

Chapter 1

INTRODUCTION

OVERVIEW

In 1994-95, the International Association for the Evaluation of Educational Achievement (IEA) conducted the Third International Mathematics and Science Study (TIMSS) in 41 countries. The IEA is a collaborative of research institutions in 53 education systems¹ around the world. Its primary purpose is to conduct large-scale comparative studies of educational achievement and to gain a better understanding of the effects of policies and practices on achievement within and across systems of education. Since its inception in 1959, the IEA has sponsored more than 15 studies of cross-national achievement, including TIMSS — the largest and most ambitious IEA study conducted to date. TIMSS assessed students in mathematics and science at three points in the education system — at the end of primary school (third and fourth grades in most countries), at the end of middle or lower-secondary school (seventh and eighth grades in most countries), and in the final year of secondary school (twelfth grade in most countries). Countries were required to participate in the assessment of students at the end of middle school, but could choose to participate in the other two assessments.

Achievement was measured through written tests of mathematics and science achievement taken by students in the third, fourth, seventh, and eighth grades. Students in their final year of secondary school were also tested in mathematics and science literacy. In addition, sub-populations of final-year students who had taken advanced mathematics or physics were tested in these subjects. In some countries, students in the fourth and eighth grades completed a performance assessment in addition to the written tests.

In the tradition of previous IEA studies, TIMSS sought to describe the contexts in which mathematics and science teaching and learning take place. To accomplish this, TIMSS gathered contextual information from students, teachers, and schools; investigated the curricula of the participating countries through an analysis of mathematics and science curriculum guides and textbooks; and compiled extensive information about the education systems of the participating countries. The mathematics and science achievement results for the three student populations, as well as background data collected from students and teachers, have been published in a series of reports.²

¹ While most IEA members are countries, some are education systems representing regions within countries.

² Mullis, I.V.S., Martin, M.O., Beaton, A.E., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1998). *Mathematics and Science Achievement in the Final Year of Secondary School: IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College; Mullis, I.V.S., Martin, M.O., Beaton, A.E., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1997). *Mathematics Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College; Martin, M.O., Mullis, I.V.S., Beaton, A.E., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1997). *Science Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College; Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J.,

The purpose of this report is to present information about the school contexts for learning mathematics and science, including school characteristics, policies, and practices. In each of the 41 education systems, the principal of each school sampled for the assessment was asked to complete a questionnaire addressing the school-level instructional context. The report is organized around five major topics:

- Role and responsibilities of schools and school principals
- School organization and staffing
- Organization for learning mathematics and science
- School resources
- School atmosphere

Table 1.1 presents the countries included in this report at each of the three grade levels.³ Results are reported for the upper grade of the primary school student population (fourth grade in most countries), the upper grade of the middle school student population (eighth grade in most countries), and for all students in their final year of secondary school (twelfth grade in most countries).⁴ Although there was considerable overlap in the questions asked of the school principals, some questions were not administered at all three populations.

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

³Because the characteristics of its sample are not completely known, results for Israel at the final year of secondary school are not included in this report. Data for Greece and Latvia from the final year of secondary school are not included, as only advanced mathematics or physics students were sampled.

⁴Information about population definitions and sampling procedures is provided in Appendix A.

Table 1.1**Countries Included in Report**

Fourth Grade	Eighth Grade	Final Year of Secondary School
Australia	Australia	Australia
Austria	Austria	Austria
Canada	Belgium (Flemish)	Canada
Cyprus	Belgium (French)	Cyprus
Czech Republic	Bulgaria	Czech Republic
England	Canada	Denmark
Greece	Colombia	France
Hong Kong	Cyprus	Germany
Hungary	Czech Republic	Hungary
Iceland	Denmark	Iceland
Iran, Islamic Republic	England	Italy
Ireland	France	Lithuania
Israel	Germany	Netherlands
Japan	Greece	New Zealand
Korea, Republic of	Hong Kong	Norway
Kuwait	Hungary	Russian Federation
Latvia	Iceland	Slovenia
Netherlands	Iran, Islamic Republic	South Africa
New Zealand	Ireland	Sweden
Norway	Israel	Switzerland
Portugal	Japan	United States
Scotland	Korea, Republic of	
Singapore	Kuwait	
Slovenia	Latvia	
Thailand	Lithuania	
United States	Netherlands	
	New Zealand	
	Norway	
	Portugal	
	Romania	
	Russian Federation	
	Scotland	
	Singapore	
	Slovak Republic	
	Slovenia	
	South Africa	
	Spain	
	Sweden	
	Switzerland	
	Thailand	
	United States	

Table 1.2 presents information about the grades and students tested for TIMSS and included in this report. For grades four and eight, the table presents, for each country, the name the country uses for the grade, the years of formal schooling the students tested have had, and the average age of the students tested. In most countries, the fourth-grade students have had four years of formal schooling, not including pre-primary school; at the eighth grade, students in most countries have had eight years.

Table 1.2 also presents information about the students tested in the final year of secondary school. There are variations across and within countries with respect to the grades representing the final year of schooling. In some countries, all students in their final year of schooling are in the same grade (e.g., secondary schooling ends for all students in grade 12). In other countries, determining the final year of schooling is more complicated because there are one or more academic tracks, one or more vocational tracks, and apprenticeship programs. Nonetheless, the goal was to identify the final year of each type of program and test the students in that final year. More information about the structure of the upper-secondary systems and the students tested is provided in the international report for this population.

For the students in the final year of secondary school, Table 1.2 presents the grades tested in each country and the average age of these students, as well as the TIMSS Coverage Index (TCI), which is a measure of how much of the school-leaving age cohort is represented in the sample.⁵ The TCI reflects any omissions from the sample, such as students who were excluded because of handicap or who had dropped out of school, and, in some countries, tracks or educational programs that were not covered by the sample.

⁵ More information about the TIMSS Coverage Index and how it was computed for each country is provided in Appendix A.

Table 1.2**Information About the Grades Tested**

Country	Fourth Grade (TIMSS Population 1 Upper Grade)			Eighth Grade (TIMSS Population 2 Upper Grade)		
	Country's Name for Grade Tested	Years of Formal Schooling Including Grade Tested ¹	Average Age of Students Tested	Country's Name for Grade Tested	Years of Formal Schooling Including Grade Tested ¹	Average Age of Students Tested
² Australia	4 or 5	4 or 5	10.2	8 or 9	8 or 9	14.2
Austria	4	4	10.5	4. Klasse	8	14.3
Belgium (Fl)	–	–	–	2A & 2P	8	14.1
Belgium (Fr)	–	–	–	2A & 2P	8	14.3
Bulgaria	–	–	–	8	8	14.0
Canada	4	4	10.0	8	8	14.1
Colombia	–	–	–	8	8	15.7
Cyprus	4	4	9.8	8	8	13.7
Czech Republic	4	4	10.4	8	8	14.4
Denmark	–	–	–	7	7	13.9
England	Year 5	5	10.0	Year 9	9	14.0
France	–	–	–	4ème (90%) or 4ème Technologique (10%)	8	14.3
Germany	–	–	–	8	8	14.8
Greece	4	4	9.6	Secondary 2	8	13.6
Hong Kong	Primary 4	4	10.1	Secondary 2	8	14.2
Hungary	4	4	10.4	8	8	14.3
Iceland	4	4	9.6	8	8	13.6
Iran, Islamic Rep.	4	4	10.5	8	8	14.6
Ireland	4th Class	4	10.3	2nd Year	8	14.4
Israel	4	4	10.0	8	8	14.1
Japan	4	4	10.4	2nd Grade Lower Secondary	8	14.4
Korea	4th Grade	4	10.3	2nd Grade Middle School	8	14.2
Kuwait	5	5	10.8	9	9	15.3
Latvia	4	4	10.5	8	8	14.3
Lithuania	–	–	–	8	8	14.3
Netherlands	6	4	10.3	Secondary 2	8	14.3
³ New Zealand	Standard 3	4.5 - 5.5	10.0	Form 3	8.5 - 9.5	14.0
Norway	3	3	9.9	7	7	13.9
Portugal	4	4	10.4	Grade 8	8	14.5
Romania	–	–	–	8	8	14.6
⁴ Russian Federation	–	–	–	8	7 or 8	14.0
Scotland	Year 5	5	9.7	Secondary 2	9	13.7
Singapore	Primary 4	4	10.3	Secondary 2	8	14.5
Slovak Republic	–	–	–	8	8	14.3
Slovenia	4	4	10.9	8	8	14.8
South Africa	–	–	–	Standard 6	8	15.4
Spain	–	–	–	8 EGB	8	14.3
Sweden	–	–	–	7	7	13.9
Switzerland (German)	–	–	–	7	7	14.2
(French and Italian)	–	–	–	8	8	–
Thailand	Primary 4	4	10.5	Secondary 2	8	14.3
United States	4	4	10.2	8	8	14.2

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

- Years of Formal Schooling based on the number of years children in the grade level have been in formal schooling, beginning with primary education (International Standard Classification of Education Level 1). Does not include preprimary education.
 - Australia: Each state/territory has its own policy regarding age of entry to primary school. In four of the eight states/territories students in grades 4 and 8 were tested; in the other four states/territories students in grades 5 and 9 were tested.
 - New Zealand: The majority of students begin school on or near their fifth birthday so the "years of formal schooling" vary.
 - Russian Federation: 70% of students in the eighth grade have had 7 years of formal schooling.
- A dash (–) indicates that the country did not test students in this grade level or that data are not presented in this report.

Table 1.2 (Continued)
Information About the Grades Tested

Country	Final Year of Secondary School (Varies Across and Within Countries)		
	Grades Tested for TIMSS	TIMSS Coverage Index (TCI) [†]	Average Age of Students Tested
Australia	Grade 12	68%	17.7
Austria	Grade 12 (academic); Grade 13 (higher technical and vocational), Grades 10, 11, 12 (intermediate technical and vocational); Grades 12, 13, 14 (apprenticeship programs)	76%	19.1
Canada	Grade 12 (all provinces except Quebec); Grades 13 and 14 (depending on program) in Quebec; Ontario OAC students in Grade 13	70%	18.6
Cyprus	Grade 12 of lycea and technical schools	48%	17.7
Czech Republic	Grades 12 and 13 (technical and gymnasias); Grades 10, 11, 12 (vocational schools)	78%	17.8
Denmark	Grade 12 (general and vocational schools)	58%	19.1
France	Grade 12 (general and technicological schools); Grade 13 (vocational); Grade 11 and 13 (vocational)	84%	18.8
Germany	Grade 12 (former East Germany); Grade 13 (former West Germany)	75%	19.5
Hungary	Grade 12 (academic and vocational); Grade 10 (trade school)	65%	17.5
Iceland	Grades 12, 13, 14	55%	21.2
Italy	Grades 12, 13, 14	52%	18.7
Lithuania	Grade 12	43%	18.1
Netherlands	Grade 12 (pre-university); Grade 11 (senior general secondary); Grade 12 (senior secondary vocational)	78%	18.5
New Zealand	Grade 11 and Grade 12	70%	17.6
Norway	Grade 12	84%	19.5
Russian Federation	Grade 11 (general secondary)	48%	16.9
Slovenia	Grade 12 (gymnasias and technical); Grade 11 (vocational)	88%	18.8
South Africa	Grade 12	49%	20.1
Sweden	Grade 11 or 12 (depending on whether reform had been implemented in school)	71%	18.9
Switzerland	Grade 12 or 13 (gymnasium); Grade 12 (general and teacher training); Grade 11, 12, 13 (vocational)	82%	19.8
United States	Grade 12	63%	18.1

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

[†] TIMSS Coverage Index (TCI): Estimated percentage of school-leaving age cohort covered by the TIMSS final-year sample. The TCI was computed by forming a ratio of the size of the student population covered by the TIMSS sample, as estimated from the sample itself, to the size of the school-leaving age cohort, which was derived from official census figures supplied by each country (see Appendix A).

TIMSS ACHIEVEMENT RESULTS

To help interpret the school questionnaire data, this section summarizes the mathematics and science achievement of students in the fourth and eighth grades, and the mathematics and science literacy achievement of students in their final year of secondary school. Each table presents the mean (or average) achievement for the countries that participated in each assessment and whether the country mean is higher than, the same as, or lower than the international average.⁶

To illustrate the broad range of achievement across and within countries, each table also shows the distribution of student performance within each country. Achievement is shown for the 25th and 75th percentiles as well as for the 5th and 95th percentiles. Each percentile point indicates the percentages of students performing below and above that point on the scale. For example, 25% of the students in each country performed below the 25th percentile for that country, and 75% performed above the 25th percentile. The range between the 25th and 75th percentiles represents performance by the middle half of the students. In contrast, performance below the 5th and above the 95th percentiles represents the extremes in 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.⁷ These intervals can be compared with the international average. Countries with a triangle pointing up performed above the international average, those with a dot performed about the same as the international average, and those with triangles pointing down performed below the international average.

The countries, shown in decreasing order of mean achievement in the upper part of the tables, 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. In the fourth- and eighth-grade assessments, to provide a better curricular match, some countries elected to test students in grades that did not meet the TIMSS requirements, which led to their students being somewhat older than those in the other countries. Some countries encountered various difficulties in implementing the prescribed methods for within-school sampling. A discussion of the sampling procedures and outcomes for each country can be found in Appendix A.

⁶ TIMSS used item response theory (IRT) methods to summarize the achievement. Data in this section are from six scales: third & fourth grade mathematics, third & fourth grade science, seventh & eighth grade mathematics, seventh & eighth grade science, final-year mathematics literacy, and final-year science literacy. Each scale was constructed to have a mean of 500 and a standard deviation of 100. For more detailed information, see the “IRT Scaling and Data Analysis” section of Appendix A.

⁷ See Appendix A for more details about calculating standard errors and confidence intervals for the TIMSS statistics.

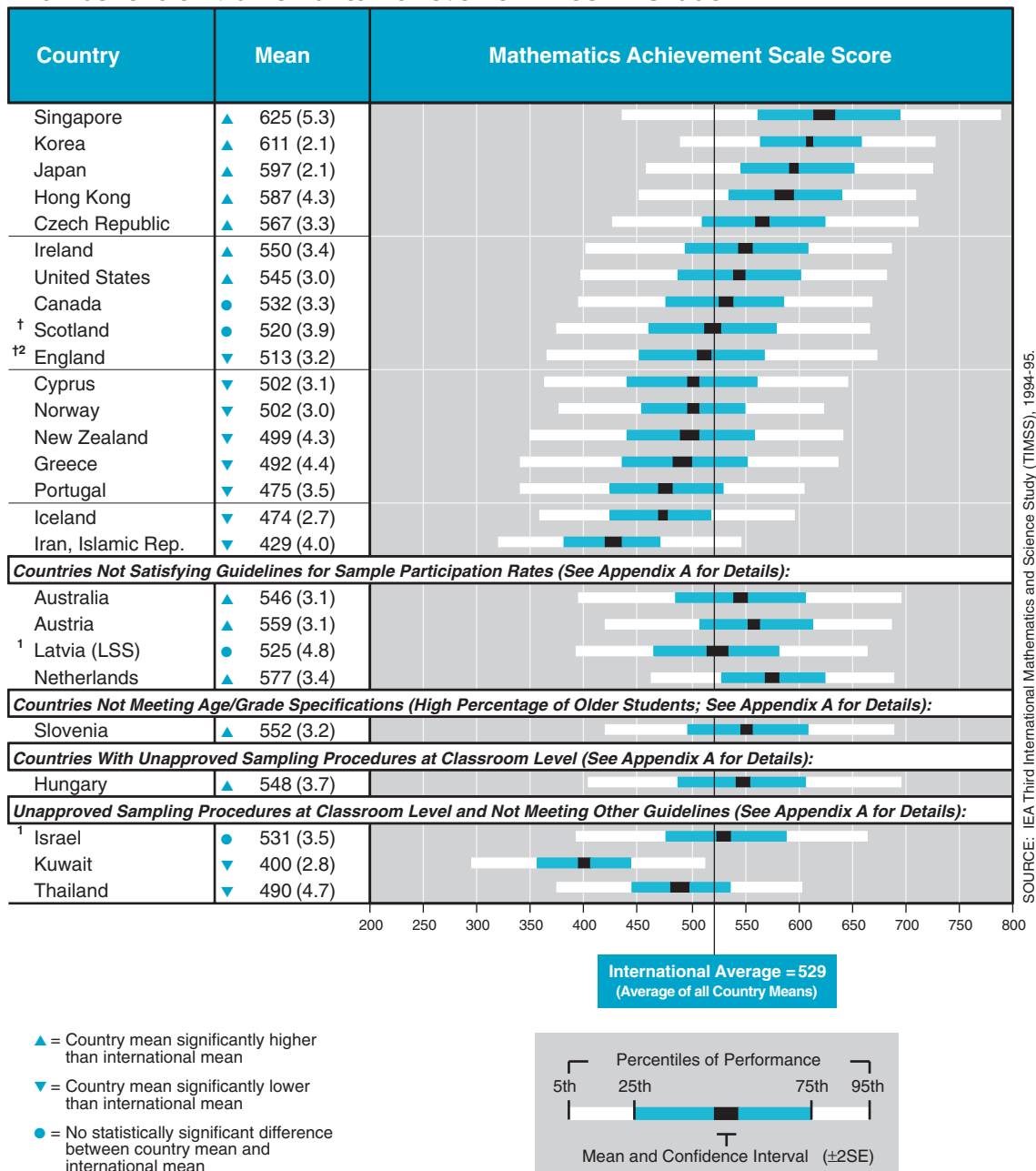
Tables 1.3 and 1.4 present the mathematics and science achievement results, respectively, for students in the fourth grade in 26 countries. As shown in Table 1.3, in mathematics at fourth grade, Singapore was the top-performing country, followed by Korea, Japan, and Hong Kong. In science, shown in Table 1.4, the top-performing countries at fourth grade were Korea, Japan, the United States, and Austria.

Tables 1.5 and 1.6 present the mathematics and science achievement results, respectively, for students in the eighth grade in 41 countries. As shown in Table 1.5, in mathematics at eighth grade, Singapore was the top-performing country, followed by Korea, Japan, and Hong Kong. In science, shown in Table 1.6, the top-performing countries at eighth grade were Singapore, the Czech Republic, Japan, and Korea.

Tables 1.7 and 1.8 present achievement on the mathematics literacy scale and the science literacy scale, respectively, for students in their final year of secondary school in 21 countries. As shown in Table 1.7, in mathematics literacy, the top-performing countries were the Netherlands, Sweden, Denmark, and Switzerland. In science literacy, shown in Table 1.8, the top-performing countries were Sweden, the Netherlands, Iceland, and Norway. Not all countries were able to test all students in their final year of secondary school, and not all students of school-leaving age are still enrolled in school. Tables 1.7 and 1.8 also present, for each country, a value for the “TIMSS Coverage Index,” or TCI. The TCI is an estimate of the percentage of the school-leaving age cohort covered by the TIMSS final-year student sample.

Table 1.3

Distributions of Mathematics Achievement - Fourth Grade*



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

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

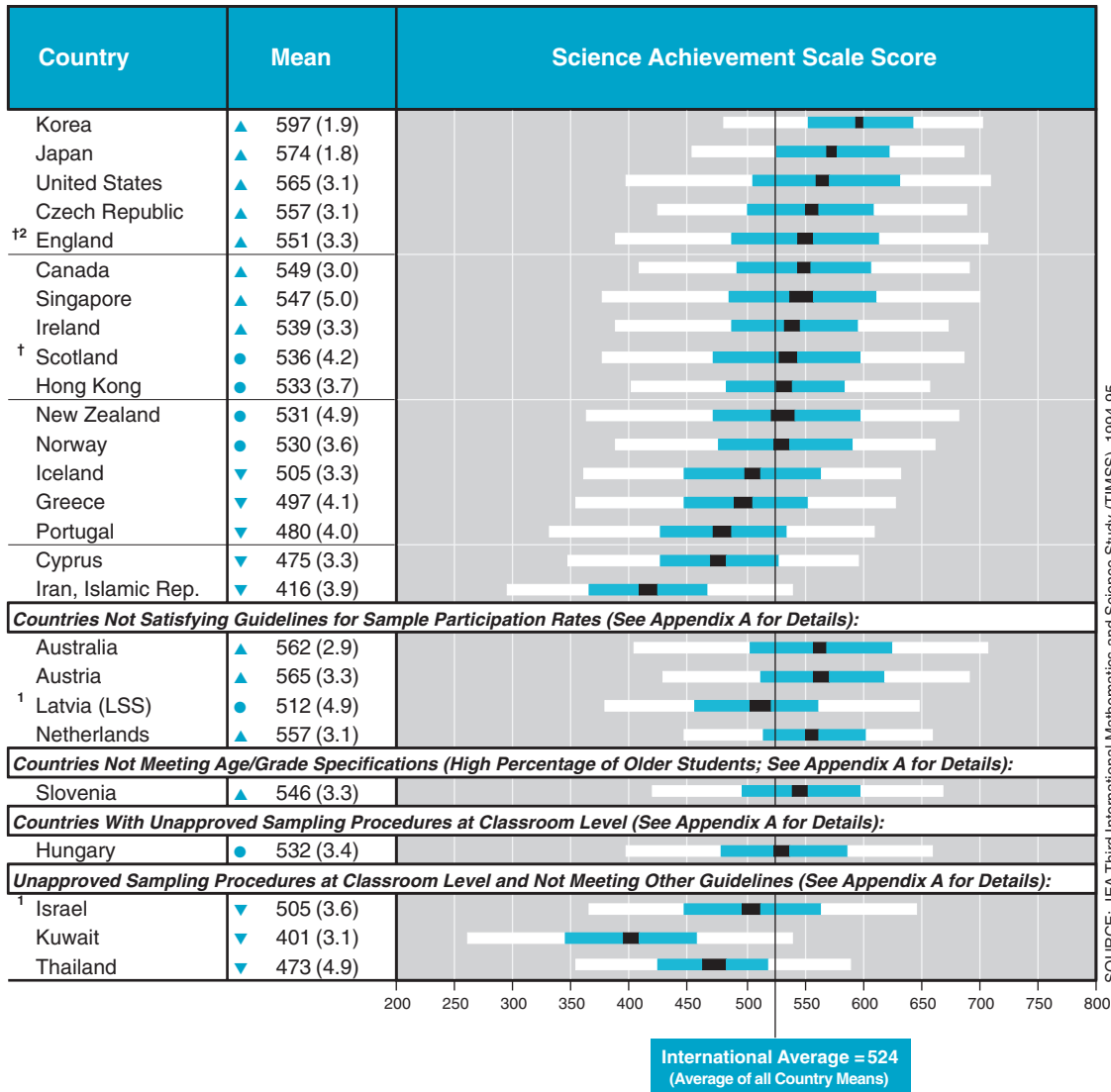
[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

* See Table 1.2 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.

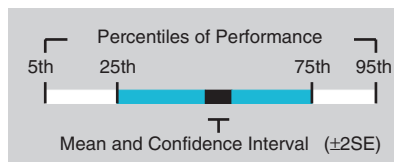
Table 1.4

Distributions of Science Achievement - Fourth Grade*



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

- ▲ = Country mean significantly higher than international mean
- ▼ = Country mean significantly lower than international mean
- = No statistically significant difference between country mean and international mean



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

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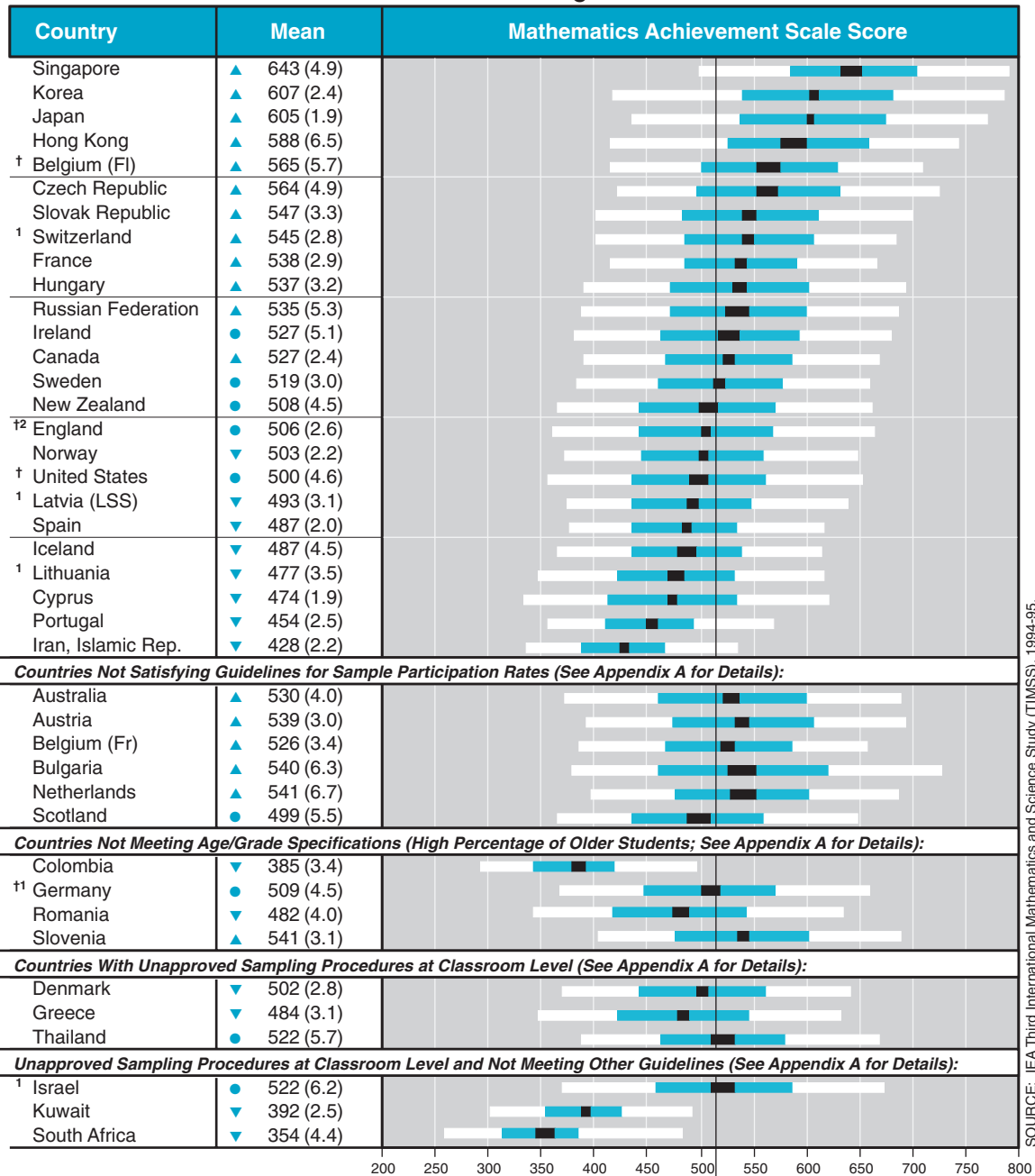
† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

* See Table 1.2 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.

Table 1.5

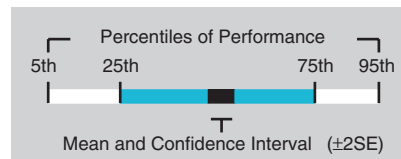
Distributions of Mathematics Achievement - Eighth Grade*



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

International Average = 513
(Average of all Country Means)

- ▲ = Country mean significantly higher than international mean
- ▼ = Country mean significantly lower than international mean
- = No statistically significant difference between country mean and international mean



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).

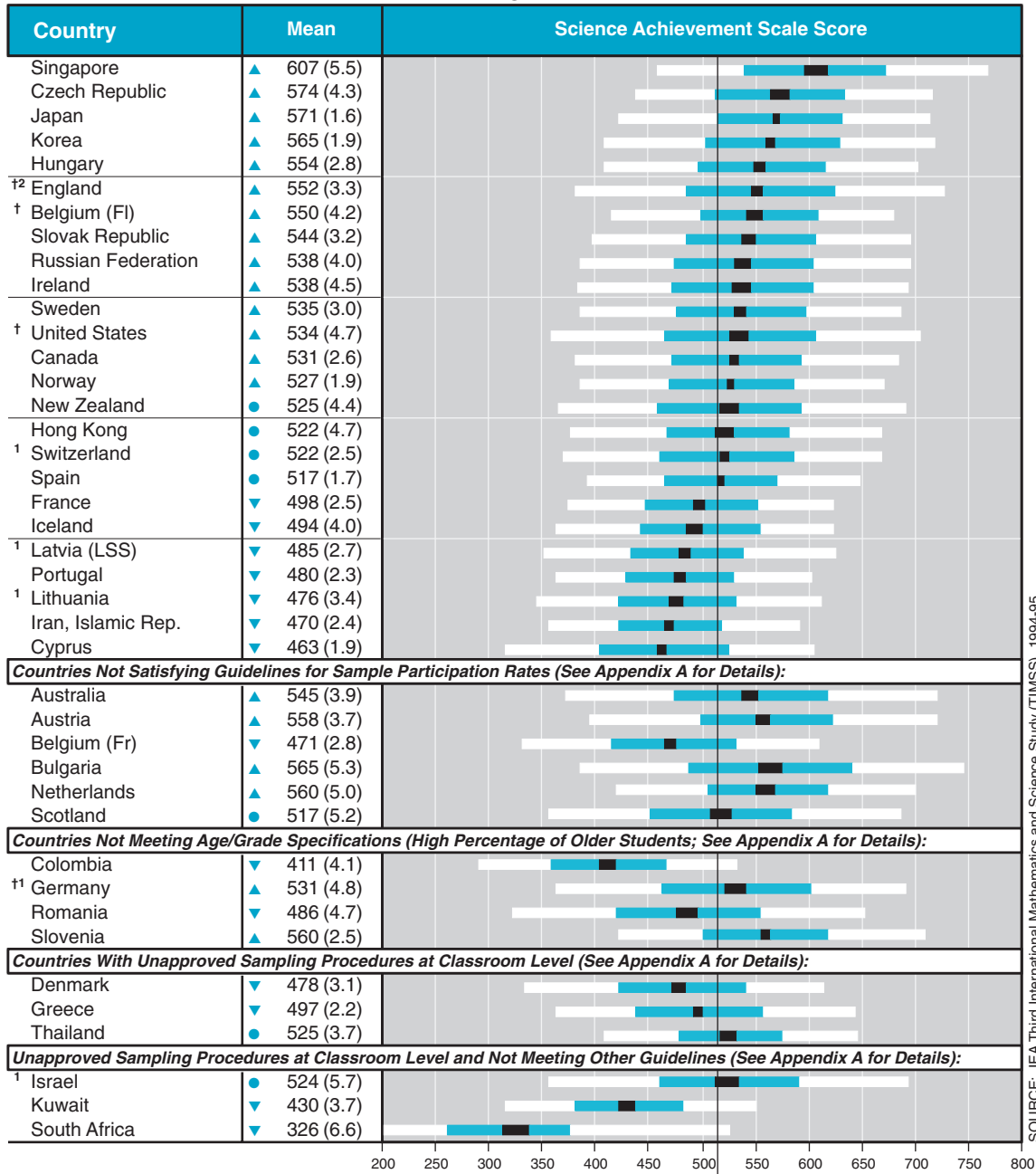
† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

* See Table 1.2 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.

Table 1.6

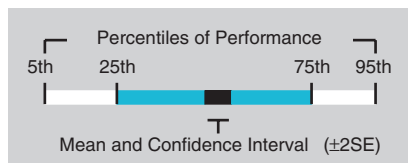
Distributions of Science Achievement - Eighth Grade*



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

International Average = 516
(Average of all Country Means)

- ▲ = Country mean significantly higher than international mean
- ▼ = Country mean significantly lower than international mean
- = No statistically significant difference between country mean and international mean



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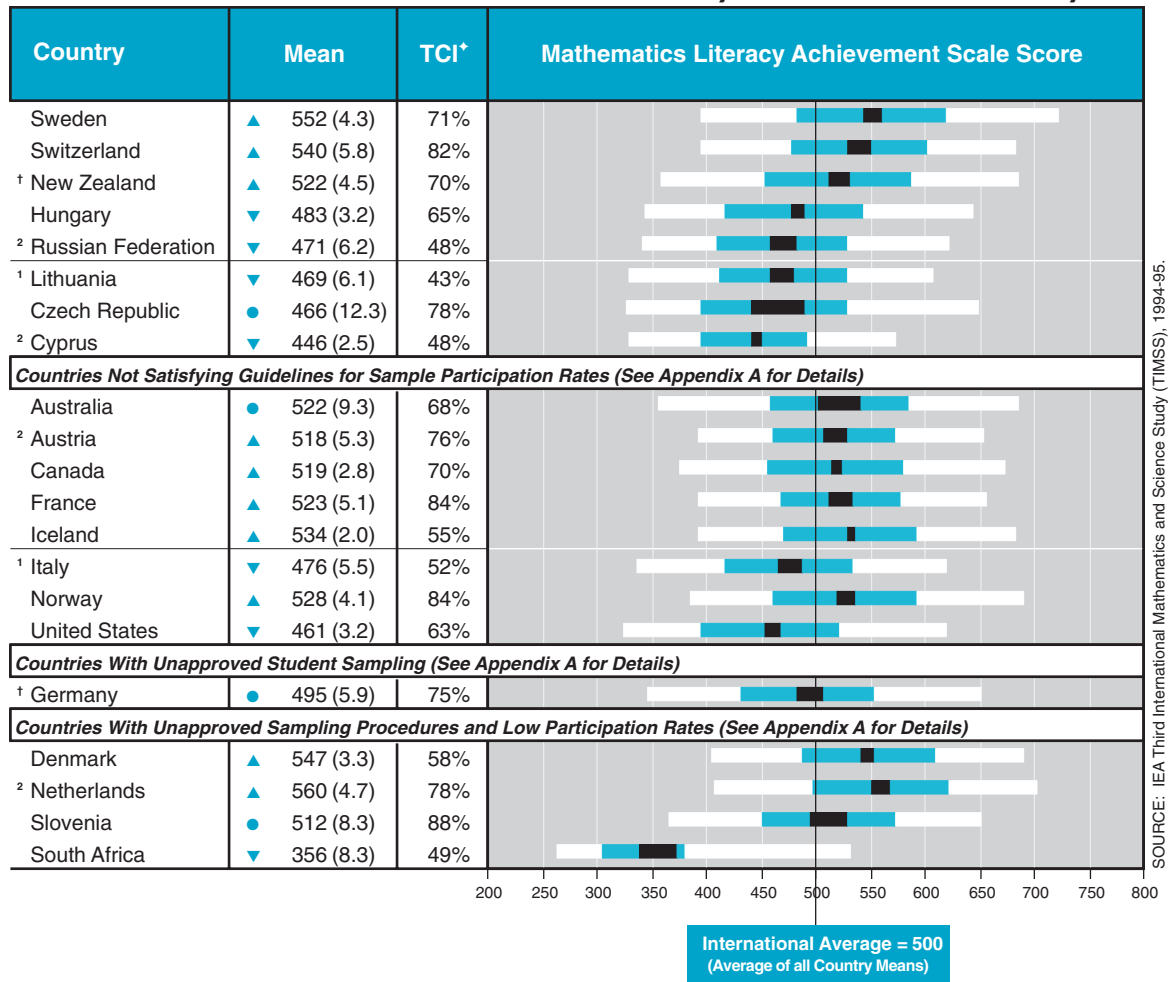
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* See Table 1.2 for more information about the grades tested in each country.

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

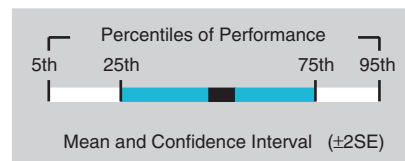
Table 1.7

Distributions of Achievement in Mathematics Literacy - Final Year of Secondary School*



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

- ▲ = Country mean significantly higher than international mean
- ▼ = Country mean significantly lower than international mean
- = No statistically significant difference between country mean and international mean



1 National Desired Population does not cover all of International Desired Population (see Table A.3).

2 National Defined Population covers less than 90 percent of National Desired Population (see Table A.3).

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

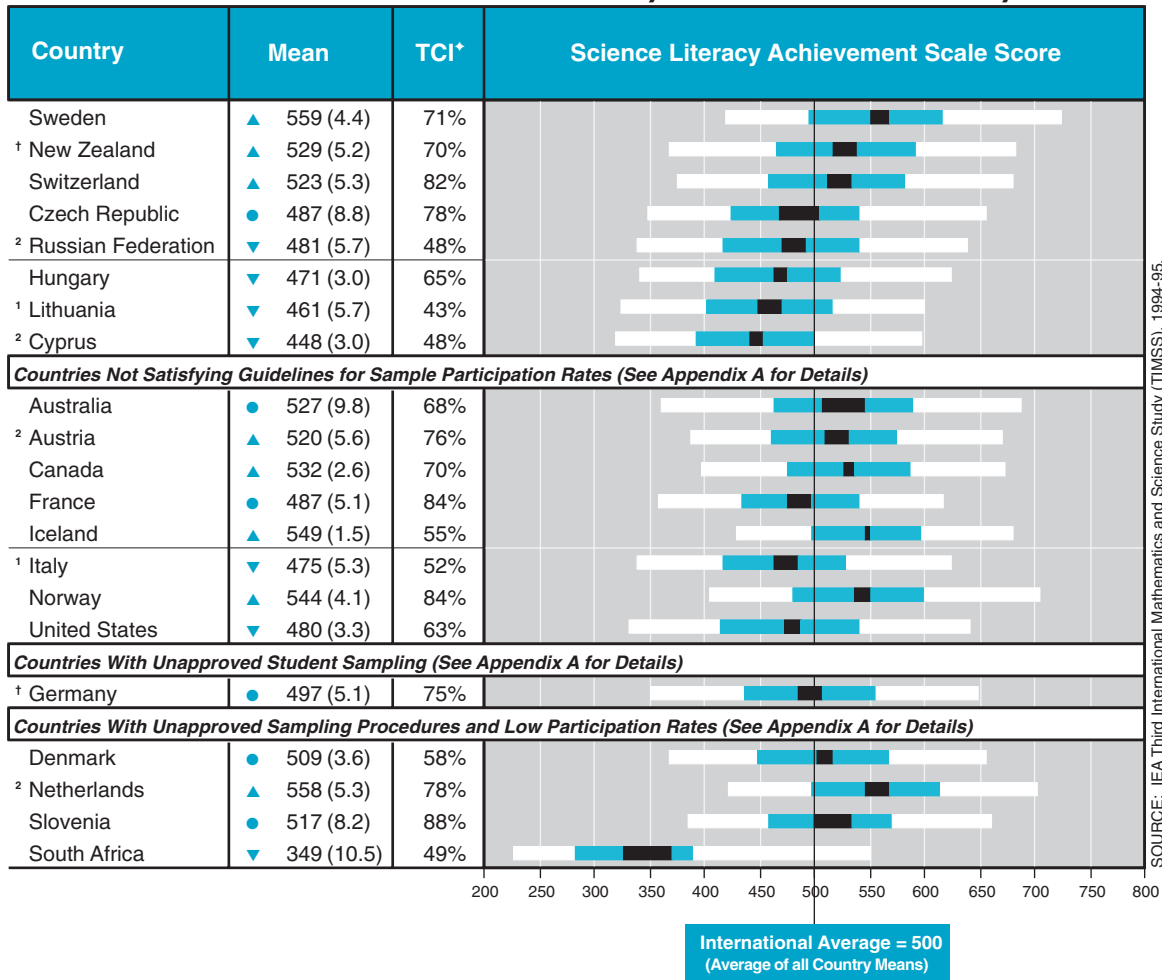
◆ The TIMSS Coverage Index (TCI) is an estimate of the percentage of the school-leaving age cohort covered by the TIMSS final-year student sample.

* See Table 1.2 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.

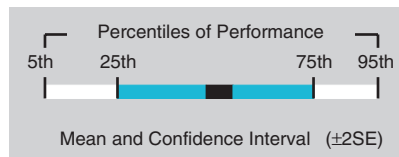
Table 1.8

Distributions of Achievement in Science Literacy - Final Year of Secondary School*



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

- ▲ = Country mean significantly higher than international mean
- ▼ = Country mean significantly lower than international mean
- = No statistically significant difference between country mean and international mean



¹ National Desired Population does not cover all of International Desired Population (see Table A.3).
² National Defined Population covers less than 90 percent of National Desired Population (see Table A.3).
[†] Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
 ◆ The TIMSS Coverage Index (TCI) is an estimate of the percentage of the school-leaving age cohort covered by the TIMSS final-year student sample.
 * See Table 1.2 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.