# Chapter 1

# International Student Achievement in Mathematics

## What Are the Overall Differences in Mathematics Achievement?

Chapter 1 summarizes achievement on the TIMSS mathematics test for each of the participating countries. Comparisons are provided overall and by gender for the upper grade tested (often the fourth grade) and the lower grade tested (often the third grade), as well as for 9-year-olds.

Table 1.1 presents the mean (or average) achievement for 26 countries at the fourth grade.[1] The 17 countries shown in decreasing order of mean achievement in the upper part of the table were judged to have met the TIMSS requirements for testing a representative sample of students. Although all countries tried very hard to meet the TIMSS sampling requirements, several encountered resistance from schools and teachers and did not have participation rates of 85% or higher as specified in the TIMSS guidelines (i.e., Australia, Austria, Latvia, and the Netherlands). To provide a better curricular match, Slovenia elected to test its third- and fourth-grade students, even though that meant not testing the two grades with the most 9-year-olds and led to its students being somewhat older than those in the other countries. The countries in the remaining two categories encountered various degrees of difficulty in implementing the prescribed methods for sampling classrooms within schools. A full discussion of the sampling procedures and outcomes for each country can be found in Appendix A.

To aid in interpretation, the table also contains the years of formal schooling and average age of the students. Equivalence of chronological age does not necessarily mean that students have received the same number of years of formal schooling or studied the same curriculum. Notably, students in Norway had fewer years of formal schooling than their counterparts in other countries, and those in Scotland, England, New Zealand, and Kuwait had more. Countries with a high percentage of older students may have policies that include retaining students in lower grades.

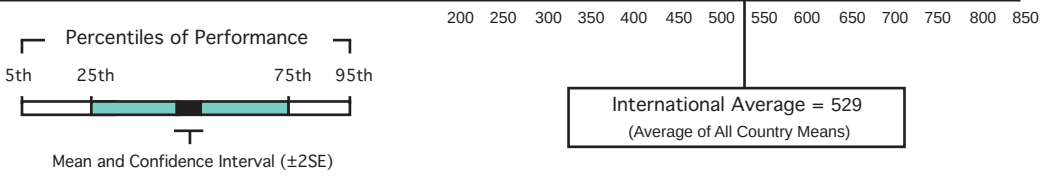
The results reveal substantial differences in average mathematics achievement between the top- and bottom-performing countries, although most countries had achievement somewhere in the middle ranges. To illustrate the broad range of achievement both across and within countries, Table 1.1 also provides a visual representation of the distribution of student performance within each country.

[1] TIMSS used item response theory (IRT) methods to summarize the achievement results for both grades on a scale with a mean of 500 and a standard deviation of 100. Scaling averages students' responses to the subsets of items they took in a way that accounts for differences in the difficulty of those items. It allows students' performance to be summarized on a common metric even though individual students responded to different items in the mathematics test. For more detailed information, see the "IRT Scaling and Data Analysis" section of Appendix A.

# Table 1.1

## Distributions of Mathematics Achievement - Upper Grade (Fourth Grade*)

| Country | Mean | Years of Formal Schooling | Average Age | Mathematics Achievement Scale Score |
|---|---|---|---|---|
| Singapore | 625 (5.3) | 4 | 10.3 | |
| Korea | 611 (2.1) | 4 | 10.3 | |
| Japan | 597 (2.1) | 4 | 10.4 | |
| Hong Kong | 587 (4.3) | 4 | 10.1 | |
| Czech Republic | 567 (3.3) | 4 | 10.4 | |
| Ireland | 550 (3.4) | 4 | 10.3 | |
| United States | 545 (3.0) | 4 | 10.2 | |
| Canada | 532 (3.3) | 4 | 10.0 | |
| † Scotland | 520 (3.9) | 5 | 9.7 | |
| †2 England | 513 (3.2) | 5 | 10.0 | |
| Cyprus | 502 (3.1) | 4 | 9.8 | |
| Norway | 502 (3.0) | 3 | 9.9 | |
| New Zealand | 499 (4.3) | 4.5–5.5 | 10.0 | |
| Greece | 492 (4.4) | 4 | 9.6 | |
| Portugal | 475 (3.5) | 4 | 10.4 | |
| Iceland | 474 (2.7) | 4 | 9.6 | |
| Iran, Islamic Rep. | 429 (4.0) | 4 | 10.5 | |
| ***Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):*** | | | | |
| Australia | 546 (3.1) | 4 or 5 | 10.2 | |
| Austria | 559 (3.1) | 4 | 10.5 | |
| 1 Latvia (LSS) | 525 (4.8) | 4 | 10.5 | |
| Netherlands | 577 (3.4) | 4 | 10.3 | |
| ***Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):*** | | | | |
| Slovenia | 552 (3.2) | 4 | 10.9 | |
| ***Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):*** | | | | |
| Hungary | 548 (3.7) | 4 | 10.4 | |
| ***Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):*** | | | | |
| 1 Israel | 531 (3.5) | 4 | 10.0 | |
| Kuwait | 400 (2.8) | 5 | 10.8 | |
| Thailand | 490 (4.7) | 4 | 10.5 | |




*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.
† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
1 National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
2 National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

# Figure 1.1

## Multiple Comparisons of Mathematics Achievement - Upper Grade (Fourth Grade*)

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 | Singapore | Korea | Japan | Hong Kong | Netherlands | Czech Republic | Austria | Slovenia | Ireland | Hungary | Australia | United States | Canada | Israel | Latvia (LSS) | Scotland | England | Cyprus | Norway | New Zealand | Greece | Thailand | Portugal | Iceland | Iran, Islamic Rep. | Kuwait |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Singapore** | | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Korea** | ● | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Japan** | ▼ | ▼ | | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Hong Kong** | ▼ | ▼ | ● | | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Netherlands* | ▼ | ▼ | ▼ | ● | | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Czech Republic** | ▼ | ▼ | ▼ | ▼ | ● | | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Austria* | ▼ | ▼ | ▼ | ▼ | ▼ | ● | | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Slovenia* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Ireland** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Hungary* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Australia* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | ● | | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **United States** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | ● | | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Canada** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Israel* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Latvia (LSS)* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Scotland** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **England** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Cyprus** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ |
| **Norway** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | | ● | ● | ● | ▲ | ▲ | ▲ | ▲ |
| **New Zealand** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | | ● | ● | ▲ | ▲ | ▲ | ▲ |
| **Greece** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | | ● | ● | ▲ | ▲ | ▲ |
| *Thailand* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | ● | | ● | ● | ▲ | ▲ |
| **Portugal** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | | ● | ▲ | ▲ |
| **Iceland** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | | ▲ | ▲ |
| **Iran, Islamic Rep.** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | | ▲ |
| *Kuwait* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | |

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

* Fourth grade in most countries; see Table 2 for information about the grades tested in each country.

† Statistically significant at .05 level, adjusted for multiple comparisons.
Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Appendix A for details).

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Achievement for each country is shown for the 25th and 75th percentiles as well as for the 5th and 95th percentiles.[2] Each percentile point indicates the percentages of students performing below and above that point on the scale. For example, 25% of the fourth-grade students in each country performed below the 25th percentile for that country, and 75% performed above the 25th percentile.

The range between the 25th and 75th percentiles represents performance by the middle half of the students. In contrast, performance at the 5th and 95th percentiles represents the extremes in both lower and higher achievement. The dark boxes at the midpoints of the distributions show the 95% confidence intervals around the average achievement in each country.[3] These intervals can be compared with the international average of 529, which was derived by averaging across the means for each of the 26 participants shown on the table. A number of countries had mean achievement well above the international average of 529, and others had mean achievement well below that level.

Comparisons also can be made across the means and percentiles. For example, average performance in Singapore was comparable to or even exceeded performance at the 95th percentile in several of the lower-performing countries such as Iran and Kuwait. Also, the differences between the extremes in performance were very large within most countries. The range in performance was particularly large in Singapore.

Figure 1.1 provides a method for making appropriate comparisons in overall mean achievement between countries.[4] This figure shows whether or not the differences in mean achievement between pairs of countries are statistically significant. For a given country of interest, read across the figure. 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.

At the fourth grade, Singapore and Korea, with all triangles pointing up, had significantly higher mean achievement than the other participating countries. Japan and Hong Kong also performed very well, as did the Netherlands, the Czech Republic, and Austria. Japan performed similarly to Hong Kong and better than all of the other participating countries except Singapore and Korea. Besides showing no significant difference from Japan, Hong Kong also performed about the same as the Netherlands. Interestingly, from the top-performing countries on down through the list of participants, the differences in performance from one country to the next were often negligible. For example, in addition to performing similarly to Hong Kong, the Netherlands performed similarly to the Czech Republic, which also performed similarly to Austria. In turn, Austria also performed similarly to Slovenia, Ireland, Hungary, and Australia.

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

[3] See the "Estimating Sampling Error" section of Appendix A for more details about calculating standard errors and confidence intervals for the TIMSS statistics.

[4] The significance tests in Figures 1.1 and 1.2 are based on a Bonferroni procedure for multiple comparisons that holds to 5% the probability of erroneously declaring the mean of one country to be different from another country.

Despite the small differences 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 very large. Because of this large range in performance, the pattern for a number of countries was one of having lower mean achievement than some countries, about the same mean achievement as some countries, and higher mean achievement than other countries. In contrast, Kuwait had significantly lower average performance than the other participating countries, and Iran had lower average performance than all other countries except Kuwait.

Table 1.2 and Figure 1.2 present corresponding data for the third grade.[5] The four highest-performing countries are the same as at the fourth grade, but the pattern is different. Third-grade students in Korea had significantly higher mean achievement than those in all other participating countries except Singapore, where achievement was similar to that in Korea. The third-grade students in Singapore also performed about the same as the students in Japan. Hong Kong also performed very well. Students in Hong Kong performed significantly below those in Singapore, Korea, and Japan, but higher than students in all of the other participating countries. For the remaining countries, performance rankings tended to be similar, but not identical, to those found at the fourth grade. For example, at the third grade, the Czech Republic, the Netherlands, Slovenia, Austria, and Australia all performed at about the same level.

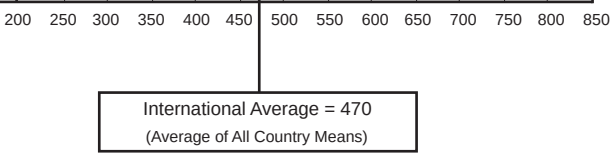
It can be noted that the international average at the fourth grade (529) was approximately 60 points higher than the international average of 470 shown at the third grade. Even though equivalent achievement increases cannot be assumed from grade to grade throughout schooling, this 60-point difference does provide a rough indication of grade-by-grade increases in mathematics achievement during the primary school years. By this gauge, the achievement differences across countries at both grades reflect several grade levels in learning between the higher- and lower-performing countries. A similarly large range in performance can be noted within most countries. Caution is required, however, in using growth from grade to grade as an indicator of achievement. The TIMSS scale measures achievement in mathematics judged to be appropriate for third- and fourth-grade students around the world. Thus, higher performance does not mean that students can do secondary-school mathematics, but only that they are more proficient at primary-school mathematics.

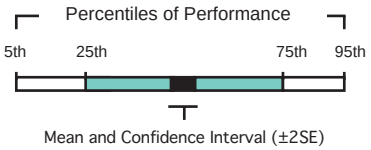
[5] Results are presented for 16 countries in the top portion of Table 1.2 because Scotland did not meet the sampling requirements at this grade. Twenty-four countries are presented in total because Kuwait and Israel tested only the fourth grade.

# Table 1.2

## Distributions of Mathematics Achievement - Lower Grade (Third Grade*)

| Country | Mean | Years of Formal Schooling | Average Age | Mathematics Achievement Scale Score |
|---|---|---|---|---|
| Korea | 561 (2.3) | 3 | 9.3 | |
| Singapore | 552 (4.8) | 3 | 9.3 | |
| Japan | 538 (1.5) | 3 | 9.4 | |
| Hong Kong | 524 (3.0) | 3 | 9.1 | |
| Czech Republic | 497 (3.3) | 3 | 9.4 | |
| United States | 480 (3.4) | 3 | 9.2 | |
| Ireland | 476 (3.6) | 3 | 9.3 | |
| Canada | 469 (2.7) | 3 | 9.1 | |
| †[2] England | 456 (3.0) | 4 | 9.1 | |
| New Zealand | 440 (4.0) | 3.5–4.5 | 9.0 | |
| Cyprus | 430 (2.8) | 3 | 8.8 | |
| Greece | 428 (4.0) | 3 | 8.6 | |
| Portugal | 425 (3.8) | 3 | 9.1 | |
| Norway | 421 (3.1) | 2 | 8.8 | |
| Iceland | 410 (2.8) | 3 | 8.6 | |
| Iran, Islamic Rep. | 378 (3.5) | 3 | 9.4 | |
| ***Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):*** | | | | |
| Australia | 483 (4.0) | 3 or 4 | 9.2 | |
| Austria | 487 (5.3) | 3 | 9.5 | |
| [1] Latvia (LSS) | 463 (4.3) | 3 | 9.7 | |
| Netherlands | 493 (2.7) | 3 | 9.3 | |
| Scotland | 458 (3.4) | 4 | 8.7 | |
| ***Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):*** | | | | |
| Slovenia | 488 (2.9) | 3 | 9.9 | |
| ***Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):*** | | | | |
| Hungary | 476 (4.2) | 3 | 9.4 | |
| ***Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):*** | | | | |
| Thailand | 444 (5.1) | 3 | 9.7 | |







*Third grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
[2]National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

# Figure 1.2

## Multiple Comparisons of Mathematics Achievement - Lower Grade (Third Grade*)

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 | Korea | Singapore | Japan | Hong Kong | Czech Republic | Netherlands | Slovenia | Austria | Australia | United States | Hungary | Ireland | Canada | Latvia (LSS) | Scotland | England | Thailand | New Zealand | Cyprus | Greece | Portugal | Norway | Iceland | Iran, Islamic Rep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Korea** | | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Singapore** | ● | | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Japan** | ▼ | ● | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Hong Kong** | ▼ | ▼ | ▼ | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Czech Republic** | ▼ | ▼ | ▼ | ▼ | | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Netherlands* | ▼ | ▼ | ▼ | ▼ | ● | | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Slovenia* | ▼ | ▼ | ▼ | ▼ | ● | ● | | ● | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Austria* | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | | ● | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Australia* | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | ● | | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **United States** | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | ● | | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Hungary* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | ● | | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Ireland** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | ● | ● | | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **Canada** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | ● | ● | | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Latvia (LSS)* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | ● | | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Scotland* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| **England** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| *Thailand* | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | | ● | ● | ● | ● | ▲ | ▲ | ▲ |
| **New Zealand** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | | ● | ● | ● | ▲ | ▲ | ▲ |
| **Cyprus** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | | ● | ● | ● | ▲ | ▲ |
| **Greece** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | | ● | ● | ▲ | ▲ |
| **Portugal** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | ● | | ● | ▲ | ▲ |
| **Norway** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | ● | ● | | ● | ▲ |
| **Iceland** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ● | | ▲ |
| **Iran, Islamic Rep.** | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | |

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

*Third grade in most countries; see Table 2 for information about the grades tested in each country.

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

Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Appendix A for details).

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

## What Are the Increases in Achievement Between the Lower and Upper Grades?

Table 1.3 shows the increases in mean achievement between the two grades tested in each TIMSS country. Countries in the upper portion of the table are shown in decreasing order by the amount of this difference. Increases in mean performance between the two grades ranged from a high of 84 points in the Netherlands to a low of 46 points in Thailand. This degree of increase can be compared with the difference of 59 points between the international averages of 529 at fourth grade and 470 at third grade. Despite the larger increases in some countries than in others, there is no obvious relationship between mean third-grade performance and the difference between that and mean fourth-grade performance. That is, countries showing the highest performance at the third grade did not necessarily show either the largest or the smallest increases in achievement at the fourth grade. In general, countries with high mean performance in the third grade also had high mean performance in the fourth grade.

Interestingly, the magnitude of the average increase in performance between the third and fourth grades is twice that found between the seventh and eighth grades. Recomputing the international averages found at the seventh and eighth grades[6] for the 26 countries that participated in the testing at the lower grades reveals an average increase of 27 points (from 493 at the seventh grade to 520 at the eighth grade).[7] This finding is consistent with observations made during TIMSS test development[8] that within-country differences in content coverage are generally small for any particular grade at the primary level, but that much new content is covered from one grade to the next. Since for most children the opportunity to learn mathematics is anchored in the school, even one year can make a substantial difference.

[6] 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.

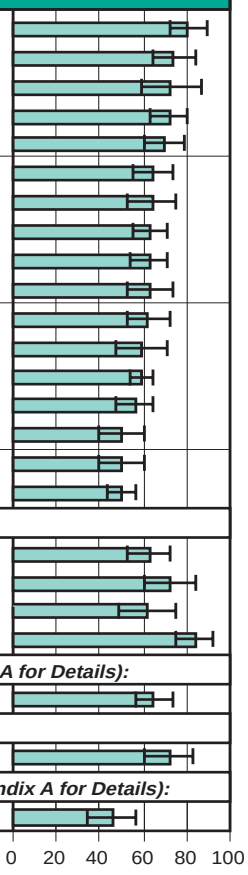
[7] Please see Table A.11 in Appendix A.

[8] Garden, R.A. (1996). "Development of the TIMSS Achievement Items" in D.F. Robitaille and R.A. Garden (Eds.), *TIMSS Monograph No. 2: Research Questions and Study Design.* Vancouver, B.C.: Pacific Educational Press.

# Table 1.3

## Achievement Differences in Mathematics Between Lower and Upper Grades (Third and Fourth Grades*)

| Country | Lower Grade Mean | Upper Grade Mean | Difference |
|---|---|---|---|
| Norway | 421 (3.1) | 502 (3.0) | 81 (4.3) |
| Ireland | 476 (3.6) | 550 (3.4) | 74 (5.0) |
| Singapore | 552 (4.8) | 625 (5.3) | 73 (7.2) |
| Cyprus | 430 (2.8) | 502 (3.1) | 72 (4.2) |
| Czech Republic | 497 (3.3) | 567 (3.3) | 70 (4.7) |
| United States | 480 (3.4) | 545 (3.0) | 65 (4.5) |
| Greece | 428 (4.0) | 492 (4.4) | 64 (5.9) |
| Iceland | 410 (2.8) | 474 (2.7) | 64 (3.9) |
| Canada | 469 (2.7) | 532 (3.3) | 63 (4.2) |
| Hong Kong | 524 (3.0) | 587 (4.3) | 63 (5.3) |
| † Scotland | 458 (3.4) | 520 (3.9) | 62 (5.1) |
| New Zealand | 440 (4.0) | 499 (4.3) | 59 (5.9) |
| Japan | 538 (1.5) | 597 (2.1) | 59 (2.6) |
| †2 England | 456 (3.0) | 513 (3.2) | 56 (4.4) |
| Iran, Islamic Rep. | 378 (3.5) | 429 (4.0) | 51 (5.3) |
| Portugal | 425 (3.8) | 475 (3.5) | 50 (5.2) |
| Korea | 561 (2.3) | 611 (2.1) | 50 (3.1) |
| ***Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):*** | | | |
| Australia | 483 (4.0) | 546 (3.1) | 63 (5.0) |
| Austria | 487 (5.3) | 559 (3.1) | 72 (6.2) |
| 1 Latvia (LSS) | 463 (4.3) | 525 (4.8) | 62 (6.4) |
| Netherlands | 493 (2.7) | 577 (3.4) | 84 (4.3) |
| ***Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):*** | | | |
| Slovenia | 488 (2.9) | 552 (3.2) | 65 (4.3) |
| ***Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):*** | | | |
| Hungary | 476 (4.2) | 548 (3.7) | 72 (5.6) |
| ***Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):*** | | | |
| Thailand | 444 (5.1) | 490 (4.7) | 46 (6.9) |




*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.

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

1 National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

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

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

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

## What Are the Differences in Performance Compared to Three Marker Levels of International Mathematics Achievement?

Tables 1.4 and 1.5 portray performance in terms of international levels of achievement for the fourth and third grades, respectively. Since the TIMSS achievement tests do not have pre-specified performance standards, three marker levels were chosen on the basis of the combined performance of all students at a grade level in the study – the Top 10%, the Top Quarter (25%), and the Top Half (50%). For example, Table 1.4 shows that 10% of all fourth graders in countries participating in the TIMSS study achieved at the level of 658 or higher. This score point, then, was designated as the marker level for the Top 10%. Similarly, the Top Quarter marker level was determined as 601 and the Top Half marker level as 535. At the third grade, these marker levels are 592, 538, and 474 respectively.

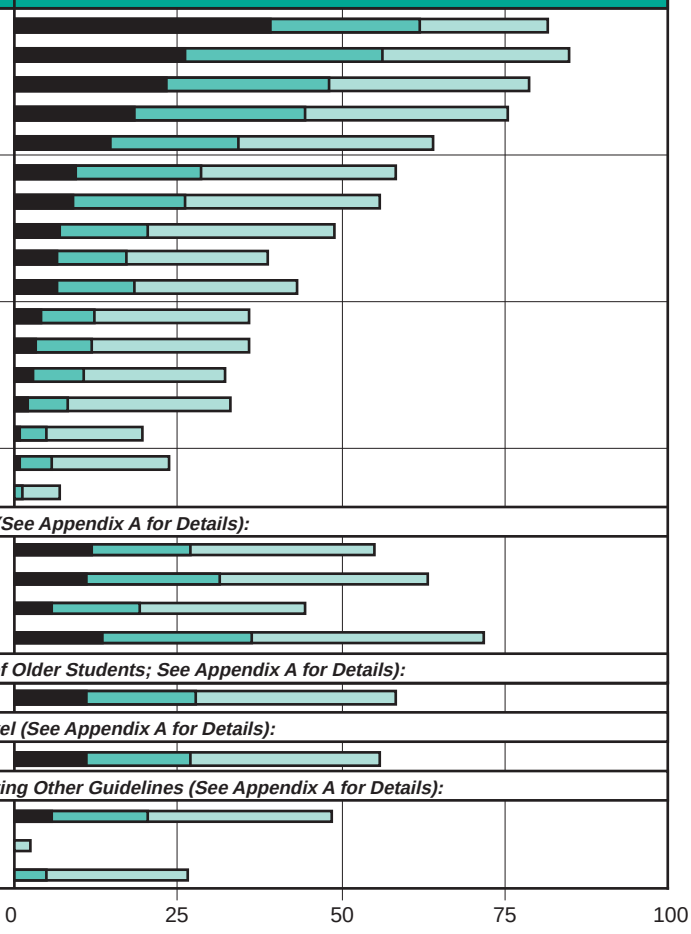
If every country had the same distribution of high-, medium-, and low-performing students, then each country would be expected to have approximately 10% of its students reaching the Top 10% level, 25% reaching the Top Quarter level, and 50% reaching the Top Half level. Although no country achieved exactly this pattern at either grade tested, the data in Tables 1.4 and 1.5 indicate that the United States at the fourth grade as well as the United States, Slovenia, and especially Hungary at the third grade came close to the international norm from the perspective of relative percentages of high-performing students. In contrast, at both grades nearly 40% of the students in Singapore (39% at the fourth grade and 36% at the third grade) reached the Top 10% level, about 60% reached the Top Quarter level (62% and 57%), and about 80% performed at or above the Top Half level (82% and 79%).

It can be informative to look at performance at each marker level. For example, the results in Table 1.4 show that 10% of the students in Ireland attained the Top 10% level, and that achievement exceeded the Top Quarter and Top Half levels (28% and 59% respectively). In Canada and Israel performance approximated the marker level for Top Half (49%), but fell slightly short of the Top 10% and Top Quarter levels.

# Table 1.4

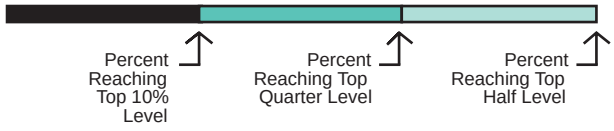
## Percentages of Students Achieving International Marker Levels in Mathematics Upper Grade (Fourth Grade* )

| Country | Top 10% Level | Top Quarter Level | Top Half Level |
|---|---|---|---|
| Singapore | 39 (2.3) | 62 (2.0) | 82 (1.2) |
| Korea | 26 (1.2) | 56 (1.3) | 85 (0.8) |
| Japan | 23 (0.9) | 48 (1.2) | 79 (0.8) |
| Hong Kong | 18 (1.5) | 44 (2.5) | 76 (1.8) |
| Czech Republic | 15 (1.3) | 34 (1.6) | 64 (1.4) |
| Ireland | 10 (0.7) | 28 (1.6) | 59 (1.8) |
| United States | 9 (0.8) | 26 (1.3) | 56 (1.6) |
| Canada | 7 (0.8) | 21 (1.4) | 49 (1.5) |
| †[2] England | 7 (0.7) | 17 (1.2) | 39 (1.5) |
| † Scotland | 6 (0.8) | 18 (1.4) | 43 (1.8) |
| Cyprus | 4 (0.5) | 12 (0.9) | 36 (1.5) |
| New Zealand | 3 (0.7) | 12 (1.1) | 36 (2.0) |
| Greece | 3 (0.5) | 11 (0.9) | 32 (1.8) |
| Norway | 2 (0.3) | 8 (0.8) | 33 (1.6) |
| Iceland | 1 (0.3) | 5 (0.7) | 20 (1.3) |
| Portugal | 1 (0.2) | 6 (0.6) | 24 (1.3) |
| Iran, Islamic Rep. | 0 (0.1) | 1 (0.4) | 7 (1.3) |
| ***Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):*** | | | |
| Australia | 12 (0.7) | 27 (1.2) | 55 (1.4) |
| Austria | 11 (1.1) | 31 (1.5) | 63 (1.6) |
| [1] Latvia (LSS) | 6 (1.3) | 19 (2.1) | 44 (2.3) |
| Netherlands | 13 (1.1) | 36 (1.9) | 72 (1.8) |
| ***Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):*** | | | |
| Slovenia | 11 (0.9) | 28 (1.4) | 58 (1.7) |
| ***Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):*** | | | |
| Hungary | 11 (1.1) | 27 (1.7) | 56 (1.8) |
| ***Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):*** | | | |
| [1] Israel | 6 (0.7) | 21 (1.5) | 49 (1.9) |
| Kuwait | 0 (0.1) | 0 (0.1) | 3 (0.4) |
| Thailand | 1 (0.2) | 5 (1.0) | 27 (2.4) |




The international levels correspond to the percentiles computed from the combined data from all of the participating countries.

Top 10% Level (90th Percentile) = 658
Top Quarter Level (75th Percentile) = 601
Top Half Level (50th Percentile) = 535



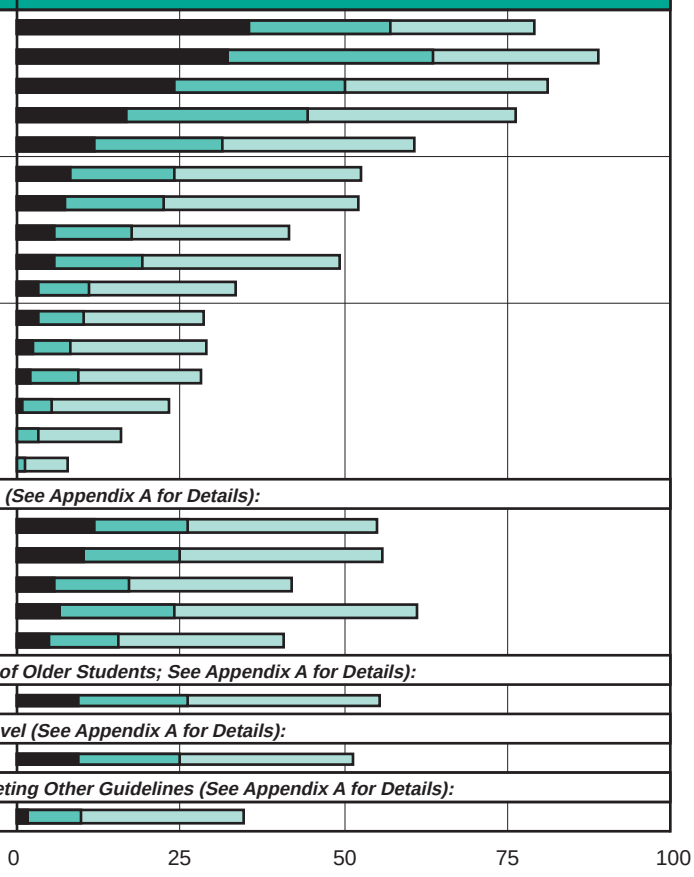

*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.
† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

# Table 1.5

## Percentages of Students Achieving International Marker Levels in Mathematics Lower Grade (Third Grade* )

| Country | Top 10% Level | Top Quarter Level | Top Half Level | Percent Reaching International Levels |
|---|---|---|---|---|
| Singapore | 36 (2.1) | 57 (1.9) | 79 (1.3) | |
| Korea | 32 (1.3) | 64 (1.4) | 89 (0.7) | |
| Japan | 24 (0.8) | 50 (0.9) | 81 (0.7) | |
| Hong Kong | 17 (1.4) | 45 (1.9) | 76 (1.4) | |
| Czech Republic | 12 (1.1) | 31 (1.7) | 61 (1.6) | |
| United States | 8 (1.0) | 24 (1.7) | 53 (1.9) | |
| Ireland | 7 (0.8) | 22 (1.5) | 52 (2.0) | |
| †[2] England | 6 (0.5) | 18 (1.1) | 42 (1.4) | |
| Canada | 6 (0.6) | 19 (1.1) | 49 (1.5) | |
| New Zealand | 3 (0.4) | 11 (1.0) | 34 (1.9) | |
| Greece | 3 (0.6) | 10 (1.2) | 29 (1.7) | |
| Cyprus | 2 (0.4) | 8 (0.8) | 29 (1.4) | |
| Portugal | 2 (0.4) | 9 (0.9) | 28 (1.7) | |
| Norway | 1 (0.3) | 5 (0.8) | 23 (1.5) | |
| Iceland | 1 (0.2) | 3 (0.5) | 16 (1.2) | |
| Iran, Islamic Rep. | 0 (0.0) | 1 (0.3) | 8 (1.2) | |
| ***Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):*** | | | | |
| Australia | 12 (1.1) | 26 (1.6) | 55 (2.0) | |
| Austria | 10 (2.0) | 25 (2.2) | 56 (1.9) | |
| [1] Latvia (LSS) | 6 (1.2) | 17 (1.6) | 42 (2.2) | |
| Netherlands | 6 (0.6) | 24 (1.4) | 61 (1.7) | |
| Scotland | 5 (0.7) | 16 (1.3) | 41 (1.8) | |
| ***Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):*** | | | | |
| Slovenia | 10 (0.9) | 26 (1.6) | 55 (1.6) | |
| ***Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):*** | | | | |
| Hungary | 10 (1.1) | 25 (1.8) | 51 (2.1) | |
| ***Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):*** | | | | |
| Thailand | 2 (0.6) | 10 (1.9) | 35 (2.8) | |




The international levels correspond to the percentiles computed from the combined data from all of the participating countries.

Top 10% Level (90th Percentile) = 592
Top Quarter Level (75th Percentile) = 538
Top Half Level (50th Percentile) = 474

*Third grade in most countries; see Table 2 for information about the grades tested in each country.
† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1] National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
[2] National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

## What Are the Gender Differences in Mathematics Achievement?

Tables 1.6 and 1.7 show the differences in achievement by gender. In most countries, girls and boys had approximately the same average mathematics achievement at both grades. However, the few significant differences in achievement that did exist in some countries favored boys rather than girls.

Each table presents mean mathematics achievement separately for boys and girls for each country, as well as the differences between the means. The visual representation of the gender difference for each country, shown by a bar, indicates the amount of the difference, whether the direction of the difference favors girls or boys, and whether or not the difference is statistically significant (indicated by a darkened bar).[9] Regardless of their directions, most of the differences were not statistically significant, indicating that, for most countries, gender differences in mathematics achievement generally are small or negligible in the primary years of schooling.

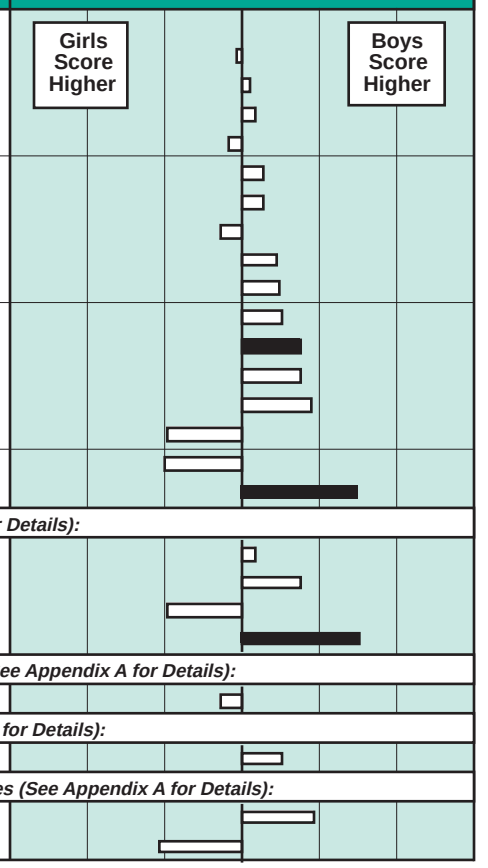
The few statistically significant differences that were observed favored boys rather than girls. At both grades, boys had significantly higher mathematics achievement than girls in Korea. Boys also outperformed girls at the fourth grade in Japan and the Netherlands. At the third grade, significant differences were found in Hong Kong, Canada, Iceland, Norway, and Slovenia.

[9] The tests for statistical significance assumed independent samples of boys and girls in each country and have not been adjusted for multiple comparisons.

# Table 1.6

## Gender Differences in Mathematics Achievement - Upper Grade (Fourth Grade*)

| Country | Boys Mean | Girls Mean | Difference Absolute Value | Gender Difference |
|---|---|---|---|---|
| †Scotland | 520 (4.3) | 520 (3.8) | 0 (5.8) | |
| Hong Kong | 586 (4.7) | 587 (4.2) | 1 (6.3) | |
| Iceland | 474 (3.3) | 473 (3.0) | 1 (4.5) | |
| United States | 545 (3.1) | 544 (3.3) | 2 (4.5) | |
| Greece | 491 (5.0) | 493 (4.5) | 2 (6.8) | |
| Canada | 534 (3.4) | 531 (3.9) | 3 (5.2) | |
| Czech Republic | 568 (3.4) | 566 (3.6) | 3 (5.0) | |
| Ireland | 548 (3.9) | 551 (4.3) | 3 (5.8) | |
| Portugal | 478 (3.8) | 473 (3.7) | 4 (5.3) | |
| †[2] England | 515 (3.4) | 510 (4.4) | 5 (5.5) | |
| Norway | 504 (3.5) | 499 (3.6) | 5 (5.0) | |
| Japan | 601 (2.5) | 593 (2.2) | 8 (3.3) | |
| Cyprus | 506 (3.5) | 499 (3.3) | 8 (4.8) | |
| Iran, Islamic Rep. | 433 (6.0) | 424 (5.0) | 9 (7.8) | |
| New Zealand | 494 (5.7) | 504 (4.3) | 10 (7.1) | |
| Singapore | 620 (5.5) | 630 (6.4) | 10 (8.4) | |
| Korea | 618 (2.5) | 603 (2.6) | 15 (3.6) | |
| ***Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):*** | | | | |
| Australia | 547 (3.5) | 545 (3.7) | 2 (5.1) | |
| Austria | 563 (3.6) | 555 (3.6) | 8 (5.1) | |
| [1] Latvia (LSS) | 521 (5.5) | 530 (5.2) | 9 (7.5) | |
| Netherlands | 585 (3.8) | 569 (3.4) | 15 (5.1) | |
| ***Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):*** | | | | |
| Slovenia | 551 (3.4) | 554 (4.0) | 3 (5.2) | |
| ***Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):*** | | | | |
| Hungary | 552 (4.2) | 546 (3.9) | 5 (5.8) | |
| ***Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):*** | | | | |
| [1] Israel | 537 (4.4) | 528 (4.1) | 9 (6.0) | |
| Thailand | 485 (5.8) | 496 (4.2) | 11 (7.1) | |




| International Averages | | |
|---|---|---|
| Boys | Girls | Difference |
| 537 | 535 | 3 |
| (Averages of all country means) | | |

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

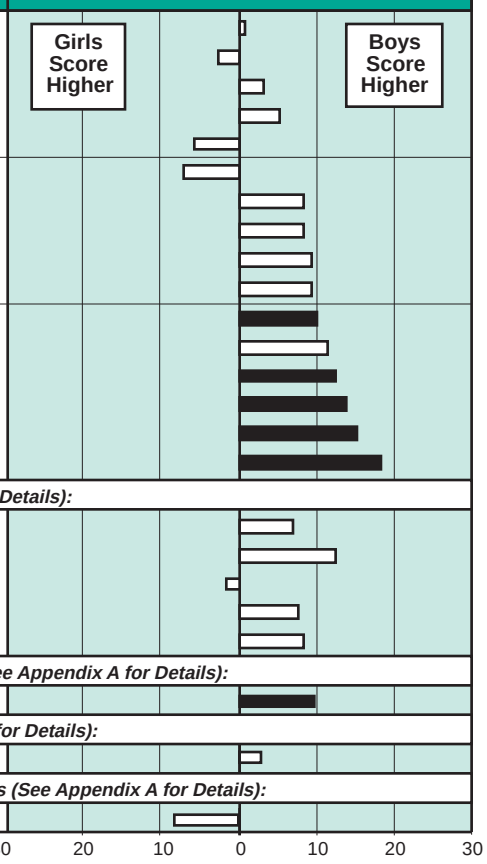
*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
[2]National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

# Table 1.7

## Gender Differences in Mathematics Achievement - Lower Grade (Third Grade*)

| Country | Boys Mean | Girls Mean | Difference Absolute Value | Gender Difference |
|---|---|---|---|---|
| United States | 480 (3.1) | 479 (4.4) | 1 (5.4) | |
| Singapore | 551 (5.4) | 553 (5.0) | 3 (7.4) | |
| Japan | 539 (2.0) | 536 (1.7) | 3 (2.7) | |
| Cyprus | 433 (3.3) | 428 (3.1) | 5 (4.5) | |
| Ireland | 473 (4.3) | 479 (4.5) | 5 (6.3) | |
| New Zealand | 436 (4.4) | 443 (4.5) | 7 (6.3) | |
| Greece | 432 (4.4) | 424 (4.2) | 8 (6.0) | |
| †[2] England | 461 (3.5) | 452 (3.4) | 8 (4.8) | |
| Czech Republic | 502 (3.7) | 493 (3.8) | 9 (5.3) | |
| Portugal | 430 (3.5) | 420 (5.0) | 10 (6.1) | |
| Hong Kong | 528 (3.2) | 518 (3.5) | 10 (4.8) | |
| Iran, Islamic Rep. | 384 (4.4) | 373 (4.9) | 12 (6.6) | |
| Korea | 567 (2.8) | 554 (2.5) | 13 (3.8) | |
| Canada | 477 (3.2) | 463 (3.0) | 14 (4.4) | |
| Iceland | 418 (3.5) | 403 (3.0) | 15 (4.7) | |
| Norway | 430 (3.5) | 411 (3.8) | 18 (5.2) | |
| ***Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):*** | | | | |
| Australia | 487 (4.5) | 480 (4.4) | 7 (6.3) | |
| Austria | 494 (9.2) | 481 (3.8) | 12 (10.0) | |
| [1] Latvia (LSS) | 462 (5.3) | 464 (4.5) | 2 (7.0) | |
| Netherlands | 497 (2.9) | 489 (3.2) | 8 (4.3) | |
| Scotland | 462 (3.8) | 454 (3.5) | 8 (5.2) | |
| ***Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):*** | | | | |
| Slovenia | 492 (3.1) | 483 (3.5) | 10 (4.7) | |
| ***Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):*** | | | | |
| Hungary | 479 (4.9) | 476 (4.4) | 3 (6.6) | |
| ***Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):*** | | | | |
| Thailand | 440 (5.0) | 448 (5.6) | 8 (7.5) | |




| International Averages | | |
|---|---|---|
| Boys | Girls | Difference |
| 475 | 468 | 7 |
| (Averages of all country means) | | |

*Third grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
[2]National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

## What Are the Differences in Median Performance at Age 9?

For countries where the grades tested contained at least 75% of the 9-year-olds, TIMSS estimated the median performance for this age group. Table 1.8 provides this estimate as well as presenting estimates of the distribution of 9-year-olds across grades.[10] For many countries, the two grades tested included practically all of their 9-year-olds (seven countries have at least 98%), whereas, for some others, there were substantial percentages outside these grades, mostly in the grade below.[11] Of the countries included in Table 1.8, Iran, Austria, Latvia, and Hungary had 10% or more of their 9-year-olds below the two grades tested.

The median is the point on the mathematics scale that divides the higher-performing 50% of the students from the lower-performing 50%. Like the mean, the median provides a useful summary statistic on which to compare performance across countries. It is used instead of the mean in this table because it can be reliably estimated even when scores from some members of the population are not available[12] (that is, those 9-year-olds outside the tested grades).

Notwithstanding the additional difficulties in calculating the age-based achievement estimates, the results for 9-year-olds appear to be generally consistent with those obtained for the two grade levels. The relative performance of countries in mathematics achievement on the basis of median performance of 9-year-olds is quite similar to that based on average fourth-grade and/or third-grade performance. Despite some differences in relative standings, the higher-performing countries in the fourth and third grades generally were those with higher-performing 9-year-olds. For example, Singapore, Hong Kong, Korea, and Japan had the highest median performance at age 9. Similar to the fourth grade in particular, the 9-year-olds in the Netherlands also performed very well. Then, in a slightly different pattern, there is a cluster of countries with very similar median scores at age 9, including Canada, the United States, Scotland, the Czech Republic, and Australia.

[10] For information about the distribution of 9-year-olds in all countries, not just those with 75% coverage, see Table A.3 in Appendix A.

[11] The number of 9-year-olds below the lower grade and above the upper grade tested were extrapolated from the estimated distribution of 9-year-olds in the tested grades.

[12] Because TIMSS sampled students in the two adjacent grades with the most 9-year-olds within a country, it was possible to estimate the median for the 9-year-old students when the two tested grades included at least an estimated 75% of the 9-year-olds in that country. To compute the median, TIMSS assumed that those 9-year-old students in the grades below the tested grades would score below the median and those in the grades above the tested grades would score above the median. The percentages assumed to be above and below the median were added to the tails of the distribution before calculating the median using the modified distribution.

# Table 1.8

## Median Mathematics Achievement of 9-Year-Old Students
### Includes Only Countries Where the Grades Tested Contained at Least 75% of the 9-Year-Olds

| Country | Median | Country's Name For Lower Grade | Country's Name For Upper Grade | Estimated Distribution of 9-Year-Olds | | | |
|---|---|---|---|---|---|---|---|
| | | | | Percent Below Lower Grade* | Percentage of 9-Year-Old Students Tested | | Percent Above Upper Grade* |
| | | | | | Percent in Lower Grade | Percent in Upper Grade | |
| Singapore | 569 (5.0) | Primary 3 | Primary 4 | 2.1% | 80.5% | 17.4% | 0.1% |
| Hong Kong | 560 (4.1) | Primary 3 | Primary 4 | 6.2% | 43.2% | 50.0% | 0.7% |
| Korea | 557 (2.5) | 3rd Grade | 4th Grade | 7.9% | 67.2% | 24.3% | 0.7% |
| Japan | 544 (1.8) | 3rd Grade | 4th Grade | 0.5% | 90.8% | 8.7% | 0.0% |
| Canada | 504 (2.7) | 3 | 4 | 4.8% | 46.3% | 47.5% | 1.3% |
| United States | 503 (3.7) | 3 | 4 | 4.5% | 61.1% | 34.2% | 0.2% |
| †Scotland | 502 (3.3) | Year 4 | Year 5 | 0.3% | 22.9% | 75.7% | 1.1% |
| Czech Republic | 502 (3.5) | 3 | 4 | 9.2% | 75.5% | 15.4% | 0.0% |
| Ireland | 489 (3.7) | 3rd Class | 4th Class | 8.4% | 68.4% | 23.2% | 0.0% |
| Greece | 487 (3.5) | 3 | 4 | 0.8% | 10.9% | 87.6% | 0.7% |
| †[2] England | 476 (3.1) | Year 4 | Year 5 | 0.9% | 57.8% | 41.2% | 0.1% |
| Cyprus | 475 (3.2) | 3 | 4 | 1.4% | 35.1% | 62.5% | 0.9% |
| Norway | 473 (3.7) | 2 | 3 | 0.1% | 38.1% | 61.7% | 0.1% |
| New Zealand | 473 (4.4) | Standard 2 | Standard 3 | 0.3% | 50.2% | 49.1% | 0.3% |
| Iceland | 463 (2.6) | 3 | 4 | 0.4% | 14.8% | 84.4% | 0.4% |
| Portugal | 452 (3.9) | 3 | 4 | 6.7% | 45.0% | 47.9% | 0.4% |
| Iran, Islamic Rep. | 385 (3.7) | 3 | 4 | 16.9% | 50.7% | 32.0% | 0.4% |
| ***Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):*** | | | | | | | |
| Australia | 499 (3.6) | 3 or 4 | 4 or 5 | 5.8% | 64.9% | 28.9% | 0.4% |
| Austria | 489 (3.2) | 3 | 4 | 13.2% | 71.5% | 15.2% | 0.0% |
| [1] Latvia (LSS) | 446 (4.1) | 3 | 4 | 23.8% | 54.7% | 21.2% | 0.3% |
| Netherlands | 512 (3.9) | 5 | 6 | 6.9% | 63.0% | 30.1% | 0.0% |
| ***Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):*** | | | | | | | |
| Hungary | 491 (4.4) | 3 | 4 | 10.5% | 70.2% | 19.0% | 0.3% |

*Data are extrapolated; students below the lower grade and above the upper grade were not included in the sample.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2).
[2]National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

## How Does Fourth-Grade Performance Compare with Eighth-Grade Performance?

Achievement at the third and fourth grades was estimated separately from achievement at the seventh and eighth grades. That is, different tests and content areas were used. Therefore, the scale scores are not comparable and direct comparisons cannot be made between the third and fourth grades on one hand and the seventh and eighth grades on the other. One way, however, to compare relative performance between the fourth grade and the eighth grade is to compare a country's performance with the international mean at each of the two grades. For example, the means for the countries participating at both grades are portrayed in Figure 1.3, with those for the eighth grade taken directly from *Mathematics in the Middle School Years: IEA's Third International Mathematics and Science Study*.[13]

As shown in Figure 1.3, Singapore, Korea, Japan, Hong Kong, the Netherlands, the Czech Republic, Austria, Slovenia, and Hungary were above the international average at both grades. However, the high-ranking countries at the fourth grade were not always the same as at the eighth grade. Ireland, Australia, and the United States were above the international average at the fourth grade. But, at the eighth grade, Ireland and Australia were about at the international average, while the United States was below it. Latvia (LSS) and Scotland performed similarly to the international average at the fourth grade, but below the international average at the eighth grade. Conversely, New Zealand and Thailand performed below the international average at the fourth grade, but not at the eighth grade.

In reading Figure 1.3, however, it is important to remember that the fourth- and eighth-grade scales are not directly comparable. For example, it is not the case that the eighth graders in Singapore outperformed the fourth graders by 18 points, nor is it true that fourth graders in Korea outperformed eighth graders by 4 points.

[13] 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.

## Figure 1.3

### Mathematics Performance at Fourth and Eighth Grades* Compared with the International Averages

| Fourth Grade | |
|---|---|
| **Country** | **Mean Scale Score** |
| **Singapore** | 625 (5.3) |
| **Korea** | 611 (2.1) |
| **Japan** | 597 (2.1) |
| **Hong Kong** | 587 (4.3) |
| *Netherlands* | 577 (3.4) |
| **Czech Republic** | 567 (3.3) |
| *Austria* | 559 (3.1) |
| *Slovenia* | 552 (3.2) |
| **Ireland** | 550 (3.4) |
| *Hungary* | 548 (3.7) |
| *Australia* | 546 (3.1) |
| **United States** | 545 (3.0) |
| **Canada** | 532 (3.3) |
| *Israel* | 531 (3.5) |
| *Latvia (LSS)* | 525 (4.8) |
| **Scotland** | 520 (3.9) |
| **England** | 513 (3.2) |
| **Cyprus** | 502 (3.1) |
| **Norway** | 502 (3.0) |
| **New Zealand** | 499 (4.3) |
| **Greece** | 492 (4.4) |
| *Thailand* | 490 (4.7) |
| **Portugal** | 475 (3.5) |
| **Iceland** | 474 (2.7) |
| **Iran, Islamic Rep.** | 429 (4.0) |
| *Kuwait* | 400 (2.8) |
| International Average = | 529 (0.7) |
| (Average of All Country Means) | |

| Eighth Grade | |
|---|---|
| **Country** | **Mean Scale Score** |
| **Singapore** | 643 (4.9) |
| **Korea** | 607 (2.4) |
| **Japan** | 605 (1.9) |
| **Hong Kong** | 588 (6.5) |
| **Czech Republic** | 564 (4.9) |
| *Netherlands* | 541 (6.7) |
| *Slovenia* | 541 (3.1) |
| *Austria* | 539 (3.0) |
| **Hungary** | 537 (3.2) |
| *Australia* | 530 (4.0) |
| **Ireland** | 527 (5.1) |
| **Canada** | 527 (2.4) |
| *Thailand* | 522 (5.7) |
| *Israel* | 522 (6.2) |
| **New Zealand** | 508 (4.5) |
| **England** | 506 (2.6) |
| **Norway** | 503 (2.2) |
| **United States** | 500 (4.6) |
| *Scotland* | 498 (5.5) |
| **Latvia (LSS)** | 493 (3.1) |
| **Iceland** | 487 (4.5) |
| *Greece* | 484 (3.1) |
| **Cyprus** | 474 (1.9) |
| **Portugal** | 454 (2.5) |
| **Iran, Islamic Rep.** | 428 (2.2) |
| *Kuwait* | 392 (2.5) |
| International Average = | 520 (0.8) |
| (Average of All Country Means) | |

Significantly Higher than International Average

Not Significantly Different from International Average

Significantly Lower than International Average

*Fourth and eighth grades in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
Includes countries that participated in TIMSS testing at both fourth and eighth grades. The eighth-grade means are the same as those reported in *Mathematics Achievement in the Middle School Years: IEA's Third Mathematics and Science Study.*

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

In order to provide a more direct basis for comparison, TIMSS established a link between the results for the third- and fourth-grade students and the scale used to report seventh- and eighth-grade performance. Because 15 of the 102 mathematics items in the third- and fourth-grade assessment also were included in the seventh- and eighth-grade assessment, it was possible to use the average increase in performance on these items to estimate where on the seventh- and eighth-grade scale the younger students should be placed.[14]

Table 1.9 provides an estimate of how the fourth-grade students would have performed on the eighth-grade scale. The mean for fourth-grade students in this table is based on all items administered to fourth-grade students, although only the common items were used to establish the link. Since there were relatively few items in common in the mathematics tests given at the two grades, the size of the link is approximate. The standard error for the fourth-grade estimate incorporates an added component to account for the uncertainty of this approximation. (The eighth-grade means are the same as those reported in *Mathematics Achievement in the Middle School Years: IEA's Third Mathematics and Science Study*.)

Table 1.9 provides information about the difference in performance between the two grades. The estimated increases between the fourth and eighth grades were generally comparable for most countries, although there was a range from a low of 93 for the United States to a high of 168 for Thailand. For most countries, the differences in growth between the fourth and eighth grades are reflected in the changes in standing relative to the international mean as shown in Figure 1.3. For example, Thailand showed the largest increase, and its relative standing moved from below the international mean at the fourth grade to near the international mean at the eighth grade. A similar pattern was observed for New Zealand. In contrast, Australia, Ireland, Scotland, and Latvia (LSS) had smaller increases than many countries, and the United States had the smallest increase. These countries lost ground between the fourth and eighth grades in their standing relative to the international mean.

[14] See the section on "Estimating the Link Between Fourth- and Eighth-Grade Performance" in Appendix A.

## Table 1.9

### Increases in Mathematics Performance Between the Fourth and Eighth Grades*
### Based on Fourth-Grade Performance Estimated on the Eighth-Grade Scale

| Country | Estimated Fourth-Grade Mean on Eighth-Grade Scale | Eighth-Grade Mean | Difference |
|---|---|---|---|
| *Thailand* | 354 (9.1) | 522 (5.7) | 168 (10.7) |
| **Singapore** | 484 (9.4) | 643 (4.9) | 159 (10.6) |
| **Iceland** | 338 (8.3) | 487 (4.5) | 149 (9.5) |
| **Japan** | 457 (8.1) | 605 (1.9) | 148 (8.3) |
| **New Zealand** | 362 (8.9) | 508 (4.5) | 146 (10.0) |
| **Hong Kong** | 447 (8.9) | 588 (6.5) | 141 (11.0) |
| **Norway** | 365 (8.4) | 503 (2.2) | 138 (8.7) |
| **Korea** | 471 (8.1) | 607 (2.4) | 137 (8.5) |
| **Czech Republic** | 428 (8.5) | 564 (4.9) | 135 (9.8) |
| **Iran, Islamic Rep.** | 294 (8.8) | 428 (2.2) | 134 (9.0) |
| **Canada** | 395 (8.5) | 527 (2.4) | 133 (8.8) |
| **England** | 376 (8.5) | 506 (2.6) | 130 (8.9) |
| **Greece** | 356 (8.9) | 484 (3.1) | 128 (9.4) |
| *Israel* | 394 (8.6) | 522 (6.2) | 128 (10.6) |
| *Hungary* | 410 (8.7) | 537 (3.2) | 127 (9.2) |
| *Slovenia* | 414 (8.5) | 541 (3.1) | 127 (9.0) |
| *Kuwait* | 267 (8.3) | 392 (2.5) | 125 (8.7) |
| *Australia* | 408 (8.4) | 530 (4.0) | 121 (9.3) |
| *Austria* | 421 (8.4) | 539 (3.0) | 119 (9.0) |
| **Ireland** | 412 (8.6) | 527 (5.1) | 116 (10.0) |
| **Scotland** | 383 (8.7) | 498 (5.5) | 115 (10.3) |
| **Portugal** | 340 (8.6) | 454 (2.5) | 115 (8.9) |
| **Cyprus** | 366 (8.4) | 474 (1.9) | 108 (8.6) |
| *Latvia (LSS)* | 388 (9.2) | 493 (3.1) | 105 (9.7) |
| *Netherlands* | 438 (8.5) | 541 (6.7) | 103 (10.8) |
| **United States** | 407 (8.4) | 500 (4.6) | 93 (9.6) |

*Fourth and eighth grades in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures at the fourth grade (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
Includes countries that participated in TIMSS achievement testing at both fourth and eighth grades.
Note: Table 1.9 provides an estimate of how the fourth-grade students would have performed on the eighth-grade scale. Since there are only 15 mathematics items in common in the tests given to the two grades, the estimate of the relationship is approximate. The standard error for the fourth-grade estimate incorporates an added component to account for the uncertainty of this approximation. The eighth-grade means are the same as those reported in *Mathematics Achievement in the Middle School Years: IEA's Third Mathematics and Science Study.*
Table C.5 contains the means for the third and fourth grades, as well as for the seventh and eighth grades.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.