

Chapter 2

AVERAGE ACHIEVEMENT IN THE MATHEMATICS CONTENT AREAS

Recognizing that important curricular differences exist between and within countries is an important aspect of IEA studies, TIMSS attempted to measure achievement in different areas within mathematics that would be useful in relating achievement to curriculum. After much deliberation, the mathematics test for the third and fourth grades was designed to enable reporting by six content areas.¹ These six content areas consist of:

- whole numbers
- fractions and proportionality
- measurement, estimation, and number sense
- data representation, analysis, and probability
- geometry
- patterns, relations, and functions

Following the discussion in this chapter about differences in average achievement for the TIMSS countries across the content areas, Chapter 3 contains further information about the types of items within each content area, including five example items within each content area and the percentage of correct responses on those items for each of the TIMSS countries.

HOW DOES ACHIEVEMENT DIFFER ACROSS MATHEMATICS CONTENT AREAS?

As described in Chapter 1, there are substantial differences in achievement among the participating countries on the TIMSS mathematics test. Given that the mathematics test was designed to include items from different curricular areas, it is important to examine whether or not the participating countries have particular strengths and weaknesses in their achievement in these content areas.

This chapter uses an analysis based on the average percentage of correct responses to items within each content area to address whether countries performed at the same level in each of the content areas as they did on the mathematics test as a whole. Because additional resources and time would have been required to use the more complex IRT scaling methodology that served as the basis for the overall achievement estimates in Chapter 1, TIMSS could not generate scale scores for the six content areas for this report.²

¹ Please see the test development section of Appendix A for more information about the process used to develop the TIMSS tests. Appendix B provides an analysis of the match between the test and curriculum in the different TIMSS countries and the effect of this match on the TIMSS results.

² TIMSS plans to generate IRT scale scores for the mathematics content areas for future reports.

Tables 2.1 and 2.2 provide the average percentages of correct responses to items in the different content areas for the fourth- and third-grade students, respectively. The countries are listed in order of their average percent correct across all items in the test. As indicated by the numbers of items overall and in each content area, the overall test contains more items in the areas of whole numbers (25%), fractions (21%), and measurement (20%) and fewer items in the areas of data representation (12%), geometry (14%), and patterns (10%). Thus, countries that did well on the items testing the first three content areas were more likely to have higher overall scores than those that performed better in the second three content areas.³

The results for the average percent correct across all mathematics items are presented for each country primarily to provide a basis for comparison of performance in each of the content areas. For the purpose of comparing overall achievement among countries, it is preferable to use the results presented in Chapter 1.⁴ It is interesting to note, however, that even though the relative standings of countries differ somewhat from Tables 1.1 and 1.2, the slight differences for most countries are well within the limits of sampling error and can be attributed to the differences in the methods used.

The major difference can be found in the relative standing of Singapore. Particularly at the fourth grade, a rather substantial percentage of students in Singapore answered all of the items in their booklets correctly – 7%. Although the scaling technology used in Chapter 1 takes these high-performing students into account in producing estimates of achievement distributions, the percentage correct metric does not. The percentage correct simply reflects how many students answered each of the TIMSS mathematics items correctly, on average. Although no other country had as large a percentage of students with perfect scores as Singapore, a number of countries had from 1% to 3%, including Australia, Austria, Cyprus, the Czech Republic, England, Hong Kong, Hungary, Ireland, Israel, Japan, Korea, Latvia, the Netherlands, Scotland, Slovenia, and the United States. At the third grade, this phenomenon occurred to a much lesser extent. Approximately 1% of the students in Singapore and Korea received perfect scores, while fewer than .5% did in almost every other country.

In Tables 2.1 and 2.2, the data in each column show each country's average percent correct for items in that content area and the international average across all countries for the content area (shown as the last entry in the column). Looking down each of the columns, in turn, two findings become apparent. First, the countries that did well on the overall test generally did well in each of the various content areas, and those that did poorly overall also tended to do so in each of the content areas. There are differences between the relative standing of countries within each of the content areas and their overall standing, but these differences are small when sampling error is considered.

³ Table A.1 in Appendix A provides details about the distributions of items across the content areas, by format and score points (taking into account multi-part items and items scored for partial credit).

⁴ The IRT scale scores provide better estimates of overall achievement, because they take the difficulty of items into account. This is important in a study such as TIMSS, where different students take overlapping but somewhat different sets of items.

Table 2.1

Average Percent Correct by Mathematics Content Areas Upper Grade (Fourth Grade*)

Country	Mathematics Overall (102 items)	Whole Numbers (25 items)	Fractions and Proportionality (21 items)	Measurement, Estimation, and Number Sense (20 items)	Data Representation, Analysis, and Probability (12 items)	Geometry (14 items)	Patterns, Relations, and Functions (10 items)
Korea	76 (0.4)	88 (0.3)	65 (0.5)	72 (0.5)	80 (0.6)	72 (0.6)	83 (0.7)
Singapore	76 (0.8)	83 (0.7)	74 (1.0)	67 (1.0)	81 (0.8)	72 (0.8)	76 (0.9)
Japan	74 (0.4)	82 (0.4)	65 (0.6)	72 (0.5)	79 (0.5)	72 (0.6)	76 (0.6)
Hong Kong	73 (0.9)	79 (0.9)	66 (1.0)	69 (0.9)	76 (1.0)	74 (0.8)	73 (1.2)
Czech Republic	66 (0.6)	75 (0.6)	53 (0.8)	68 (0.7)	67 (0.9)	71 (0.7)	67 (0.9)
Ireland	63 (0.8)	70 (0.8)	58 (1.0)	56 (0.9)	69 (0.9)	66 (0.8)	64 (1.0)
United States	63 (0.6)	71 (0.7)	51 (0.8)	53 (0.6)	73 (0.9)	71 (0.7)	66 (0.9)
Canada	60 (1.0)	68 (0.9)	48 (1.0)	54 (1.1)	68 (1.4)	72 (1.4)	62 (1.5)
[†] Scotland	58 (0.8)	61 (0.8)	46 (1.0)	53 (0.9)	66 (1.0)	72 (0.8)	57 (1.0)
¹² England	57 (0.7)	58 (0.7)	45 (0.8)	52 (0.7)	64 (0.9)	74 (0.8)	55 (1.0)
Cyprus	54 (0.6)	65 (0.7)	48 (0.7)	48 (0.8)	52 (0.9)	53 (0.9)	55 (1.1)
Norway	53 (0.7)	61 (0.8)	38 (0.7)	56 (0.7)	59 (0.9)	58 (0.9)	50 (1.2)
New Zealand	53 (1.0)	57 (1.0)	41 (1.1)	49 (1.1)	61 (1.3)	66 (1.1)	52 (1.2)
Greece	51 (0.9)	62 (1.0)	42 (1.1)	48 (1.0)	50 (1.2)	53 (1.2)	47 (1.2)
Iceland	50 (0.8)	56 (0.9)	36 (1.0)	44 (0.9)	58 (1.2)	63 (1.0)	48 (1.4)
Portugal	48 (0.7)	57 (0.8)	38 (0.7)	49 (0.8)	43 (1.1)	52 (1.0)	47 (1.1)
Iran, Islamic Rep.	38 (0.9)	51 (1.2)	32 (1.0)	36 (0.9)	23 (0.9)	42 (0.9)	40 (1.4)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):							
Australia	63 (0.6)	67 (0.6)	51 (0.7)	60 (0.7)	67 (0.8)	74 (0.7)	64 (0.9)
Austria	65 (0.7)	74 (0.8)	51 (0.8)	69 (0.8)	66 (1.1)	67 (0.8)	64 (1.1)
¹ Latvia (LSS)	59 (1.0)	68 (0.9)	44 (1.3)	60 (1.0)	54 (1.3)	67 (1.0)	65 (1.2)
Netherlands	69 (0.7)	75 (0.8)	60 (0.9)	70 (0.8)	75 (0.9)	71 (0.8)	65 (1.1)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):							
Slovenia	64 (0.6)	74 (0.6)	50 (0.9)	64 (0.9)	64 (1.0)	72 (0.8)	68 (0.8)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):							
Hungary	64 (0.8)	76 (0.7)	49 (0.9)	64 (0.9)	60 (1.0)	66 (0.8)	69 (1.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):							
¹ Israel	59 (1.0)	71 (1.0)	48 (1.1)	54 (1.0)	64 (1.2)	62 (1.0)	60 (1.5)
Kuwait	32 (0.5)	36 (0.5)	25 (0.5)	35 (0.6)	26 (0.6)	36 (0.6)	33 (1.0)
Thailand	50 (1.1)	58 (1.3)	44 (1.0)	44 (1.0)	56 (1.5)	53 (1.2)	50 (1.3)
International Average Percent Correct	59 (0.2)	67 (0.2)	49 (0.2)	56 (0.2)	62 (0.2)	64 (0.2)	60 (0.2)

*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).

¹National 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.

²National 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.

Table 2.2

Average Percent Correct by Mathematics Content Areas Lower Grade (Third Grade*)

Country	Mathematics Overall (102 items)	Whole Numbers (25 items)	Fractions and Proportionality (21 items)	Measurement, Estimation, and Number Sense (20 items)	Data Representation, Analysis, and Probability (12 items)	Geometry (14 items)	Patterns, Relations, and Functions (10 items)
Korea	67 (0.5)	81 (0.5)	53 (0.6)	61 (0.6)	70 (0.8)	67 (0.6)	73 (0.7)
Japan	63 (0.3)	72 (0.4)	52 (0.5)	60 (0.5)	69 (0.5)	62 (0.6)	64 (0.6)
Singapore	62 (0.9)	75 (0.8)	55 (1.0)	52 (1.0)	68 (1.1)	60 (0.8)	65 (1.1)
Hong Kong	59 (0.7)	68 (0.7)	48 (0.8)	56 (0.8)	63 (1.0)	65 (0.8)	58 (1.0)
Czech Republic	52 (0.7)	59 (0.8)	38 (0.8)	54 (0.7)	51 (1.0)	61 (0.8)	53 (1.0)
United States	49 (0.7)	57 (0.7)	36 (0.8)	41 (0.8)	56 (1.0)	61 (0.9)	53 (1.1)
Ireland	48 (0.8)	55 (0.9)	41 (1.0)	41 (0.7)	50 (1.2)	55 (0.9)	48 (1.1)
Canada	47 (0.7)	53 (0.7)	33 (0.8)	42 (0.7)	52 (1.0)	62 (1.0)	48 (1.3)
^{†2} England	45 (0.6)	46 (0.8)	34 (0.6)	42 (0.7)	50 (1.0)	63 (0.9)	43 (1.0)
New Zealand	41 (0.8)	42 (1.0)	30 (0.7)	38 (0.8)	43 (1.2)	58 (1.2)	41 (1.2)
Cyprus	38 (0.6)	48 (0.7)	31 (0.7)	35 (0.7)	33 (0.8)	42 (0.8)	41 (1.0)
Portugal	37 (0.8)	46 (1.0)	30 (0.7)	37 (0.8)	31 (1.1)	42 (1.0)	36 (1.3)
Greece	37 (0.8)	46 (1.0)	30 (0.9)	36 (1.0)	35 (1.0)	41 (0.9)	33 (1.3)
Norway	36 (0.7)	40 (0.9)	24 (0.6)	38 (0.9)	37 (1.0)	44 (0.9)	34 (1.1)
Iceland	35 (0.6)	37 (0.8)	25 (0.6)	33 (0.8)	39 (1.0)	50 (1.1)	32 (1.1)
Iran, Islamic Rep.	28 (0.7)	38 (1.1)	20 (0.5)	29 (0.8)	17 (0.7)	33 (0.9)	30 (1.1)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):							
Australia	50 (0.9)	54 (1.0)	38 (0.9)	48 (0.8)	51 (1.2)	65 (1.2)	50 (1.1)
Austria	50 (1.0)	58 (0.8)	35 (1.1)	55 (1.2)	48 (1.4)	57 (1.3)	48 (1.4)
¹ Latvia (LSS)	45 (0.8)	50 (1.0)	30 (0.9)	48 (1.0)	39 (1.1)	57 (1.0)	53 (1.4)
Netherlands	52 (0.6)	57 (0.7)	39 (0.6)	54 (0.7)	56 (1.0)	61 (0.8)	50 (1.2)
Scotland	45 (0.8)	47 (0.9)	33 (0.6)	41 (0.9)	49 (1.1)	65 (0.9)	45 (1.1)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):							
Slovenia	51 (0.7)	60 (0.8)	36 (0.7)	47 (0.8)	52 (1.0)	64 (0.7)	54 (1.3)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):							
Hungary	49 (0.9)	62 (1.0)	34 (0.8)	47 (0.9)	45 (1.0)	52 (1.0)	57 (1.3)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):							
Thailand	40 (1.2)	47 (1.4)	33 (1.2)	35 (1.0)	41 (1.7)	44 (1.4)	40 (1.5)
International Average Percent Correct	47 (0.2)	54 (0.2)	36 (0.2)	45 (0.2)	48 (0.2)	56 (0.2)	48 (0.2)

*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).

¹National 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.

²National 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.

Second, the international averages show that the different content areas in the TIMSS test were not equally difficult for the students taking the test. Whole numbers and geometry were the least difficult content areas. At the fourth-grade, on average, the whole number items were answered correctly by 67% of the students across countries, and the geometry items by 64% of the students. At the third grade, the international averages were 54% in whole numbers and 56% in geometry. Internationally, the fractions and proportionality items (international averages of 49% at fourth grade and 36% at third grade) were the most difficult items for the students at both grades.

It is important to keep these differences in average difficulty in mind when reading across the rows of the table. These differences mean that for many countries, students will appear to have higher than average performance in whole numbers and geometry and lower than average performance in fractions and proportionality. For example, even the fourth-grade students in Korea, Singapore, Japan, and Hong Kong who performed above the international average for the area of fractions and proportionality by a substantial margin, still performed somewhat less well in this area than they did on the test as a whole. That is, simply comparing performance across the rows gives an unclear picture of each country's relative performance across the content areas because the differing difficulty of the items has not been taken into account.

To facilitate more meaningful comparisons across rows, TIMSS has developed profiles of relative performance, which are shown for both grades in Table 2.3. These profiles are designed to show whether participating countries performed better or worse in some content areas than they did on the test as a whole, after adjusting for the differing difficulty of the items in each of the content areas.⁵ An up-arrow indicates that a country performed significantly better in a content area than it did on the test as a whole, a down-arrow indicates significantly lower performance, and a circle indicates that the country's performance in a content area is not very different from its performance on the test as a whole.⁶

The profiles in Table 2.3 reveal that many countries performed relatively better or worse in several content areas than they did overall. Each country had at least two content areas in which it did either relatively better or worse than it did on average. Although countries that did well in one content area tended to do well in others, there were still significant performance differences by content area among countries. Also, although there were differences between the two grades, relative performance tended to be similar at both the third and fourth grades. That countries have different relative strengths and weaknesses is consistent with the existence of differing curricular patterns and approaches among countries as discussed in the curriculum analysis report, *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics*.⁷

⁵ In performing the computations, the first step was to adjust the average percents to make all content areas equally difficult so that the comparisons would not reflect the various difficulties of the items in the content areas. The next step was to subtract these adjusted percentages for each content area from a country's average percentage over all six content areas. If the overall percentage of correct items by students in a country was the same as the adjusted average for that country for each of the content areas, then these differences would all be zero. The standard errors for these differences were computed, and then each difference was examined for statistical significance. This approach is similar to testing interaction terms in the analysis of variance. The jackknife method was used to compute the standard error of each interaction term. The significance level was adjusted using the Bonferroni method, assuming 6×26 (content areas by countries) comparisons at the fourth grade and 6×24 at the third grade.

⁶ The statistics are not independent. That is, a country cannot do better (or worse) than its average on all scales, since a country's differences must add up to zero. However, it is possible for a country to have no statistically significant differences in performance.

⁷ Schmidt, W.H., McKnight, C.C., Valverde, G.A., Houang, R.T., and Wiley, D.E. (1997). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics*. Dordrecht, the Netherlands: Kluwer Academic Publishers.

Table 2.3**Profiles of Relative Performance in Mathematics Content Areas - Lower and Upper Grades (Third and Fourth Grades*)**

Third Grade							Fourth Grade						
Country	Whole Numbers	Fractions and Proportionality	Measurement, Estimation, and Number Sense	Data Representation, Analysis, & Probability	Geometry	Patterns, Relations, and Functions	Country	Whole Numbers	Fractions and Proportionality	Measurement, Estimation, and Number Sense	Data Representation, Analysis, & Probability	Geometry	Patterns, Relations, and Functions
Korea	▲	▼	▼	▲	▼	▲	Korea	▲	●	▼	●	▼	▲
Japan	▲	●	●	▲	▼	●	Singapore	●	▲	▲	▲	▼	●
Singapore	▲	▲	▼	▲	▼	▲	Japan	●	▲	▲	▲	▼	▲
Hong Kong	▲	●	●	▲	▼	▼	Hong Kong	▼	▲	●	●	▼	●
Czech Republic	●	▼	▲	●	●	●	Czech Republic	●	▼	▲	●	●	●
United States	●	▼	▼	▲	▲	●	Ireland	●	▲	▼	▲	▼	●
Ireland	●	▲	▼	●	●	●	United States	●	▼	▼	▲	▲	▲
Canada	▼	▼	▼	▲	▲	●	Canada	●	▼	▼	▲	▲	●
¹² England	▼	●	●	▲	▲	▼	¹ Scotland	▼	▼	▼	▲	▲	▼
New Zealand	▼	●	●	●	▲	●	¹² England	▼	▼	▼	▲	▲	▼
Cyprus	▲	▲	●	▼	▼	●	Cyprus	▲	▲	▼	▼	▼	●
Portugal	▲	▲	▲	▼	▼	●	Norway	●	▼	▲	▲	●	▼
Greece	▲	▲	●	▼	▼	▼	New Zealand	▼	▼	▼	▲	▲	▼
Norway	▲	●	●	●	●	▼	Greece	▲	▲	●	▼	●	▼
Iceland	▼	●	▲	▲	▲	▼	Iceland	▼	▼	▼	▲	▲	●
Iran, Islamic Rep.	▲	▲	▲	▼	▼	●	Portugal	▲	●	▲	▼	●	●
							Iran, Islamic Rep.	▲	▲	▲	▼	●	●
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):													
Australia	▼	●	●	●	▲	●	Australia	▼	▼	●	●	▲	●
Austria	●	▼	▲	●	●	●	Austria	●	▼	▲	●	▼	●
¹ Latvia (LSS)	▼	▼	▲	▼	●	▲	¹ Latvia (LSS)	●	▼	▲	▼	▲	▲
Netherlands	▼	▼	▲	▲	●	●	Netherlands	●	●	▲	▲	▼	▼
Scotland	▼	▼	▼	●	▲	●							
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):													
Slovenia	●	▼	▼	●	▲	●	Slovenia	●	▼	▲	▼	●	▲
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):													
Hungary	▲	▼	●	▼	▼	▲	Hungary	▲	▼	▲	▼	▼	▲
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):													
Thailand	●	▲	●	●	▼	●	¹ Israel	▲	●	▼	▲	▼	●
							Kuwait	▼	▲	▲	▼	●	●
							Thailand	●	▲	▼	▲	▼	●

▲ = Significantly higher than the country's overall average performance after adjusting for the difficulty of the content area

● = No significant difference from the country's overall average performance after adjusting for the difficulty of the content area

▼ = Significantly lower than the country's overall average performance after adjusting for the difficulty of the content area

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

¹Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

¹National 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.

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

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

WHAT ARE THE INCREASES IN ACHIEVEMENT BETWEEN THE LOWER AND UPPER GRADES?

Figure 2.1, which profiles the increases in average percent correct between the third and fourth grade for each country across content areas, also reflects these curricular differences. The figure portrays the amount of the increase in mathematics achievement overall as well as the increase in achievement for each of the six content areas. The dashed line indicates the overall increase, for ease in comparing the growth within content areas with the growth in performance overall.

The results are presented in descending order by the amount of overall increase between the grades, beginning with Norway, Cyprus, and Ireland, all three of which showed the greatest increases (15 percentage points or more). Since students in Norway begin school at a later age than those in the other participating countries, its 9-year-olds were generally in the second and third grades rather than the third and fourth grades. Not surprisingly, staff from the TIMSS national research center in Norway reported that the second graders had difficulty in reading some of the items, and that the improvements in reading literacy skills from second to third grade undoubtedly accounted for part of the large increase in Norway.

Consistent with the scale scores presented in Chapter 1, for most countries the overall increase in average percent correct between the third and fourth grades was larger than that observed between the seventh and eighth grades.⁸ The increases between seventh and eighth grades ranged from approximately 1 to 10 percentage points.

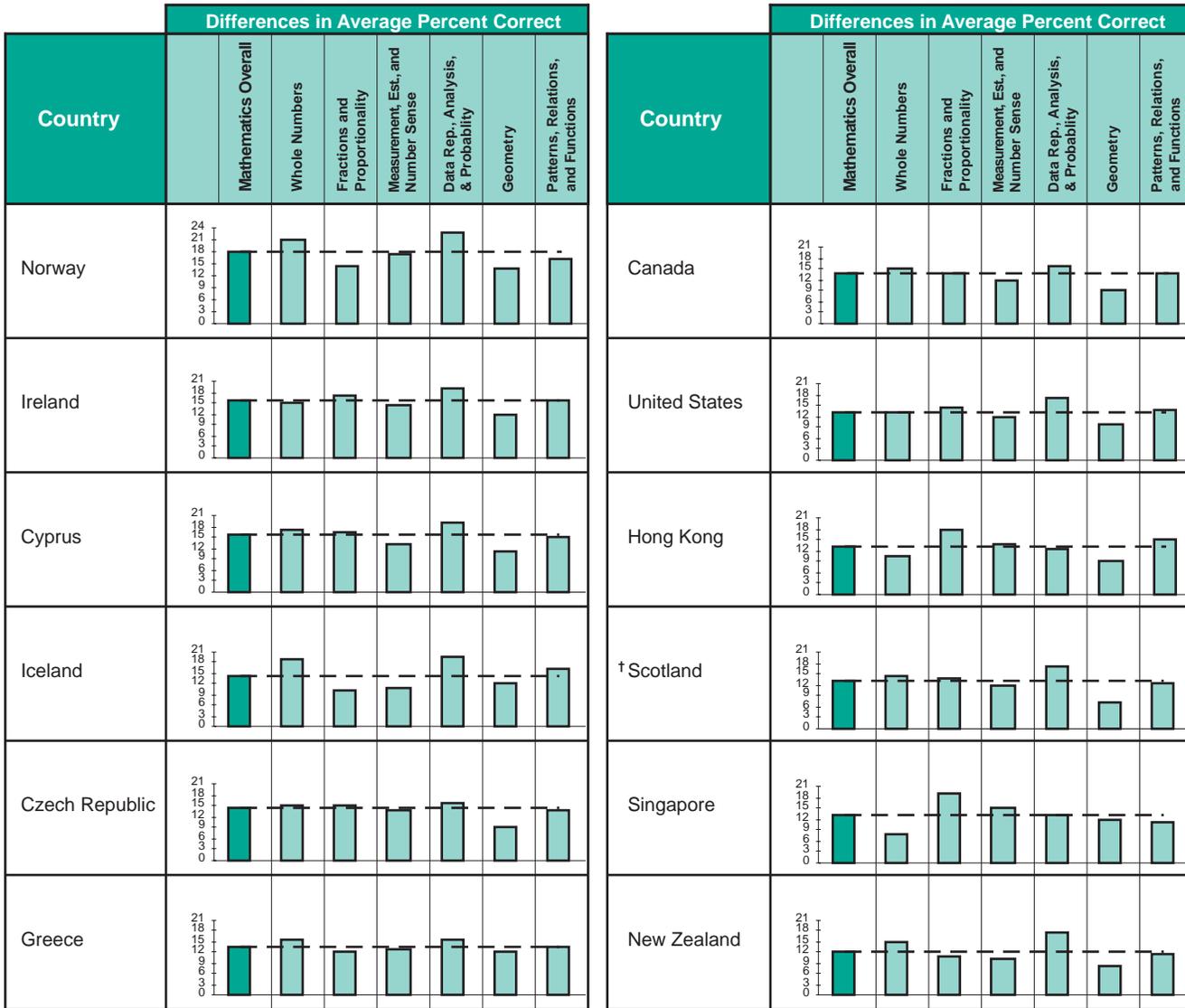
The results show that the degree of increase across the different content areas was uneven in most countries, generally reflecting a greater emphasis in the curriculum on some areas than others during the fourth grade. However, there were several countries, Greece, England, Japan, Portugal, and Hungary, for example, where the increases in the content areas were similar to the overall between-grade increase across most content areas.

⁸ 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.

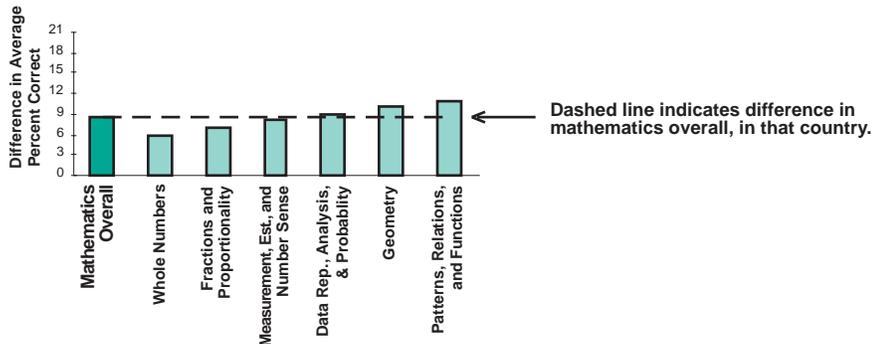
In general, performance in data representation, analysis, and probability showed the largest growth between the third and fourth grades. Growth also was found in either whole numbers or fractions and proportionality. This is most noticeable in whole numbers for Norway, Iceland, and Latvia. Hong Kong, Singapore, Korea, and the Netherlands, four of the highest performing countries, were among those countries showing higher-than-average between-grade increases in fractions and proportionality. The growth in measurement, estimation, and number sense tended to be quite similar to or somewhat below the average between-grade increase, except in Slovenia and Hungary. In general, the increases in patterns, relations, and functions were very similar to the increases overall. Geometry often showed a smaller-than-average increase compared with that overall, presumably because this content area is not particularly emphasized in either third or fourth grade.

Figure 2.1

Difference in Average Percent Correct Between Lower and Upper Grades (Third and Fourth Grades*) Overall and in Mathematics Content Areas



Legend:



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

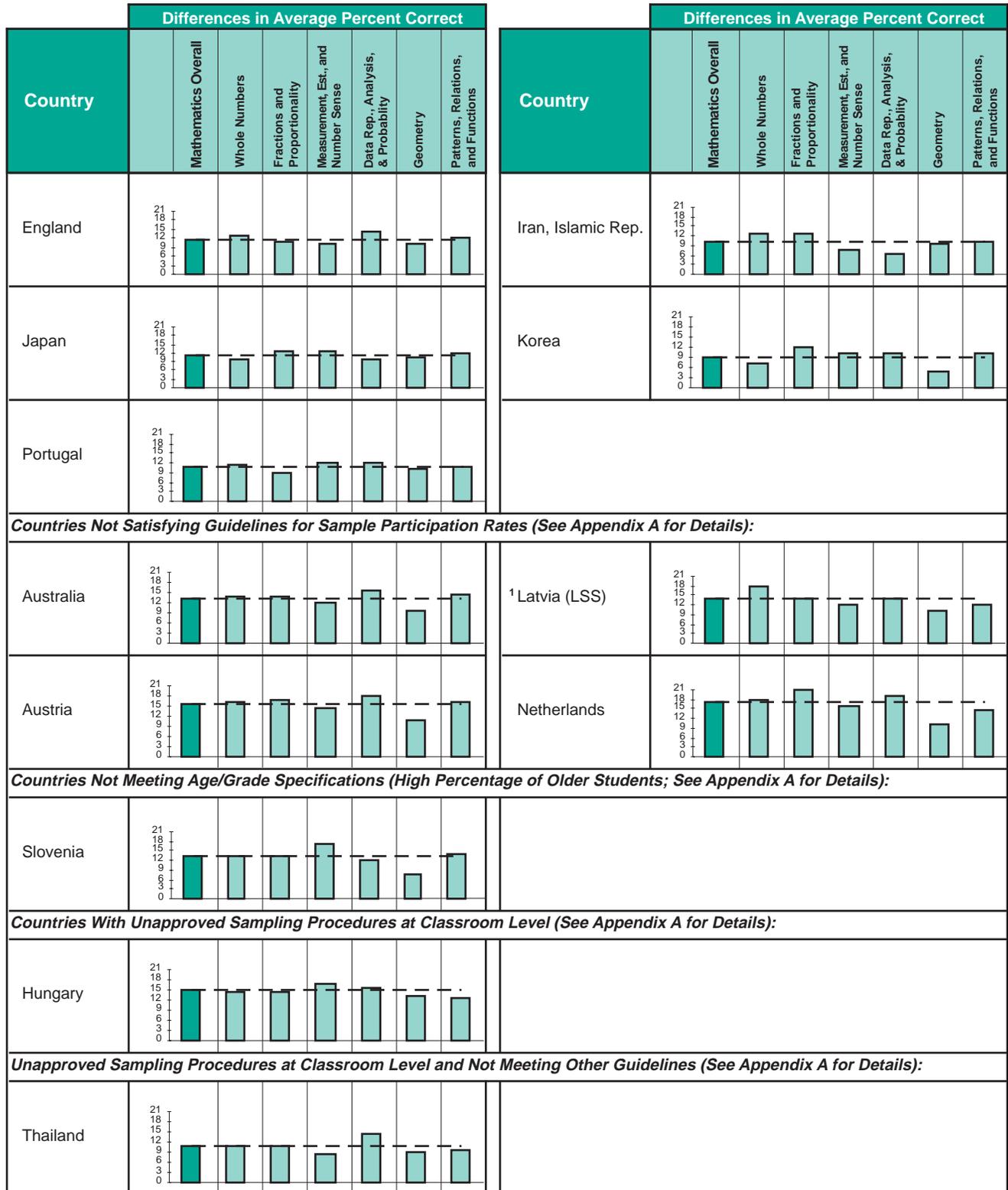
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

¹National 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.

²National Defined Population covers less than 90 percent of National Desired Population (see Table A.2). Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Figure 2.1 (Continued)

Difference in Average Percent Correct Between Lower and Upper Grades (Third and Fourth Grades*) Overall and in Mathematics Content Areas



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

¹Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

¹National 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.

²National Defined Population covers less than 90 percent of National Desired Population (see Table A.2). Because results are rounded to the nearest whole number, some totals may appear inconsistent.

WHAT ARE THE GENDER DIFFERENCES IN ACHIEVEMENT FOR THE CONTENT AREAS?

Tables 2.4 and 2.5 indicate few statistically significant gender differences in achievement overall. The results are nearly identical to those in Chapter 1. However, the slightly reduced number of gender differences in performance overall compared to the differences in scale scores discussed in Chapter 1 reinforces the idea of less precision in the percent-correct metric. Still, the findings are consistent: few gender differences, but the differences that do exist tend to favor boys. In the content areas, especially at the third grade, boys tended to have higher achievement than girls in a number of countries in whole numbers and in fractions and proportionality, as well as in measurement, estimation, and number sense. For the remaining three content areas, there were few differences in performance between boys and girls.

In whole numbers, the fourth-grade boys had significantly higher achievement than the girls in England, Japan, and Korea. The fourth-grade girls outperformed the boys in Singapore. However, at the third grade, the boys had higher achievement than the girls in Canada, England, Iceland, Japan, Korea, Norway, and the Netherlands. In fractions and proportionality, the gender differences at the fourth grade were minimal in all countries except Korea and Austria where boys had significantly higher achievement than girls. The third-grade boys showed a significant advantage in the Czech Republic, Hong Kong, Iceland, and Korea. In the area of measurement, estimation, and number sense, gender differences favoring boys over the girls were found in more than one-third of the countries at either the fourth or third grades. The advantage for boys was observed in several countries at both grades, including the Czech Republic, England, Iran, Japan, Korea, and Norway. In no country did the girls have higher achievement than the boys in this content area.

Boys and girls at both grades performed about the same in the content area of data representation, analysis, and probability. The exceptions were New Zealand and Thailand, where the fourth-grade girls performed significantly better than the boys did, and Cyprus and Iceland, where the third-grade boys outperformed the girls. Similarly, there were few gender differences in geometry. The boys had higher achievement than the girls in the Netherlands at the fourth grade and in Korea at the third grade. The girls had higher achievement than the boys in New Zealand at the fourth and third grades and in Ireland at the third grade. The only differences in the area of patterns, relations, and functions were in New Zealand, where the girls outperformed the boys at both grades, and in the Czech Republic, where the third-grade boys had significantly higher achievement than the girls did. (The Second International Mathematics Study did not include students in the lower grades, so comparisons are not possible. In the International Assessment of Educational Progress, content area results were not reported by gender, but the overall results showed few differences.⁹)

⁹ Lapointe, A.E., Mead, N.A., and Askew, J.M. (1992). *Learning Mathematics*, Princeton, NJ: Educational Testing Service.

Table 2.4**Average Percent Correct for Boys and Girls by Mathematics Content Areas
Upper Grade (Fourth Grade*)**

Country	Mathematics Overall		Whole Numbers		Fractions and Proportionality		Measurement, Estimation, and Number Sense	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Canada	61 (1.1)	60 (1.2)	69 (0.8)	66 (1.3)	47 (1.1)	48 (1.2)	55 (1.1)	53 (1.3)
Cyprus	55 (0.8)	53 (0.7)	66 (0.9)	64 (0.9)	49 (0.9)	47 (0.8)	▲ 49 (1.1)	46 (0.8)
Czech Republic	67 (0.7)	66 (0.7)	75 (0.8)	74 (0.6)	53 (1.0)	52 (0.9)	▲ 69 (0.8)	67 (0.8)
¹² England	57 (0.8)	56 (0.9)	▲ 60 (0.9)	57 (1.0)	46 (1.1)	45 (1.2)	▲ 54 (0.9)	50 (1.0)
Greece	50 (1.2)	51 (0.9)	61 (1.4)	63 (0.9)	42 (1.3)	42 (1.1)	49 (1.2)	48 (1.0)
Hong Kong	73 (1.1)	73 (0.8)	79 (1.1)	79 (0.9)	67 (1.1)	66 (1.0)	69 (1.2)	69 (0.7)
Iceland	50 (1.0)	49 (0.9)	58 (1.2)	55 (1.0)	36 (1.1)	35 (1.1)	44 (1.1)	44 (1.2)
Iran, Islamic Rep.	39 (1.4)	37 (1.1)	52 (1.9)	49 (1.5)	32 (1.3)	32 (1.4)	▲ 38 (1.4)	34 (1.1)
Ireland	63 (0.9)	64 (0.9)	70 (0.9)	70 (1.1)	57 (1.1)	59 (1.2)	57 (1.1)	55 (1.1)
Japan	75 (0.5)	74 (0.5)	▲ 83 (0.5)	81 (0.5)	66 (0.8)	65 (0.6)	▲ 73 (0.6)	71 (0.6)
Korea	▲ 77 (0.4)	75 (0.5)	▲ 89 (0.4)	87 (0.5)	▲ 66 (0.7)	63 (0.7)	▲ 73 (0.7)	70 (0.7)
New Zealand	52 (1.3)	54 (0.9)	57 (1.5)	57 (1.1)	41 (1.5)	42 (1.0)	48 (1.3)	49 (1.2)
Norway	54 (0.9)	53 (0.8)	62 (1.0)	61 (1.1)	39 (1.0)	38 (0.8)	▲ 57 (1.0)	54 (1.1)
Portugal	48 (0.8)	48 (0.8)	57 (1.0)	57 (0.9)	38 (0.9)	38 (0.7)	50 (0.9)	49 (1.0)
[†] Scotland	58 (0.9)	58 (0.9)	61 (1.0)	61 (1.0)	46 (1.2)	47 (1.2)	54 (1.0)	53 (1.1)
Singapore	75 (0.9)	76 (1.0)	81 (0.8)	▲ 84 (0.8)	73 (1.0)	75 (1.2)	67 (1.0)	66 (1.3)
United States	63 (0.7)	62 (0.7)	71 (0.7)	70 (0.8)	51 (0.9)	50 (0.8)	▲ 54 (0.7)	52 (0.8)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):								
Australia	63 (0.7)	63 (0.8)	68 (0.9)	67 (0.8)	51 (0.8)	51 (1.0)	60 (0.8)	59 (0.9)
Austria	66 (0.9)	64 (0.8)	74 (0.9)	74 (0.9)	▲ 53 (1.1)	50 (1.0)	71 (1.1)	68 (1.0)
¹ Latvia (LSS)	58 (1.2)	60 (1.1)	66 (1.1)	69 (1.1)	43 (1.5)	44 (1.4)	60 (1.3)	61 (1.2)
Netherlands	▲ 71 (0.8)	68 (0.8)	76 (0.9)	74 (1.0)	61 (1.1)	59 (1.0)	▲ 72 (0.8)	68 (1.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):								
Slovenia	64 (0.7)	65 (0.9)	73 (0.7)	75 (0.8)	51 (1.1)	49 (1.2)	65 (1.0)	63 (1.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):								
Hungary	64 (0.8)	64 (0.9)	77 (0.9)	76 (0.9)	50 (1.0)	49 (1.1)	65 (1.0)	63 (1.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):								
¹ Israel	60 (1.1)	59 (1.0)	71 (1.1)	71 (1.1)	48 (1.2)	47 (1.2)	▲ 57 (1.4)	52 (1.1)
Thailand	49 (1.3)	52 (1.0)	57 (1.5)	60 (1.4)	42 (1.3)	45 (1.1)	44 (1.3)	43 (1.2)

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

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

¹Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).¹National 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.²National 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.

Table 2.4 (Continued)**Average Percent Correct for Boys and Girls by Mathematics Content Areas – Upper Grade (Fourth Grade*)**

Country	Data Representation, Analysis, and Probability		Geometry		Patterns, Relations, and Functions	
	Boys	Girls	Boys	Girls	Boys	Girls
Canada	67 (1.6)	69 (1.4)	72 (1.3)	72 (1.6)	62 (1.6)	60 (2.1)
Cyprus	53 (1.1)	52 (1.1)	52 (1.2)	53 (1.1)	57 (1.2)	54 (1.6)
Czech Republic	67 (1.1)	67 (1.1)	71 (0.9)	71 (0.8)	67 (1.1)	66 (1.1)
¹² England	64 (1.2)	65 (1.2)	74 (0.9)	74 (1.0)	56 (1.4)	54 (1.2)
Greece	48 (1.6)	51 (1.4)	53 (1.8)	54 (1.1)	46 (1.8)	48 (1.3)
Hong Kong	75 (1.2)	77 (1.0)	75 (0.9)	74 (1.1)	71 (1.5)	75 (1.2)
Iceland	59 (1.7)	58 (1.3)	62 (1.3)	63 (1.2)	49 (1.8)	48 (1.6)
Iran, Islamic Rep.	25 (1.5)	22 (0.8)	42 (1.4)	43 (1.2)	40 (2.0)	40 (1.8)
Ireland	68 (1.2)	70 (1.1)	66 (1.0)	67 (1.0)	64 (1.4)	63 (1.1)
Japan	79 (0.7)	79 (0.7)	73 (0.8)	72 (0.7)	77 (0.7)	76 (0.8)
Korea	80 (0.8)	79 (0.8)	72 (0.8)	71 (0.8)	84 (0.9)	82 (1.1)
New Zealand	58 (1.8)	▲ 64 (1.4)	64 (1.5)	▲ 69 (1.2)	50 (1.5)	▲ 55 (1.4)
Norway	59 (1.2)	60 (1.1)	57 (1.2)	58 (1.1)	49 (1.5)	51 (1.7)
Portugal	43 (1.1)	43 (1.3)	52 (1.2)	52 (1.2)	49 (1.3)	46 (1.4)
[†] Scotland	65 (1.3)	67 (1.2)	72 (1.0)	73 (0.9)	58 (1.4)	57 (1.2)
Singapore	80 (0.9)	82 (1.0)	71 (0.9)	73 (1.0)	76 (1.0)	76 (1.2)
United States	72 (1.1)	74 (1.0)	71 (0.7)	71 (0.9)	67 (1.1)	66 (1.0)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):						
Australia	66 (1.0)	68 (1.0)	73 (0.8)	75 (1.0)	65 (1.2)	63 (1.2)
Austria	67 (1.5)	66 (1.4)	68 (0.9)	67 (1.0)	65 (1.5)	64 (1.8)
¹ Latvia (LSS)	52 (1.5)	55 (1.6)	65 (1.3)	68 (1.2)	64 (1.7)	67 (1.2)
Netherlands	76 (1.0)	75 (1.3)	▲ 73 (1.0)	69 (0.9)	65 (1.3)	66 (1.5)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):						
Slovenia	64 (1.1)	64 (1.3)	71 (1.1)	73 (1.0)	67 (1.3)	69 (1.1)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):						
Hungary	60 (1.3)	61 (1.3)	67 (1.0)	65 (1.2)	68 (1.2)	71 (1.4)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):						
¹ Israel	65 (1.5)	64 (1.3)	61 (1.3)	63 (1.0)	60 (1.5)	61 (1.8)
Thailand	53 (1.8)	▲ 59 (1.5)	52 (1.6)	54 (1.2)	48 (1.8)	51 (1.2)

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

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

¹Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

¹National 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.

²National 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.

Table 2.5**Average Percent Correct for Boys and Girls by Mathematics Content Areas
Lower Grade (Third Grade*)**

Country	Mathematics Overall		Whole Numbers		Fractions and Proportionality		Measurement, Estimation, and Number Sense	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Canada	▲ 48 (0.7)	46 (0.8)	▲ 55 (0.9)	51 (0.8)	34 (0.7)	33 (1.0)	▲ 44 (0.8)	40 (1.0)
Cyprus	39 (0.7)	38 (0.7)	49 (0.9)	47 (0.9)	32 (0.8)	31 (0.7)	▲ 36 (0.8)	34 (0.7)
Czech Republic	53 (0.8)	51 (0.9)	61 (1.0)	58 (1.0)	▲ 39 (0.9)	36 (1.0)	▲ 56 (1.0)	52 (0.9)
^{1,2} England	46 (0.7)	44 (0.7)	▲ 47 (0.9)	44 (0.9)	35 (0.8)	34 (0.7)	▲ 43 (1.0)	40 (0.8)
Greece	38 (1.0)	36 (0.9)	47 (1.2)	45 (1.3)	31 (1.1)	29 (0.9)	37 (1.1)	35 (1.3)
Hong Kong	60 (0.9)	58 (0.9)	69 (0.8)	67 (0.9)	▲ 50 (1.0)	47 (1.0)	57 (1.0)	54 (0.8)
Iceland	▲ 37 (0.9)	33 (0.8)	▲ 39 (1.1)	35 (1.0)	▲ 28 (0.9)	23 (0.8)	35 (0.9)	32 (1.1)
Iran, Islamic Rep.	29 (0.9)	27 (1.0)	39 (1.4)	37 (1.5)	20 (0.7)	19 (0.7)	▲ 31 (1.0)	27 (1.0)
Ireland	47 (1.0)	49 (1.0)	54 (1.1)	56 (1.0)	41 (1.3)	41 (1.3)	41 (1.0)	41 (0.9)
Japan	64 (0.5)	63 (0.4)	▲ 74 (0.6)	71 (0.6)	52 (0.7)	52 (0.6)	▲ 61 (0.7)	59 (0.6)
Korea	▲ 68 (0.6)	65 (0.5)	▲ 82 (0.6)	79 (0.7)	▲ 54 (0.8)	52 (0.7)	▲ 63 (0.8)	59 (0.7)
New Zealand	40 (0.9)	41 (1.0)	43 (1.2)	41 (1.1)	29 (0.8)	32 (1.0)	39 (0.9)	38 (1.1)
Norway	▲ 37 (0.8)	34 (0.8)	▲ 42 (1.0)	38 (1.2)	25 (0.8)	23 (0.8)	▲ 40 (1.1)	36 (0.9)
Portugal	38 (0.8)	36 (1.1)	47 (1.0)	45 (1.4)	30 (0.7)	29 (0.9)	▲ 39 (1.1)	35 (1.1)
Singapore	62 (1.0)	63 (1.0)	74 (0.9)	76 (0.9)	55 (1.2)	54 (1.1)	52 (1.1)	51 (1.1)
United States	49 (0.6)	49 (0.8)	57 (0.8)	57 (0.9)	37 (0.8)	36 (1.0)	41 (0.8)	40 (1.0)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):								
Australia	50 (1.1)	49 (1.0)	56 (1.3)	52 (1.3)	38 (1.1)	38 (1.1)	49 (1.2)	47 (1.1)
Austria	51 (1.6)	49 (0.8)	58 (1.3)	58 (1.0)	36 (1.7)	33 (1.0)	▲ 57 (1.9)	53 (1.1)
¹ Latvia (LSS)	44 (1.0)	45 (1.0)	50 (1.1)	50 (1.2)	29 (1.1)	30 (1.1)	48 (1.3)	48 (1.1)
Netherlands	53 (0.7)	51 (0.7)	▲ 59 (0.8)	56 (0.9)	40 (0.6)	38 (0.8)	55 (0.9)	53 (0.9)
Scotland	46 (0.9)	44 (0.8)	48 (1.1)	45 (1.0)	33 (0.9)	32 (0.8)	42 (1.1)	40 (1.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):								
Slovenia	52 (0.7)	50 (0.9)	61 (0.8)	59 (1.1)	37 (0.7)	35 (1.0)	▲ 49 (0.9)	44 (1.0)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):								
Hungary	49 (1.1)	49 (0.9)	62 (1.3)	62 (1.1)	35 (0.9)	34 (1.0)	49 (1.2)	46 (1.0)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):								
Thailand	39 (1.1)	41 (1.4)	47 (1.5)	48 (1.6)	31 (1.2)	34 (1.5)	35 (1.0)	36 (1.3)

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

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

¹Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).¹National 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.²National 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.

Table 2.5 (Continued)**Average Percent Correct for Boys and Girls by Mathematics Content Areas – Lower Grade (Third Grade*)**

Country	Data Representation, Analysis, and Probability		Geometry		Patterns, Relations, and Functions	
	Boys	Girls	Boys	Girls	Boys	Girls
Canada	52 (1.1)	52 (1.4)	63 (1.2)	63 (1.1)	49 (1.6)	47 (1.4)
Cyprus	▲ 35 (1.1)	32 (0.9)	42 (1.1)	42 (0.9)	41 (1.3)	40 (1.4)
Czech Republic	52 (1.2)	50 (1.5)	62 (1.0)	61 (1.0)	53 (1.2)	53 (1.4)
¹² England	50 (1.3)	50 (1.3)	63 (1.1)	63 (1.0)	▲ 45 (1.3)	40 (1.3)
Greece	35 (1.2)	34 (1.4)	42 (1.3)	41 (1.2)	35 (1.7)	32 (1.4)
Hong Kong	63 (1.3)	63 (1.1)	66 (1.1)	65 (1.1)	58 (1.4)	58 (1.5)
Iceland	▲ 42 (1.6)	36 (1.2)	50 (1.3)	50 (1.7)	35 (1.4)	30 (1.6)
Iran, Islamic Rep.	18 (1.0)	16 (0.9)	34 (1.0)	33 (1.3)	32 (1.5)	28 (1.5)
Ireland	49 (1.3)	50 (1.5)	53 (1.3)	▲ 57 (1.2)	47 (1.4)	49 (1.3)
Japan	69 (0.6)	70 (0.6)	62 (0.7)	62 (0.8)	64 (1.0)	65 (0.9)
Korea	71 (1.1)	68 (1.0)	▲ 68 (0.8)	66 (0.9)	74 (1.0)	72 (1.0)
New Zealand	43 (1.5)	44 (1.5)	56 (1.4)	▲ 60 (1.4)	38 (1.3)	▲ 44 (1.6)
Norway	38 (1.2)	35 (1.3)	44 (1.2)	44 (1.4)	35 (1.7)	33 (1.4)
Portugal	32 (1.1)	30 (1.5)	42 (1.2)	42 (1.5)	37 (1.4)	36 (1.7)
Singapore	67 (1.3)	69 (1.2)	59 (1.0)	61 (0.8)	65 (1.2)	65 (1.3)
United States	56 (0.9)	56 (1.2)	60 (1.0)	62 (1.2)	52 (1.2)	53 (1.6)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):						
Australia	51 (1.5)	52 (1.4)	64 (1.6)	66 (1.1)	51 (1.3)	48 (1.3)
Austria	50 (2.1)	47 (1.4)	58 (2.2)	56 (1.1)	49 (1.8)	47 (1.8)
¹ Latvia (LSS)	40 (1.5)	39 (1.4)	56 (1.3)	57 (1.3)	52 (1.8)	55 (1.6)
Netherlands	57 (1.1)	55 (1.3)	61 (1.3)	61 (0.9)	50 (1.3)	51 (1.5)
Scotland	50 (1.3)	48 (1.2)	65 (1.1)	65 (1.1)	47 (1.3)	44 (1.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):						
Slovenia	52 (1.3)	52 (1.3)	65 (1.0)	64 (1.1)	54 (1.5)	53 (1.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):						
Hungary	44 (1.3)	46 (1.3)	52 (1.5)	53 (1.1)	56 (1.8)	58 (1.5)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):						
Thailand	39 (1.6)	43 (2.0)	44 (1.5)	44 (1.7)	39 (1.6)	41 (2.0)

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

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

¹Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

¹National 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.

²National 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.

