2)	492 (8.9)	13 (1.9)	412 (13.0)	2 (0.4)	~ ~	5 (0.6)	383 (12.4)
Sweden	93 (1.2)	519 (4.8)	2 (0.6)	~ ~	3 (0.7)	424 (20.2)	1 (0.4)	~ ~
Switzerland	88 (1.1)	538 (4.9)	2 (0.4)	~ ~	5 (0.7)	497 (11.2)	5 (0.7)	493 (15.5)
United States	93 (0.9)	448 (5.3)	2 (0.5)	~ ~	5 (0.7)	391 (9.4)	0 (0.2)	~ ~

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

† Educational options were defined by each country to conform to their national systems 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.5).

( ) 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.

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

Table 7.12

Advanced Mathematics Students' Reports on the Area They Intend to Study After Secondary School – Advanced Mathematics

Final Year of Secondary School*

Country		Percent of Students						
		Mathematics	Computer or Information Sciences	Engineering	Business	Health Sciences or Related Occupations	Sciences[1]	Other
Australia		3 (1.2)	9 (1.3)	18 (1.9)	21 (3.1)	21 (2.2)	12 (1.4)	17 (2.1)
Austria	r	2 (0.6)	3 (1.3)	6 (1.2)	17 (2.0)	13 (1.8)	10 (1.9)	48 (3.0)
Canada		3 (0.5)	6 (.8)	17 (1.2)	16 (1.0)	25 (1.5)	16 (1.2)	17 (0.8)
Cyprus		9 (1.2)	9 (1.3)	15 (2.4)	5 (0.9)	27 (2.1)	16 (2.1)	19 (1.6)
Czech Republic		4 (0.8)	7 (1.3)	3 (0.6)	20 (1.9)	12 (1.5)	17 (1.4)	37 (4.1)
Denmark	r	3 (0.6)	6 (0.8)	16 (1.3)	18 (1.6)	16 (1.3)	15 (1.5)	26 (1.3)
France		12 (1.2)	6 (0.8)	14 (1.8)	6 (1.0)	19 (1.3)	29 (2.2)	13 (1.7)
Germany		2 (0.3)	3 (0.6)	10 (1.0)	26 (1.6)	13 (1.4)	11 (1.2)	36 (1.4)
Greece		4 (0.9)	25 (2.2)	36 (2.9)	2 (0.8)	1 (0.5)	16 (1.9)	17 (1.9)
Italy		2 (1.3)	4 (1.4)	22 (3.8)	18 (2.5)	13 (4.0)	12 (3.8)	29 (2.8)
Lithuania	s	2 (0.4)	13 (2.1)	4 (0.8)	23 (1.8)	7 (1.2)	6 (1.0)	46 (2.0)
Russian Federation		6 (1.3)	23 (1.9)	9 (1.1)	32 (1.5)	5 (0.5)	8 (1.3)	17 (1.5)
Slovenia		2 (0.4)	9 (1.9)	11 (2.1)	28 (2.9)	9 (1.8)	11 (1.6)	31 (2.8)
Sweden		2 (0.5)	12 (2.4)	41 (2.8)	5 (0.7)	10 (1.7)	16 (2.0)	14 (1.5)
Switzerland		1 (0.4)	2 (0.5)	8 (1.2)	17 (1.4)	17 (1.8)	14 (1.0)	42 (2.3)
United States		3 (0.4)	5 (0.7)	16 (1.1)	15 (1.1)	24 (1.1)	11 (0.8)	26 (1.3)

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

* See Appendix A for characteristics of the students sampled.

[1] Includes biological sciences, chemistry, earth sciences, and physics.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.5).

( ) 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.

represented the area of choice in Canada, Cyprus, and the United States, and were also popular in Australia and Switzerland. Engineering was reported most often by advanced mathematics students in Greece, Italy, and Sweden. Only in France did the most students indicate the sciences, which included biology, physics, chemistry, and earth science. France was also the only country where more than 10% of advanced mathematics students chose mathematics as their future area of study. In no country did students report computer or information sciences as the most popular choice, but more than 20% of students in Greece and the Russian Federation indicated it as their preferred area.

The results in Table 7.13 reveal substantial differences between males and females in their plans for further study. Among students choosing engineering or computer or information sciences, males outnumbered females by a wide margin in most countries, while in mathematics, business, and the sciences, the numbers were more even. Females outnumbered males in choosing health sciences and related occupations in nearly all countries. Among students choosing the "other" category there were more females than males in most countries, suggesting that many females who have taken advanced mathematics will pursue further studies in areas unrelated to mathematics.

Table 7.13

Advanced Mathematics Students' Reports on the Area They Intend to Study After Secondary School by Gender – Advanced Mathematics

Final Year of Secondary School*

Country		Percent of Students							
		Mathematics		Computer or Information Sciences		Engineering		Business	
		Males	Females	Males	Females	Males	Females	Males	Females
Australia		1 (1.1)	4 (1.7)	14 (2.5)	3 (0.9)	28 (3.4)	6 (1.8)	16 (2.4)	26 (5.7)
Austria	r	2 (1.0)	2 (0.7)	7 (2.9)	1 (0.6)	10 (2.3)	4 (1.4)	26 (2.7)	11 (2.2)
Canada		4 (0.8)	2 (0.8)	9 (1.2)	2 (.8)	27 (2.1)	7 (0.8)	17 (1.5)	15 (1.3)
Cyprus		6 (1.8)	14 (2.9)	13 (2.2)	5 (1.8)	21 (3.3)	6 (2.1)	5 (0.9)	4 (1.7)
Czech Republic		6 (1.5)	2 (0.8)	17 (2.7)	0 (0.0)	4 (1.1)	1 (0.5)	21 (2.4)	19 (2.0)
Denmark	r	2 (0.7)	4 (1.2)	10 (1.3)	1 (0.6)	22 (1.7)	5 (1.3)	21 (2.2)	13 (2.2)
France		12 (1.8)	12 (2.0)	9 (1.3)	1 (0.4)	21 (2.5)	4 (1.1)	7 (1.3)	6 (1.4)
Germany		2 (0.5)	2 (0.3)	5 (1.2)	1 (0.3)	18 (2.1)	4 (0.7)	28 (3.1)	25 (1.4)
Greece		2 (0.7)	10 (3.1)	28 (2.7)	17 (3.1)	36 (4.1)	35 (3.4)	2 (1.1)	1 (0.5)
Italy		1 (0.9)	3 (2.4)	7 (2.2)	1 (0.7)	34 (5.9)	8 (4.2)	21 (3.3)	14 (4.7)
Lithuania	s	2 (0.8)	2 (0.3)	25 (4.0)	1 (0.5)	6 (1.7)	2 (0.4)	21 (2.4)	25 (2.8)
Russian Federation		5 (1.0)	7 (2.2)	35 (2.3)	9 (1.5)	15 (1.6)	2 (0.7)	23 (2.3)	41 (2.3)
Slovenia		2 (0.5)	1 (0.5)	17 (3.3)	1 (1.0)	20 (3.0)	4 (2.3)	25 (2.6)	31 (4.6)
Sweden		2 (0.5)	2 (1.0)	16 (2.9)	1 (0.6)	48 (2.8)	28 (2.9)	4 (1.0)	5 (1.2)
Switzerland		1 (0.3)	1 (0.7)	4 (0.9)	0 (0.0)	13 (2.0)	2 (0.8)	22 (1.8)	10 (1.6)
United States		2 (0.5)	4 (0.7)	7 (1.3)	2 (0.6)	26 (2.0)	6 (1.0)	16 (1.5)	14 (1.1)

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.5).

( ) 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.

Table 7.13 (Continued)

Advanced Mathematics Students' Reports on the Area They Intend to Study After Secondary School by Gender – Advanced Mathematics

Final Year of Secondary School*

Country	Percent of Students					
	Health Sciences or Related Occupations		Sciences[1]		Other	
	Males	Females	Males	Females	Males	Females
Australia	16 (3.2)	27 (3.8)	10 (2.1)	14 (2.6)	15 (2.1)	19 (3.1)
Austria	9 (2.1)	17 (2.7)	10 (2.8)	10 (2.2)	37 (3.7)	57 (3.8)
Canada	16 (1.9)	34 (2.0)	14 (1.7)	18 (2.2)	13 (1.3)	21 (1.6)
Cyprus	23 (2.5)	34 (4.0)	14 (2.7)	18 (3.5)	18 (2.1)	20 (3.5)
Czech Republic	9 (1.6)	15 (1.8)	17 (2.2)	17 (1.7)	25 (4.4)	46 (4.1)
Denmark	10 (1.1)	28 (2.6)	13 (1.5)	19 (2.7)	23 (1.7)	30 (2.9)
France	11 (1.5)	33 (2.5)	27 (2.9)	32 (2.3)	13 (1.7)	13 (1.9)
Germany	7 (1.3)	17 (1.8)	11 (1.5)	10 (1.6)	28 (2.6)	41 (1.1)
Greece	1 (0.6)	1 (0.6)	14 (2.2)	20 (4.7)	17 (2.2)	17 (3.8)
Italy	6 (2.4)	21 (6.4)	11 (5.0)	13 (4.7)	21 (3.4)	39 (6.7)
Lithuania	5 (0.9)	10 (2.4)	7 (1.5)	5 (1.5)	35 (2.1)	56 (3.8)
Russian Federation	2 (0.5)	8 (1.0)	7 (1.0)	8 (2.7)	12 (1.7)	24 (2.1)
Slovenia	5 (1.5)	12 (2.8)	10 (2.2)	11 (2.1)	22 (2.6)	39 (3.8)
Sweden	6 (1.5)	20 (2.4)	12 (2.1)	26 (2.9)	12 (1.7)	18 (2.1)
Switzerland	12 (2.0)	22 (2.8)	18 (1.6)	11 (1.4)	31 (2.3)	54 (3.5)
United States	17 (2.4)	31 (1.7)	12 (1.2)	11 (1.2)	19 (1.6)	33 (2.1)

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

* See Appendix A for characteristics of the students sampled.

[1] Includes biological sciences, chemistry, earth sciences, and physics.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates or student sampling (see Figure B.5).

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

Even though not many students chose mathematics as their preferred area of study, the majority of the students in 10 of the countries agreed that they would like a job that involved using mathematics (see Table 7.14). Only in Austria, the Czech Republic, Germany, Italy, Slovenia, and Switzerland did a majority of advanced mathematics students report that they would not like such a job. In Austria, 55% of advanced mathematics students strongly disagreed that they would like a job that involved mathematics. Not surprisingly, high achievement in mathematics went hand in hand with wanting a job that involved using mathematics. In every country, there was a direct relationship between higher achievement and the strength of agreement in wanting a job that involved using mathematics.

In general, among those agreeing that they would like a job in mathematics there were more males than females, with more females than males disagreeing with that statement (see Table 7.15). Since females also had lower average achievement than males, it is unclear whether female students' relative lack of enthusiasm for a job involving mathematics reflects their lower average achievement, or whether the latter is partly the result of less interest in mathematical pursuits.

Table 7.14

Advanced Mathematics Students' Reports That They Would Like a Job That Involved Using Mathematics – Advanced Mathematics

Final Year of Secondary School*

Country	Strongly Agree		Agree		Disagree		Strongly Disagree	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	8 (1.5)	580 (21.6)	50 (2.7)	545 (11.8)	30 (3.2)	502 (16.6)	13 (1.4)	481 (12.6)
Austria	5 (0.8)	490 (17.0)	15 (1.4)	489 (10.2)	26 (2.2)	461 (9.8)	55 (2.7)	410 (6.9)
Canada	15 (1.2)	566 (6.4)	48 (1.7)	517 (5.2)	25 (1.4)	483 (6.8)	11 (0.9)	459 (9.3)
Cyprus	25 (2.5)	545 (13.0)	42 (3.1)	520 (6.1)	21 (1.8)	502 (7.9)	12 (2.3)	496 (10.0)
Czech Republic	9 (1.5)	600 (20.0)	23 (1.4)	529 (13.8)	33 (1.4)	456 (7.9)	35 (2.6)	411 (7.9)
Denmark	20 (1.5)	557 (6.2)	45 (1.7)	531 (4.5)	26 (1.6)	504 (5.1)	9 (0.9)	471 (7.3)
France	16 (1.3)	599 (7.1)	40 (1.7)	571 (4.9)	27 (1.6)	535 (6.4)	17 (1.3)	523 (5.8)
Germany	10 (1.0)	532 (10.0)	22 (1.0)	500 (7.4)	25 (0.9)	481 (6.3)	43 (1.2)	428 (5.4)
Greece	21 (2.3)	554 (12.9)	51 (2.8)	528 (8.4)	20 (2.3)	484 (9.7)	8 (1.5)	441 (21.4)
Italy	8 (1.2)	556 (16.1)	35 (4.4)	496 (11.2)	28 (3.2)	461 (10.5)	29 (4.4)	437 (11.2)
Lithuania	12 (1.3)	537 (8.6)	49 (2.1)	528 (3.9)	28 (1.6)	499 (5.2)	11 (1.1)	489 (7.2)
Russian Federation	16 (1.3)	574 (13.7)	49 (1.9)	561 (8.9)	25 (1.3)	507 (11.6)	9 (1.2)	487 (9.2)
Slovenia	6 (1.2)	531 (20.9)	29 (2.0)	513 (10.8)	33 (1.7)	467 (9.7)	31 (2.3)	438 (11.0)
Sweden	12 (1.6)	571 (7.0)	47 (1.6)	532 (4.5)	30 (1.6)	483 (6.1)	10 (1.1)	441 (10.4)
Switzerland	10 (1.0)	612 (7.2)	21 (1.6)	575 (6.9)	31 (1.8)	529 (6.5)	38 (2.3)	493 (7.2)
United States	17 (1.1)	500 (9.1)	43 (1.3)	450 (5.3)	26 (1.4)	424 (7.6)	13 (1.3)	391 (11.2)

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.5).

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

Table 7.15

Advanced Mathematics Students' Reports That They Would Like a Job That Involved Using Mathematics by Gender – Advanced Mathematics

Final Year of Secondary School*

Country	Strongly Agree				Agree			
	Males		Females		Males		Females	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	7 (2.0)	585 (25.3)	8 (2.0)	574 (29.8)	56 (3.8)	546 (10.6)	42 (4.2)	545 (20.6)
Austria	6 (1.2)	530 (17.7)	3 (0.9)	444 (23.4)	20 (2.2)	524 (14.8)	11 (1.7)	452 (12.0)
Canada	20 (1.9)	581 (9.7)	11 (1.2)	534 (14.3)	51 (3.1)	530 (7.4)	45 (2.7)	501 (5.9)
Cyprus	24 (3.4)	560 (13.8)	27 (3.4)	524 (17.4)	45 (3.9)	522 (8.4)	37 (2.7)	517 (9.2)
Czech Republic	13 (2.1)	630 (24.3)	6 (1.5)	561 (21.5)	33 (2.2)	560 (14.2)	16 (1.6)	487 (14.7)
Denmark	22 (1.9)	565 (7.9)	17 (2.3)	539 (9.0)	49 (2.3)	534 (5.0)	39 (2.3)	525 (7.4)
France	18 (1.7)	604 (8.2)	13 (2.1)	589 (9.3)	45 (2.0)	579 (5.5)	33 (3.0)	557 (6.7)
Germany	13 (1.7)	547 (11.3)	8 (1.1)	519 (11.8)	28 (2.0)	514 (7.9)	18 (1.2)	483 (11.4)
Greece	20 (2.2)	575 (16.9)	23 (4.4)	511 (20.6)	51 (3.4)	536 (8.7)	53 (4.7)	512 (13.7)
Italy	10 (1.9)	573 (21.0)	5 (2.7)	504 (17.9)	35 (4.1)	500 (12.0)	36 (6.2)	491 (16.7)
Lithuania	11 (1.6)	558 (10.5)	12 (1.7)	516 (12.4)	56 (2.0)	552 (5.1)	42 (3.2)	496 (7.7)
Russian Federation	16 (1.3)	611 (14.9)	16 (2.0)	534 (21.7)	52 (2.3)	584 (10.5)	46 (2.6)	533 (8.7)
Slovenia	7 (1.3)	531 (30.0)	5 (1.4)	530 (20.5)	35 (3.0)	523 (12.7)	23 (1.8)	498 (13.6)
Sweden	13 (2.0)	575 (8.3)	11 (1.8)	562 (11.9)	51 (1.7)	538 (5.5)	39 (2.9)	514 (5.7)
Switzerland	15 (2.1)	627 (10.9)	4 (0.9)	548 (14.9)	26 (1.7)	595 (8.1)	15 (2.2)	538 (10.3)
United States	22 (1.6)	514 (10.8)	12 (1.4)	475 (15.7)	48 (2.3)	462 (6.7)	39 (1.9)	436 (7.3)

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.5).

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

Table 7.15 (Continued)

Advanced Mathematics Students' Reports That They Would Like a Job That Involved Using Mathematics by Gender – Advanced Mathematics

Final Year of Secondary School*

Country	Disagree				Strongly Disagree			
	Males		Females		Males		Females	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	28 (4.6)	513 (23.0)	32 (4.6)	491 (17.8)	9 (1.8)	484 (24.6)	17 (2.2)	479 (13.1)
Austria	32 (3.3)	490 (10.3)	22 (2.7)	433 (16.2)	41 (3.5)	459 (8.5)	64 (3.0)	391 (8.0)
Canada	22 (2.0)	496 (13.3)	28 (2.4)	473 (5.9)	7 (1.0)	468 (13.9)	16 (1.8)	453 (11.7)
Cyprus	21 (2.5)	512 (13.1)	21 (3.0)	487 (14.7)	10 (2.6)	498 (16.2)	15 (3.3)	493 (11.3)
Czech Republic	28 (1.9)	504 (9.5)	36 (2.1)	431 (8.2)	26 (2.9)	458 (11.4)	41 (2.8)	392 (7.5)
Denmark	21 (1.6)	506 (7.4)	35 (2.7)	502 (6.2)	8 (1.1)	476 (12.5)	10 (1.7)	464 (8.2)
France	21 (2.0)	542 (10.5)	36 (3.7)	528 (6.6)	16 (1.9)	531 (6.5)	18 (2.2)	511 (12.2)
Germany	26 (2.3)	490 (9.1)	24 (1.4)	473 (8.6)	34 (2.4)	436 (7.2)	50 (2.0)	424 (6.8)
Greece	20 (2.9)	472 (11.1)	18 (4.4)	517 (15.6)	9 (2.0)	429 (26.9)	6 (1.8)	487 (23.2)
Italy	29 (3.9)	474 (12.1)	27 (6.5)	439 (19.3)	27 (3.1)	439 (15.0)	32 (8.1)	434 (15.7)
Lithuania	25 (2.1)	526 (8.0)	31 (2.6)	476 (6.5)	7 (1.6)	498 (19.8)	15 (1.6)	484 (13.2)
Russian Federation	24 (1.9)	532 (10.2)	27 (2.3)	485 (16.4)	8 (1.4)	494 (15.7)	11 (1.8)	481 (10.6)
Slovenia	31 (2.7)	474 (14.6)	35 (2.3)	460 (10.8)	27 (2.2)	439 (11.8)	36 (3.3)	437 (16.0)
Sweden	26 (2.0)	491 (9.9)	39 (2.5)	471 (10.6)	10 (1.3)	435 (14.5)	11 (1.9)	454 (13.4)
Switzerland	32 (2.8)	540 (6.4)	29 (2.4)	515 (9.5)	27 (1.7)	508 (9.7)	52 (3.5)	484 (7.9)
United States	22 (1.7)	430 (11.0)	31 (2.1)	419 (8.9)	9 (1.0)	404 (10.7)	17 (2.0)	385 (15.5)

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.5).

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