Chapter 2

Performance at the TIMSS 2007 International Benchmarks for Mathematics Achievement

The TIMSS mathematics achievement scale summarizes student performance on test items designed to measure breadth of content in number, algebra, geometry, and data as well as a range of cognitive processes within the knowing, applying, and reasoning domains. To interpret the achievement results in meaningful ways, it is important to understand the content of the assessment. As a way of interpreting the scaled results, TIMSS uses four points on the scale as international benchmarks and describes achievement at those benchmarks in relation to students' performance on the test questions. The benchmarks represent the range of performance shown by students internationally (and, at the fourth grade, complement the PIRLS International Benchmarks). The Advanced International Benchmark is 625, the High International Benchmark is 550, the Intermediate International Benchmark is 475, and the Low International Benchmark is 400.

The TIMSS & PIRLS International Study Center worked with the TIMSS 2007 Science and Mathematics Item Review Committee (SMIRC)[1] to conduct a detailed scale anchoring analysis to describe mathematics achievement at these benchmarks. Scale anchoring is a way of describing TIMSS 2007 performance at different points on the TIMSS mathematics scale in terms of the types of items students answered correctly. In addition to a data analysis component to identify items that discriminated between

1 The members of the Science and Mathematics Item Review Committee (SMIRC) are listed in Appendix F.

successive points on the scale,[2] the analysis also involved a judgmental component in which the SMIRC members examined the mathematics content and cognitive processing dimensions assessed by each item and generalized to describe students' knowledge and understandings.

This chapter presents the TIMSS 2007 mathematics achievement results for the International Benchmarks for the countries and benchmarking participants. Then, benchmark by benchmark for each grade, there is a detailed description of the understanding of mathematics content and types of cognitive processing skills and strategies demonstrated by students at each of the international benchmarks together with illustrative items. For each example item, the percent correct for each of the TIMSS 2007 participants is given as well as the international average across countries. The correct answer is circled for multiple-choice items. For open-ended items, the answers exemplify the types of student responses that were given full credit.[3] Of course, the items published herein were selected from the items released for public use.[4] Beyond illustrating the benchmark and being released, an effort was made across the benchmarks to include examples of different item formats and content area domains.

How Do Countries Compare with the TIMSS 2007 International Benchmarks of Mathematics Achievement?

Exhibit 2.1 summarizes what fourth- and eighth-grade students scoring at the TIMSS International Benchmarks typically know and can do in mathematics. At each grade, there was a substantial variation in performance between students achieving at the high end of the scale and the low end of the scale. At the fourth grade, students at the Advanced International Benchmark applied mathematical understanding and knowledge in a variety of relatively complex problem situations and were able to explain their reasoning whereas those at the Low International Benchmark demonstrated some basic mathematical knowledge and were able to compute with whole numbers, recognize some geometric shapes, and read simple graphs and tables. At the

2 For example, in brief, a multiple-choice item anchored at the Advanced International Benchmark if at least 65 percent of students scoring at 625 answered the item correctly and fewer than 50 percent of students scoring at the High International Benchmark (550) answered correctly, and so on, for each successively lower benchmark. Since constructed-response questions nearly eliminate guessing, the criterion for the constructed-response items was simply 50 percent at the particular benchmark. For more information, see the "Scale Anchoring Analysis" section of Appendix A as well as the *TIMSS 2007 Technical Report*.

3 All of the constructed-response items were scored according to detailed scoring guides containing descriptions and examples of the types of responses that should receive credit. Although most constructed-response items were worth 1 point, some were worth 2 points (with 1 point awarded for partial credit). If the example item was worth 2 points, the data are for responses receiving 2 points (full credit).

4 After each TIMSS assessment, approximately one-third of the items are released into the public domain and the rest of the items are kept secure for use in measuring trends over time in subsequent assessments.

eighth grade, students at the Advanced International Benchmark organized and drew conclusions from information, made generalizations, and solved non-routine problems involving numeric, algebraic, and geometric concepts and relationships. In comparison, those at the Low International Benchmark demonstrated some knowledge of whole numbers and decimals, operations, and basic graphs.

Exhibit 2.2 displays the percentage of students in each country and benchmarking entity that reached each international benchmark. At each grade, the results are presented in descending order according to the percentage of students reaching the Advanced International Benchmark (indicated by the blue dots, and shown in the column labeled "Advanced").

Generally, the TIMSS 2007 participants with the highest average achievement had greater percentages of students reaching each benchmark, and lower achieving countries had smaller percentages. Thus, consistent with the results in Exhibit 1.1, the Asian countries had the highest percentages of students reaching the advanced benchmark and appear at the top in Exhibit 2.2. Keeping in mind that the Advanced International Benchmark represents fluency on items involving the most complex topics and reasoning skills in the *TIMSS 2007 Mathematics Framework*, remarkable percentages of students in these countries reached the advanced benchmark. In particular, at the fourth grade, Singapore and Hong Kong SAR had 41 and 40 percent of their students, respectively, achieving at or above the Advanced International Benchmark. At the eighth grade, Chinese Taipei, Korea, and Singapore had 40 to 45 percent of their students achieving at or above the Advanced International Benchmark.

Exhibit 2.1 **TIMSS 2007 International Benchmarks of Mathematics Achievement**

TIMSS2007 Mathematics 4th Grade

Advanced International Benchmark – 625

Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning. They can apply proportional reasoning in a variety of contexts. They demonstrate a developing understanding of fractions and decimals. They can select appropriate information to solve multi-step word problems. They can formulate or select a rule for a relationship. Students can apply geometric knowledge of a range of two- and three-dimensional shapes in a variety of situations. They can organize, interpret, and represent data to solve problems.

High International Benchmark – 550

Students can apply their knowledge and understanding to solve problems. Students can solve multi-step word problems involving operations with whole numbers. They can use division in a variety of problem situations. They demonstrate understanding of place value and simple fractions. Students can extend patterns to find a later specified term and identify the relationship between ordered pairs. Students show some basic geometric knowledge. They can interpret and use data in tables and graphs to solve problems.

Intermediate International Benchmark – 475

Students can apply basic mathematical knowledge in straightforward situations. Students at this level demonstrate an understanding of whole numbers. They can extend simple numeric and geometric patterns. They are familiar with a range of two-dimensional shapes. They can read and interpret different representations of the same data.

Low International Benchmark – 400

Students have some basic mathematical knowledge. Students demonstrate an understanding of adding and subtracting with whole numbers. They demonstrate familiarity with triangles and informal coordinate systems. They can read information from simple bar graphs and tables.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Exhibit 2.1 **TIMSS 2007 International Benchmarks of Mathematics Achievement (Continued)**

TIMSS2007 Mathematics 8th Grade

Advanced International Benchmark – 625

Students can organize and draw conclusions from information, make generalizations, and solve non-routine problems. They can solve a variety of ratio, proportion, and percent problems. They can apply their knowledge of numeric and algebraic concepts and relationships. Students can express generalizations algebraically and model situations. They can apply their knowledge of geometry in complex problem situations. Students can derive and use data from several sources to solve multi-step problems.

High International Benchmark – 550

Students can apply their understanding and knowledge in a variety of relatively complex situations. They can relate and compute with fractions, decimals, and percents, operate with negative integers, and solve word problems involving proportions. Students can work with algebraic expressions and linear equations. Students use knowledge of geometric properties to solve problems, including area, volume, and angles. They can interpret data in a variety of graphs and table and solve simple problems involving probability.

Intermediate International Benchmark – 475

Students can apply basic mathematical knowledge in straightforward situations. They can add and multiply to solve one-step word problems involving whole numbers and decimals. They can work with familiar fractions. They understand simple algebraic relationships. They demonstrate understanding of properties of triangles and basic geometric concepts. They can read and interpret graphs and tables. They recognize basic notions of likelihood.

Low International Benchmark – 400

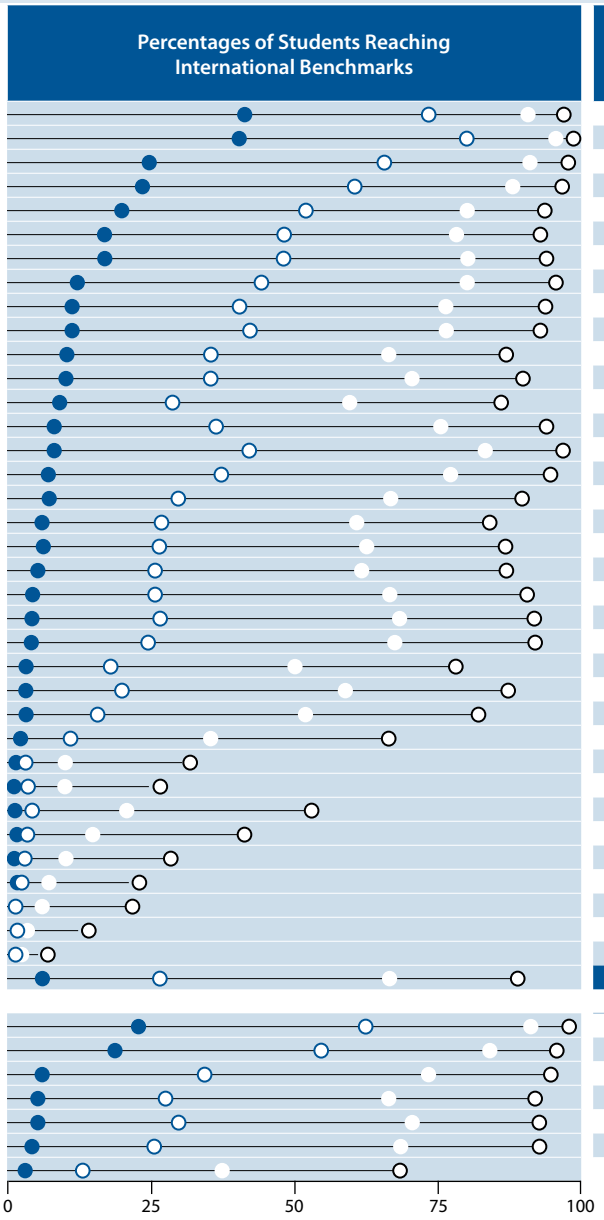
Students have some knowledge of whole numbers and decimals, operations, and basic graphs.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Exhibit 2.2 Percentages of Students Reaching the TIMSS 2007 International Benchmarks of Mathematics Achievement

TIMSS2007 Mathematics 4th Grade

Country	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
Singapore	41 (2.1)	74 (1.7)	92 (0.9)	98 (0.3)
Hong Kong SAR	40 (2.2)	81 (1.6)	97 (0.5)	100 (0.1)
Chinese Taipei	24 (1.2)	66 (1.2)	92 (0.5)	99 (0.2)
Japan	23 (1.2)	61 (1.2)	89 (0.8)	98 (0.4)
[1] Kazakhstan	19 (2.1)	52 (3.5)	81 (2.9)	95 (1.5)
England	16 (1.2)	48 (1.4)	79 (1.2)	94 (0.7)
Russian Federation	16 (1.8)	48 (2.3)	81 (1.7)	95 (0.7)
[1] Latvia	11 (0.8)	44 (1.5)	81 (1.2)	97 (0.5)
[2] † United States	10 (0.8)	40 (1.3)	77 (1.2)	95 (0.5)
[1] Lithuania	10 (0.7)	42 (1.4)	77 (1.4)	94 (0.7)
Hungary	9 (0.8)	35 (1.4)	67 (1.7)	88 (1.2)
Australia	9 (0.8)	35 (1.9)	71 (1.7)	91 (1.0)
Armenia	8 (1.5)	28 (1.8)	60 (1.8)	87 (1.2)
† Denmark	7 (0.7)	36 (1.5)	76 (1.2)	95 (0.8)
‡ Netherlands	7 (0.7)	42 (1.6)	84 (1.3)	98 (0.4)
Germany	6 (0.5)	37 (1.3)	78 (1.2)	96 (0.5)
Italy	6 (0.7)	29 (1.6)	67 (1.6)	91 (1.0)
New Zealand	5 (0.5)	26 (1.0)	61 (1.1)	85 (1.0)
Slovak Republic	5 (0.7)	26 (1.4)	63 (1.8)	88 (1.5)
† Scotland	4 (0.5)	25 (1.1)	62 (1.4)	88 (0.9)
Slovenia	3 (0.4)	25 (1.1)	67 (0.9)	92 (0.6)
Austria	3 (0.3)	26 (1.0)	69 (1.4)	93 (0.8)
Sweden	3 (0.3)	24 (1.4)	68 (1.4)	93 (0.7)
Ukraine	2 (0.5)	17 (1.1)	50 (1.5)	79 (1.2)
Czech Republic	2 (0.4)	19 (1.4)	59 (1.6)	88 (1.1)
Norway	2 (0.3)	15 (1.0)	52 (1.6)	83 (1.1)
[1] Georgia	1 (0.4)	10 (1.0)	35 (1.8)	67 (2.0)
Colombia	0 (0.1)	2 (0.4)	9 (1.1)	31 (2.0)
Morocco	0 (0.2)	2 (0.8)	9 (1.1)	26 (2.0)
Iran, Islamic Rep. of	0 (0.1)	3 (0.5)	20 (1.5)	53 (2.0)
Algeria	0 (0.1)	2 (0.4)	14 (1.4)	41 (2.2)
Tunisia	0 (0.1)	1 (0.2)	9 (0.7)	28 (1.6)
El Salvador	0 (0.0)	1 (0.2)	6 (0.5)	22 (1.6)
◆◆ Kuwait	0 (0.0)	0 (0.1)	5 (0.6)	21 (1.2)
Qatar	0 (0.0)	0 (0.1)	2 (0.2)	13 (0.4)
Yemen	0 (0.0)	0 (0.1)	1 (0.4)	6 (0.8)
International Median	5	26	67	90
Benchmarking Participants				
[2] Massachusetts, US	22 (1.8)	63 (2.1)	92 (1.1)	99 (0.3)
[2] † Minnesota, US	18 (2.1)	55 (3.2)	85 (2.2)	97 (1.2)
[2] Quebec, Canada	5 (0.7)	34 (2.2)	74 (1.6)	96 (0.6)
[2] British Columbia, Canada	4 (0.5)	27 (1.3)	67 (1.7)	93 (0.9)
[2] Ontario, Canada	4 (0.6)	29 (1.8)	71 (1.8)	94 (1.1)
[2] Alberta, Canada	3 (0.6)	25 (1.8)	69 (1.9)	94 (1.0)
◆◆ ‡ Dubai, UAE	2 (0.3)	12 (0.7)	37 (1.2)	69 (1.3)



● Percentage of students at or above **Advanced** Benchmark

○ Percentage of students at or above **High** Benchmark

● Percentage of students at or above **Intermediate** Benchmark

○ Percentage of students at or above **Low** Benchmark

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

[1] National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

[2] National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

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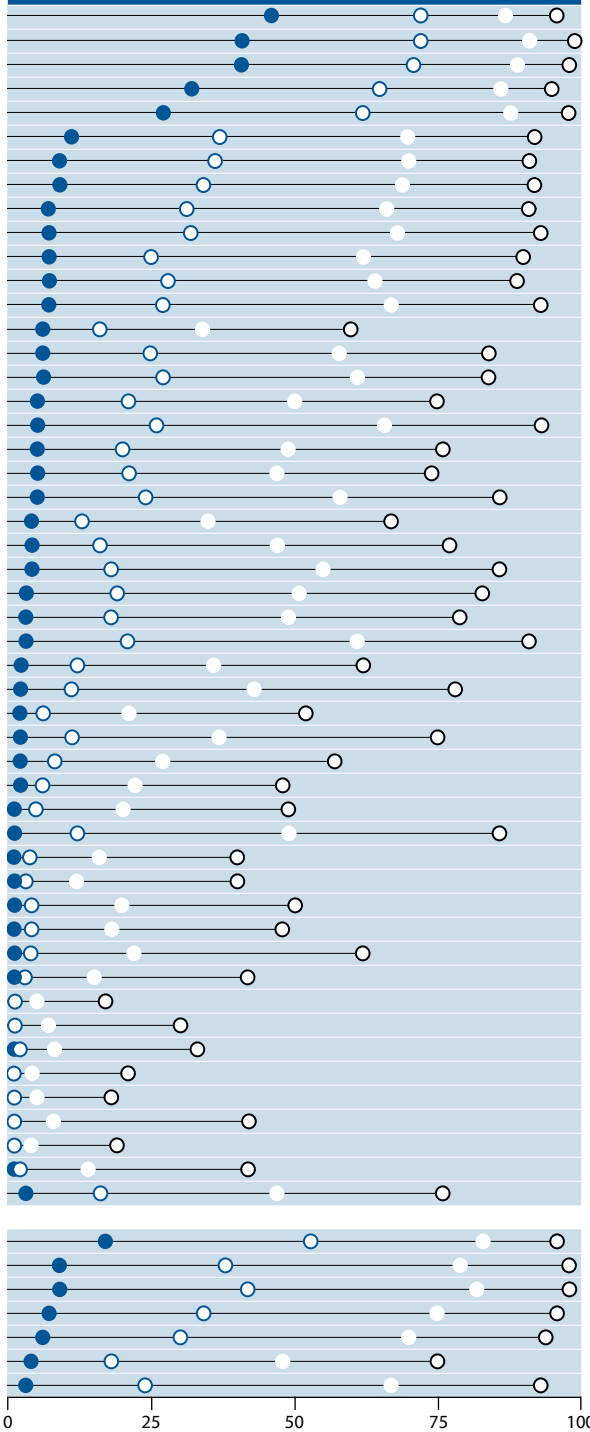
Exhibit 2.2 Percentages of Students Reaching the TIMSS 2007 International Benchmarks of Mathematics Achievement (Continued)

TIMSS2007 Mathematics 8th Grade

Country	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
Chinese Taipei	45 (1.9)	71 (1.5)	86 (1.2)	95 (0.6)
Korea, Rep. of	40 (1.2)	71 (1.1)	90 (0.7)	98 (0.3)
Singapore	40 (1.9)	70 (2.0)	88 (1.4)	97 (0.6)
† Hong Kong SAR	31 (2.1)	64 (2.6)	85 (2.1)	94 (1.1)
Japan	26 (1.3)	61 (1.2)	87 (0.9)	97 (0.3)
Hungary	10 (1.0)	36 (1.6)	69 (1.6)	91 (1.0)
† England	8 (1.5)	35 (2.5)	69 (2.3)	90 (1.4)
Russian Federation	8 (0.9)	33 (1.8)	68 (2.1)	91 (1.2)
1 Lithuania	6 (0.7)	30 (1.1)	65 (1.3)	90 (0.8)
2 † United States	6 (0.6)	31 (1.5)	67 (1.4)	92 (0.8)
Australia	6 (1.3)	24 (1.8)	61 (1.9)	89 (1.0)
Armenia	6 (0.9)	27 (1.9)	63 (1.4)	88 (0.8)
Czech Republic	6 (0.7)	26 (1.2)	66 (1.4)	92 (0.8)
Turkey	5 (0.6)	15 (1.3)	33 (1.8)	59 (1.8)
1 2 Serbia	5 (0.8)	24 (1.3)	57 (1.8)	83 (1.2)
Malta	5 (0.4)	26 (0.8)	60 (0.6)	83 (0.5)
Bulgaria	4 (0.8)	20 (1.5)	49 (1.9)	74 (1.7)
Slovenia	4 (0.6)	25 (1.0)	65 (1.4)	92 (0.8)
3 Israel	4 (0.5)	19 (1.3)	48 (1.7)	75 (1.4)
Romania	4 (0.6)	20 (1.3)	46 (1.8)	73 (1.7)
† Scotland	4 (0.6)	23 (1.8)	57 (2.2)	85 (1.3)
Thailand	3 (0.8)	12 (1.7)	34 (2.2)	66 (2.0)
Ukraine	3 (0.5)	15 (1.1)	46 (1.7)	76 (1.5)
Italy	3 (0.6)	17 (1.2)	54 (1.5)	85 (1.1)
Malaysia	2 (0.5)	18 (2.1)	50 (2.7)	82 (1.9)
Cyprus	2 (0.3)	17 (0.8)	48 (0.9)	78 (0.7)
Sweden	2 (0.3)	20 (1.0)	60 (1.3)	90 (0.9)
Jordan	1 (0.2)	11 (0.8)	35 (1.7)	61 (1.8)
Bosnia and Herzegovina	1 (0.2)	10 (0.7)	42 (1.4)	77 (1.3)
Iran, Islamic Rep. of	1 (0.2)	5 (0.9)	20 (1.7)	51 (1.9)
Lebanon	1 (0.2)	10 (1.2)	36 (2.4)	74 (2.3)
1 Georgia	1 (0.3)	7 (0.8)	26 (1.7)	56 (2.8)
Egypt	1 (0.1)	5 (0.4)	21 (1.0)	47 (1.5)
Indonesia	0 (0.2)	4 (0.6)	19 (1.4)	48 (1.9)
Norway	0 (0.1)	11 (0.7)	48 (1.5)	85 (0.8)
Palestinian Nat'l Auth.	0 (0.1)	3 (0.4)	15 (0.9)	39 (1.4)
Colombia	0 (0.0)	2 (0.3)	11 (1.1)	39 (2.1)
Bahrain	0 (0.1)	3 (0.3)	19 (0.7)	49 (0.9)
Syrian Arab Republic	0 (0.1)	3 (0.5)	17 (1.3)	47 (1.9)
Tunisia	0 (0.1)	3 (0.3)	21 (1.2)	61 (1.5)
Oman	0 (0.0)	2 (0.3)	14 (1.1)	41 (1.5)
Qatar	0 (0.0)	0 (0.1)	4 (0.2)	16 (0.5)
◆◆ Kuwait	0 (0.0)	0 (0.2)	6 (0.5)	29 (1.3)
Botswana	0 (0.0)	1 (0.1)	7 (0.7)	32 (1.3)
El Salvador	0 (0.0)	0 (0.1)	3 (0.5)	20 (1.2)
Ghana	0 (0.0)	0 (0.1)	4 (0.7)	17 (1.4)
Algeria	0 (0.0)	0 (0.1)	7 (0.5)	41 (1.4)
Saudi Arabia	0 (0.0)	0 (0.1)	3 (0.4)	18 (1.1)
‡ Morocco	0 (0.1)	1 (0.5)	13 (1.1)	41 (2.0)
International Median	2	15	46	75
Benchmarking Participants				
2 Massachusetts, US	16 (1.7)	52 (2.5)	82 (2.2)	95 (1.1)
3 Quebec, Canada	8 (1.2)	37 (2.0)	78 (1.8)	97 (0.8)
2 † Minnesota, US	8 (1.4)	41 (2.8)	81 (2.0)	97 (1.0)
2 Ontario, Canada	6 (0.8)	33 (2.0)	74 (1.8)	95 (1.1)
3 British Columbia, Canada	5 (1.0)	29 (1.7)	69 (1.5)	93 (0.9)
◆◆ ‡ Dubai, UAE	3 (0.5)	17 (1.1)	47 (1.5)	74 (1.2)
Basque Country, Spain	2 (0.4)	23 (1.5)	66 (1.9)	92 (1.0)



SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

● Percentage of students at or above **Advanced** Benchmark

○ Percentage of students at or above **High** Benchmark

○ Percentage of students at or above **Intermediate** Benchmark

○ Percentage of students at or above **Low** Benchmark

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

‡ Did not satisfy guidelines for sample participation rates (see Appendix A).

1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

3 National Defined Population covers less than 90% of National Target Population (but at least 77%, see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

As a point of reference, Exhibit 2.2 provides the median in TIMSS 2007 for each of the international benchmarks. By definition, half the countries (not including the benchmarking participants) will have a percentage above the median and half below. The median percentage of students reaching the Advanced International Benchmark was 5 percent at the fourth grade and 2 percent at the eighth grade. Following Singapore and Hong Kong SAR at the fourth grade, Chinese Taipei and Japan had nearly one-fourth of their students (23 to 24 percent) reaching the advanced benchmark. Other countries with at least 10 percent of fourth grade students reaching the advanced benchmark included Kazakhstan (19%), England (16%), the Russian Federation (16%), Latvia (11%), the United States (10%), and Lithuania (10%). Among the benchmarking participants, about one-fifth of fourth-grade students in the U.S. states of Massachusetts and Minnesota reached the advanced benchmark (22 and 18 percent, respectively). At the eighth grade, following Chinese Taipei, Korea, and Singapore, nearly one-third (31%) of students in Hong Kong (SAR) and approximately one-fourth (26%) in Japan reached the advanced benchmark. After that there is a considerable gap to the next highest percent, with Hungary having 10% of students reaching the advanced benchmark and all other countries less than that.

Although Exhibit 2.2 is organized to draw particular attention to the percentage of high-achieving students in each country and benchmarking participant, it also conveys information about the distribution of middle and low performers. Since students reaching a particular benchmark also reached lower benchmarks, the percentages illustrated graphically, and shown in the table are cumulative. At the fourth grade, the median for the Low International Benchmark was an impressive 90 percent, indicating that in at least half the countries almost all of the fourth grade students had elementary knowledge and skills in mathematics. A number of countries had 95 percent or more of fourth grade students reaching this benchmark, including Singapore, Hong Kong SAR, Chinese Taipei, Japan, Kazakhstan, the Russian Federation, Latvia, the United States, Denmark, the Netherlands,

and Germany. The two U.S. states and Canadian province of Quebec also had 95 percent or more of their fourth grade students reaching this benchmark. At the other end of the achievement distribution, however, less than half the students reached the low benchmark in Algeria (41%), Colombia (31%), Tunisia (28%), Morocco (26%), El Salvador (22%), Kuwait (21%), Qatar (13%), and Yemen (6%).

At the fourth grade, the median for the intermediate benchmark was 67 percent and the high benchmark median was 26 percent, indicating that in half the countries two-thirds or more of students could apply mathematical knowledge in straightforward situations and one-fourth or more could solve multi-step word problems. Conversely, however, the percentages at the high level, for example, also were lower than 26 percent in half of the countries. Also, while many countries have patterns consistent with the median results, several appear to be concentrating on helping students reach basic levels. For example, the results for the Netherlands are near the median (7%) for the advanced benchmark, but well above the median at the high (42%) and, most notably, the intermediate (84%) and low (98%) benchmarks. In Iran, few students reached the two highest benchmarks but one-fifth (20%) could apply mathematical knowledge (intermediate benchmark) and more than half (53%) demonstrated a grasp of the basics (low benchmark).

At the eighth grade, the substantial variation in achievement at the Advanced International Benchmark was mirrored at each of the other benchmarks. For example, the gap between the Asian countries and the remaining countries observed at the advanced benchmark also was evident at the high benchmark. The High International Benchmark was reached by at least 70 percent in Chinese Taipei, Korea, and Singapore as well as by 60 percent in Hong Kong SAR and Japan, but only about half that percent (30 to 36%) in the next highest group of countries (Hungary, England, the Russian Federation, Lithuania, and the United States). The range at the Intermediate International Benchmark was from 90 percent in Korea to 3 percent in El Salvador and Saudi Arabia. At the Low International

Benchmark, 95 percent or more achieved that level in four countries (Chinese Taipei, Korea, Singapore, and Japan), the two U.S. states, and the Canadian provinces of Quebec and Ontario. However, many countries had fewer than half of students reaching the low benchmark and several had less than 20 percent, including Saudi Arabia (18%), Ghana (17%), and Qatar (16%).

Considering their percentages reaching the advanced benchmark (2 to 6%), several countries had relatively larger percentages reaching the intermediate and low benchmarks, including the Czech Republic (66 and 92%, respectively), Slovenia (65 and 92%, respectively), and Sweden (60 and 90%, respectively). Norway also displayed this pattern with essentially no students at the advanced benchmark but 48 percent reaching the intermediate benchmark and 85 percent reaching the low benchmark.

Exhibit 2.3 presents changes in the percentages of students reaching the benchmarks. Trends across the four benchmarks generally were consistent with the patterns of overall changes across the previous assessments. For example, at the fourth grade, Hong Kong SAR had increased percentages of students at each of the benchmarks in each assessment (except at the low benchmark already reached by 99 percent of the students in 2003). Among those with lower average achievement in 2007 compared to 1995, the Czech Republic had decreased percentages of students at each benchmark and Austria had decreased percentages at the three top benchmarks.

At the eighth grade, for example, Lithuania had increased percentages reaching all four benchmarks compared to 1995 and 1999 and Malaysia had decreased percentages at all four benchmarks compared to 1999 and 2003. Sometimes, however, the changes in average achievement were reflected in some parts of the distribution more than others. For example, between 2003 and 2007 the Basque Country in Spain had the most improvements in the middle of the distribution—at the high and intermediate benchmarks but not at the advanced and low benchmarks.

Exhibit 2.3 Trends in Percentages of Students Reaching the TIMSS 2007 International Benchmarks of Mathematics Achievement

TIMSS2007 Mathematics 4th Grade

Country	Advanced International Benchmark (625)			High International Benchmark (550)		
	2007 Percent of Students	2003 Percent of Students	1995 Percent of Students	2007 Percent of Students	2003 Percent of Students	1995 Percent of Students
Singapore	41 (2.1)	38 (2.9)	38 (2.2)	74 (1.7)	73 (2.4)	70 (1.6)
Hong Kong SAR	40 (2.2)	22 (1.7) ▲	17 (1.7) ▲	81 (1.6)	67 (2.0) ▲	56 (2.2) ▲
Chinese Taipei	24 (1.2)	16 (0.9) ▲	◊ ◊	66 (1.2)	61 (1.1) ▲	◊ ◊
Japan	23 (1.2)	21 (0.8)	22 (1.0)	61 (1.2)	60 (1.0)	61 (1.1)
England	16 (1.2)	14 (1.4)	7 (0.8) ▲	48 (1.4)	43 (1.8) ▲	24 (1.5) ▲
Russian Federation	16 (1.8)	11 (1.6)	◊ ◊	48 (2.3)	41 (2.6) ▲	◊ ◊
Latvia	11 (0.8)	9 (0.9)	6 (1.3) ▲	44 (1.5)	43 (2.1)	27 (2.1) ▲
United States	10 (0.8)	7 (0.7) ▲	9 (0.9)	40 (1.3)	35 (1.3) ▲	37 (1.6)
Lithuania	10 (0.7)	10 (1.1)	◊ ◊	42 (1.4)	44 (1.7)	◊ ◊
Hungary	9 (0.8)	10 (1.0)	11 (1.0)	35 (1.4)	41 (1.6) ▼	38 (1.8)
Australia	9 (0.8)	5 (0.7) ▲	6 (0.6) ▲	35 (1.9)	26 (1.7) ▲	27 (1.4) ▲
Armenia	8 (1.5)	2 (0.3) ▲	◊ ◊	28 (1.8)	13 (1.2) ▲	◊ ◊
Netherlands	7 (0.7)	5 (0.8)	12 (1.1) ▼	42 (1.6)	44 (1.5)	50 (1.9) ▼
Italy	6 (0.7)	6 (1.0)	– –	29 (1.6)	29 (1.8)	– –
New Zealand	5 (0.5)	5 (0.5)	4 (0.6)	26 (1.0)	27 (1.2)	19 (1.4) ▲
Scotland	4 (0.5)	3 (0.4)	7 (0.9) ▼	25 (1.1)	22 (1.4)	27 (1.7)
Slovenia	3 (0.4)	2 (0.4) ▲	2 (0.4) ▲	25 (1.1)	18 (1.0) ▲	14 (1.1) ▲
Austria	3 (0.3)	◊ ◊	10 (0.9) ▼	26 (1.0)	◊ ◊	42 (1.9) ▼
Czech Republic	2 (0.4)	◊ ◊	16 (1.2) ▼	19 (1.4)	◊ ◊	46 (1.6) ▼
Norway	2 (0.3)	1 (0.2) ▲	2 (0.4)	15 (1.0)	10 (1.0) ▲	16 (1.2)
Morocco	0 (0.2)	0 (0.0)	◊ ◊	2 (0.8)	1 (0.2)	◊ ◊
Iran, Islamic Rep. of	0 (0.1)	0 (0.1)	0 (0.2)	3 (0.5)	2 (0.3)	3 (0.7)
Tunisia	0 (0.1)	0 (0.1)	◊ ◊	1 (0.2)	1 (0.3)	◊ ◊
Benchmarking Participants						
Minnesota, US	18 (2.1)	◊ ◊	9 (1.9) ▲	55 (3.2)	◊ ◊	35 (3.0) ▲
Quebec, Canada	5 (0.7)	3 (0.4) ▲	13 (1.9) ▼	34 (2.2)	25 (1.5) ▲	50 (3.4) ▼
Ontario, Canada	4 (0.6)	5 (1.1)	4 (0.5)	29 (1.8)	29 (2.2)	22 (1.5) ▲
Alberta, Canada	3 (0.6)	◊ ◊	9 (1.7) ▼	25 (1.8)	◊ ◊	39 (3.8) ▼

▲ 2007 percent significantly higher
▼ 2007 percent significantly lower

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Trend notes: Data are not shown for Kuwait, because comparable data from previous cycles are not available. Data for Tunisia do not include private schools.

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

A dash (–) indicates comparable data are not available.

A diamond (◊) indicates the country did not participate in the assessment.

Exhibit 2.3 **Trends in Percentages of Students Reaching the TIMSS 2007 International Benchmarks of Mathematics Achievement (Continued)**

TIMSS2007 Mathematics 4th Grade

Country	Intermediate International Benchmark (475)			Low International Benchmark (400)		
	2007 Percent of Students	2003 Percent of Students	1995 Percent of Students	2007 Percent of Students	2003 Percent of Students	1995 Percent of Students
Singapore	92 (0.9)	91 (1.3)	89 (1.0) ▲	98 (0.3)	97 (0.6)	96 (0.4) ▲
Hong Kong SAR	97 (0.5)	94 (0.7) ▲	87 (1.3) ▲	100 (0.1)	99 (0.2)	97 (0.6) ▲
Chinese Taipei	92 (0.5)	92 (0.7)	◊ ◊	99 (0.2)	99 (0.2)	◊ ◊
Japan	89 (0.8)	89 (0.7)	89 (0.7)	98 (0.4)	98 (0.3)	98 (0.2)
England	79 (1.2)	75 (1.6) ▲	54 (1.6) ▲	94 (0.7)	93 (0.8)	82 (1.1) ▲
Russian Federation	81 (1.7)	76 (2.0)	◊ ◊	95 (0.7)	95 (0.8)	◊ ◊
Latvia	81 (1.2)	80 (1.4)	61 (1.9) ▲	97 (0.5)	96 (0.8)	88 (1.1) ▲
United States	77 (1.2)	72 (1.2) ▲	71 (1.3) ▲	95 (0.5)	93 (0.5) ▲	92 (0.7) ▲
Lithuania	77 (1.4)	79 (1.3)	◊ ◊	94 (0.7)	96 (0.7)	◊ ◊
Hungary	67 (1.7)	76 (1.6) ▼	72 (1.5)	88 (1.2)	94 (0.8) ▼	91 (0.9) ▼
Australia	71 (1.7)	64 (1.9) ▲	61 (1.6) ▲	91 (1.0)	88 (1.3) ▲	86 (1.1) ▲
Armenia	60 (1.8)	43 (1.7) ▲	◊ ◊	87 (1.2)	75 (1.5) ▲	◊ ◊
Netherlands	84 (1.3)	89 (1.2) ▼	87 (1.4)	98 (0.4)	99 (0.4) ▼	99 (0.4)
Italy	67 (1.6)	65 (1.7)	– –	91 (1.0)	89 (1.1)	– –
New Zealand	61 (1.1)	62 (1.3)	51 (1.9) ▲	85 (1.0)	86 (1.0)	78 (1.7) ▲
Scotland	62 (1.4)	60 (1.6)	60 (1.9)	88 (0.9)	88 (1.2)	85 (1.2)
Slovenia	67 (0.9)	55 (1.5) ▲	45 (2.0) ▲	92 (0.6)	84 (1.0) ▲	77 (1.4) ▲
Austria	69 (1.4)	◊ ◊	77 (1.4) ▼	93 (0.8)	◊ ◊	94 (0.7)
Czech Republic	59 (1.6)	◊ ◊	79 (1.1) ▼	88 (1.1)	◊ ◊	95 (0.5) ▼
Norway	52 (1.6)	41 (1.3) ▲	53 (2.0)	83 (1.1)	75 (1.2) ▲	84 (1.2)
Morocco	9 (1.1)	8 (0.8)	◊ ◊	26 (2.0)	29 (2.2)	◊ ◊
Iran, Islamic Rep. of	20 (1.5)	17 (1.3)	15 (1.9) ▲	53 (2.0)	45 (2.2) ▲	44 (2.5) ▲
Tunisia	9 (0.8)	9 (1.0)	◊ ◊	28 (1.6)	28 (1.7)	◊ ◊
Benchmarking Participants						
Minnesota, US	85 (2.2)	◊ ◊	70 (3.3) ▲	97 (1.2)	◊ ◊	91 (2.2) ▲
Quebec, Canada	74 (1.6)	69 (1.4) ▲	87 (1.7) ▼	96 (0.6)	94 (0.8) ▲	98 (0.7) ▼
Ontario, Canada	71 (1.8)	70 (1.7)	59 (1.9) ▲	94 (1.1)	94 (0.9)	86 (1.3) ▲
Alberta, Canada	69 (1.9)	◊ ◊	74 (3.9)	94 (1.0)	◊ ◊	93 (2.7)

▲ 2007 percent significantly higher
▼ 2007 percent significantly lower

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Exhibit 2.3 Trends in Percentages of Students Reaching the TIMSS 2007 International Benchmarks of Mathematics Achievement (Continued)

TIMSS2007 Mathematics 8th Grade

Country	Advanced International Benchmark (625)				High International Benchmark (550)			
	2007 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students	2007 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students
Chinese Taipei	45 (1.9)	38 (2.0) ▲	37 (1.6) ▲	◊ ◊	71 (1.5)	66 (1.8) ▲	67 (1.5)	◊ ◊
Korea, Rep. of	40 (1.2)	35 (1.3) ▲	32 (0.9) ▲	31 (1.1) ▲	71 (1.1)	70 (1.0)	70 (1.0)	67 (1.0) ▲
Singapore	40 (1.9)	44 (2.0)	42 (3.5)	40 (2.9)	70 (2.0)	77 (2.0) ▼	77 (2.6) ▼	84 (1.8) ▼
Hong Kong SAR	31 (2.1)	31 (1.6)	28 (2.1)	23 (2.4) ▲	64 (2.6)	73 (1.8) ▼	70 (2.3)	65 (3.2)
Japan	26 (1.3)	24 (1.0)	29 (0.9)	29 (1.0)	61 (1.2)	62 (1.2)	66 (1.0) ▼	67 (0.8) ▼
Hungary	10 (1.0)	11 (1.0)	13 (1.2) ▼	10 (0.8)	36 (1.6)	41 (1.9) ▼	43 (1.9) ▼	40 (1.6)
England	8 (1.5)	5 (1.0)	6 (0.8)	6 (1.0)	35 (2.5)	26 (2.8) ▲	25 (2.0) ▲	27 (1.5) ▲
Russian Federation	8 (0.9)	6 (0.8) ▲	12 (1.6) ▼	9 (1.2)	33 (1.8)	30 (1.8)	39 (2.8)	38 (3.1)
Lithuania	6 (0.7)	5 (0.6)	3 (0.6) ▲	2 (0.5) ▲	30 (1.1)	28 (1.2)	18 (2.0) ▲	17 (1.5) ▲
United States	6 (0.6)	7 (0.7)	7 (1.0)	4 (0.7)	31 (1.5)	29 (1.6)	30 (1.6)	26 (2.0) ▲
Australia	6 (1.3)	7 (1.1)	– –	7 (1.0)	24 (1.8)	29 (2.4)	– –	33 (1.8) ▼
Armenia	6 (0.9)	2 (0.3) ▲	◊ ◊	◊ ◊	27 (1.9)	21 (1.3) ▲	◊ ◊	◊ ◊
Czech Republic	6 (0.7)	◊ ◊	9 (1.2) ▼	15 (2.0) ▼	26 (1.2)	◊ ◊	35 (2.1) ▼	47 (2.4) ▼
Serbia	5 (0.8)	4 (0.4)	◊ ◊	◊ ◊	24 (1.3)	21 (1.1)	◊ ◊	◊ ◊
Bulgaria	4 (0.8)	3 (0.7)	9 (2.1) ▼	17 (2.0) ▼	20 (1.5)	19 (1.8)	32 (3.0) ▼	40 (2.8) ▼
Slovenia	4 (0.6)	3 (0.5)	– –	4 (0.7)	25 (1.0)	21 (1.0) ▲	– –	22 (1.3)
Israel	4 (0.5)	6 (0.6) ▼	4 (0.5)	– –	19 (1.3)	27 (1.5) ▼	19 (1.3)	– –
Romania	4 (0.6)	4 (0.6)	4 (0.9)	4 (0.6)	20 (1.3)	21 (1.8)	20 (2.0)	21 (1.6)
Scotland	4 (0.6)	4 (0.6)	◊ ◊	5 (1.4)	23 (1.8)	25 (2.1)	◊ ◊	24 (2.7)
Thailand	3 (0.8)	◊ ◊	3 (0.7)	– –	12 (1.7)	◊ ◊	17 (1.9)	– –
Italy	3 (0.6)	3 (0.6)	4 (0.6)	– –	17 (1.2)	19 (1.5)	21 (1.5) ▼	– –
Malaysia	2 (0.5)	6 (1.0) ▼	10 (1.2) ▼	◊ ◊	18 (2.1)	30 (2.4) ▼	36 (2.4) ▼	◊ ◊
Cyprus	2 (0.3)	1 (0.2) ▲	2 (0.4)	3 (0.4)	17 (0.8)	13 (0.7) ▲	19 (0.9)	19 (1.0)
Sweden	2 (0.3)	3 (0.5)	◊ ◊	12 (1.1) ▼	20 (1.0)	24 (1.2) ▼	◊ ◊	46 (2.4) ▼
Jordan	1 (0.2)	1 (0.2) ▲	3 (0.5) ▼	◊ ◊	11 (0.8)	8 (1.0) ▲	12 (1.0)	◊ ◊
Iran, Islamic Rep. of	1 (0.2)	0 (0.2)	1 (0.2)	0 (0.2)	5 (0.9)	3 (0.4)	6 (0.9)	4 (0.6)
Lebanon	1 (0.2)	0 (0.1) ▲	◊ ◊	◊ ◊	10 (1.2)	4 (0.6) ▲	◊ ◊	◊ ◊
Indonesia	1 (0.2)	1 (0.2)	2 (0.3) ▼	◊ ◊	5 (0.8)	6 (0.7)	8 (0.9) ▼	◊ ◊
Egypt	1 (0.1)	1 (0.2)	◊ ◊	◊ ◊	5 (0.4)	6 (0.5)	◊ ◊	◊ ◊
Norway	0 (0.1)	0 (0.2)	◊ ◊	4 (0.4) ▼	11 (0.7)	10 (0.6)	◊ ◊	26 (1.3) ▼
Palestinian Nat'l Auth.	0 (0.1)	0 (0.1)	◊ ◊	◊ ◊	3 (0.4)	4 (0.4)	◊ ◊	◊ ◊
Colombia	0 (0.0)	◊ ◊	◊ ◊	0 (0.0) ▲	2 (0.3)	◊ ◊	◊ ◊	2 (0.7)
Bahrain	0 (0.1)	0 (0.0) ▲	◊ ◊	◊ ◊	3 (0.3)	2 (0.2)	◊ ◊	◊ ◊
Tunisia	0 (0.1)	0 (0.0)	0 (0.1)	◊ ◊	3 (0.3)	1 (0.3) ▲	5 (0.5) ▼	◊ ◊
Botswana	0 (0.0)	0 (0.0)	◊ ◊	◊ ◊	1 (0.1)	1 (0.2)	◊ ◊	◊ ◊
Ghana	0 (0.0)	0 (0.0)	◊ ◊	◊ ◊	0 (0.1)	0 (0.0)	◊ ◊	◊ ◊
Benchmarking Participants								
Massachusetts, US	16 (1.7)	◊ ◊	8 (1.3) ▲	◊ ◊	52 (2.5)	◊ ◊	33 (2.6) ▲	◊ ◊
Quebec, Canada	8 (1.2)	8 (1.4)	18 (4.4) ▼	14 (2.8) ▼	37 (2.0)	45 (2.2) ▼	60 (3.5) ▼	54 (4.2) ▼
Minnesota, US	8 (1.4)	◊ ◊	◊ ◊	7 (2.3)	41 (2.8)	◊ ◊	◊ ◊	36 (4.1)
Ontario, Canada	6 (0.8)	6 (0.7)	6 (0.8)	3 (0.4) ▲	33 (2.0)	34 (1.8)	32 (1.8)	26 (1.7) ▲
British Columbia, Canada	5 (1.0)	◊ ◊	7 (2.0)	◊ ◊	29 (1.7)	◊ ◊	35 (4.3)	◊ ◊
Basque Country, Spain	2 (0.4)	1 (0.3)	◊ ◊	◊ ◊	23 (1.5)	16 (1.5) ▲	◊ ◊	◊ ◊

▲ 2007 percent significantly higher
▼ 2007 percent significantly lower

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Trend notes: Data are not shown for Kuwait, Morocco, Saudi Arabia, and Turkey, because comparable data from previous cycles are not available. Data for Indonesia do not include Islamic schools.

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

A dash (–) indicates comparable data are not available.

A diamond (◊) indicates the country did not participate in the assessment.

Exhibit 2.3 Trends in Percentages of Students Reaching the TIMSS 2007 International Benchmarks of Mathematics Achievement (Continued)

TIMSS2007 Mathematics 8th Grade

Country	Intermediate International Benchmark (475)				Low International Benchmark (400)			
	2007 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students	2007 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students
Chinese Taipei	86 (1.2)	85 (1.2)	85 (1.0)	◊ ◊	95 (0.6)	96 (0.6)	95 (0.5)	◊ ◊
Korea, Rep. of	90 (0.7)	90 (0.5)	91 (0.5)	89 (0.7)	98 (0.3)	98 (0.3)	99 (0.2) ▼	97 (0.4)
Singapore	88 (1.4)	93 (1.0) ▼	94 (1.2) ▼	98 (0.4) ▼	97 (0.6)	99 (0.2) ▼	99 (0.3) ▼	100 (0.0) ▼
Hong Kong SAR	85 (2.1)	93 (1.3) ▼	92 (1.3) ▼	88 (2.1)	94 (1.1)	98 (0.6) ▼	98 (0.6) ▼	96 (1.1)
Japan	87 (0.9)	88 (0.6)	90 (0.5) ▼	91 (0.5) ▼	97 (0.3)	98 (0.2) ▼	98 (0.2) ▼	98 (0.2) ▼
Hungary	69 (1.6)	75 (1.6) ▼	75 (1.5) ▼	74 (1.6) ▼	91 (1.0)	95 (0.8) ▼	93 (1.0)	94 (0.9) ▼
England	69 (2.3)	61 (2.9) ▲	60 (2.2) ▲	61 (1.5) ▲	90 (1.4)	90 (1.5)	88 (1.2)	87 (1.0)
Russian Federation	68 (2.1)	66 (1.8)	73 (2.7)	73 (2.4)	91 (1.2)	92 (0.9)	93 (1.4)	93 (1.1)
Lithuania	65 (1.3)	63 (1.4)	53 (2.3) ▲	50 (2.3) ▲	90 (0.8)	90 (0.8)	85 (1.8) ▲	81 (1.7) ▲
United States	67 (1.4)	64 (1.6)	62 (1.8)	61 (2.4) ▲	92 (0.8)	90 (1.0)	87 (1.1) ▲	86 (1.5) ▲
Australia	61 (1.9)	65 (2.3)	– –	68 (1.7) ▼	89 (1.0)	90 (1.4)	– –	90 (1.0)
Armenia	63 (1.4)	54 (1.5) ▲	◊ ◊	◊ ◊	88 (0.8)	82 (1.0) ▲	◊ ◊	◊ ◊
Czech Republic	66 (1.4)	◊ ◊	71 (2.1) ▼	82 (1.4) ▼	92 (0.8)	◊ ◊	94 (1.1)	98 (0.5) ▼
Serbia	57 (1.8)	52 (1.4) ▲	◊ ◊	◊ ◊	83 (1.2)	80 (0.9)	◊ ◊	◊ ◊
Bulgaria	49 (1.9)	51 (2.1)	67 (2.5) ▼	69 (2.4) ▼	74 (1.7)	82 (1.6) ▼	90 (1.2) ▼	90 (1.1) ▼
Slovenia	65 (1.4)	60 (1.3) ▲	– –	60 (1.8)	92 (0.8)	90 (0.9)	– –	90 (0.9)
Israel	48 (1.7)	60 (1.8) ▼	49 (1.9)	– –	75 (1.4)	86 (1.2) ▼	76 (2.0)	– –
Romania	46 (1.8)	52 (2.2) ▼	51 (2.6)	52 (2.2) ▼	73 (1.7)	79 (1.7) ▼	79 (2.1)	79 (1.6) ▼
Scotland	57 (2.2)	63 (2.4) ▼	◊ ◊	60 (2.6)	85 (1.3)	90 (1.1) ▼	◊ ◊	87 (1.4)
Thailand	34 (2.2)	◊ ◊	45 (2.6) ▼	– –	66 (2.0)	◊ ◊	79 (1.8) ▼	– –
Italy	54 (1.5)	56 (1.7)	53 (2.1)	– –	85 (1.1)	86 (1.2)	82 (1.6)	– –
Malaysia	50 (2.7)	66 (2.1) ▼	70 (2.1) ▼	◊ ◊	82 (1.9)	93 (0.9) ▼	93 (0.9) ▼	◊ ◊
Cyprus	48 (0.9)	45 (1.0) ▲	53 (1.2) ▼	51 (1.3)	78 (0.7)	77 (1.0)	82 (0.9) ▼	77 (1.0)
Sweden	60 (1.3)	64 (1.5) ▼	◊ ◊	81 (1.8) ▼	90 (0.9)	91 (1.0)	◊ ◊	96 (0.8) ▼
Jordan	35 (1.7)	30 (1.9) ▲	33 (1.6)	◊ ◊	61 (1.8)	60 (1.9)	61 (1.4)	◊ ◊
Iran, Islamic Rep. of	20 (1.7)	20 (1.1)	26 (1.9) ▼	24 (1.9) ▼	51 (1.9)	55 (1.4)	61 (1.6) ▼	59 (1.8) ▼
Lebanon	36 (2.4)	27 (1.8) ▲	◊ ◊	◊ ◊	74 (2.3)	68 (1.9)	◊ ◊	◊ ◊
Indonesia	22 (1.8)	24 (1.7)	23 (1.4)	◊ ◊	52 (2.2)	55 (2.4)	50 (2.1)	◊ ◊
Egypt	21 (1.0)	24 (1.2)	◊ ◊	◊ ◊	47 (1.5)	52 (1.7) ▼	◊ ◊	◊ ◊
Norway	48 (1.5)	44 (1.6)	◊ ◊	64 (1.3) ▼	85 (0.8)	81 (1.2) ▲	◊ ◊	90 (0.9) ▼
Palestinian Nat'l Auth.	15 (0.9)	19 (1.2) ▼	◊ ◊	◊ ◊	39 (1.4)	46 (1.5) ▼	◊ ◊	◊ ◊
Colombia	11 (1.1)	◊ ◊	◊ ◊	7 (0.9) ▲	39 (2.1)	◊ ◊	◊ ◊	20 (1.9) ▲
Bahrain	19 (0.7)	17 (0.7)	◊ ◊	◊ ◊	49 (0.9)	51 (1.1)	◊ ◊	◊ ◊
Tunisia	21 (1.2)	15 (1.1) ▲	34 (1.5) ▼	◊ ◊	61 (1.5)	55 (1.6) ▲	78 (1.2) ▼	◊ ◊
Botswana	7 (0.7)	7 (0.7)	◊ ◊	◊ ◊	32 (1.3)	32 (1.5)	◊ ◊	◊ ◊
Ghana	4 (0.7)	2 (0.5) ▲	◊ ◊	◊ ◊	17 (1.4)	9 (1.3) ▲	◊ ◊	◊ ◊
Benchmarking Participants								
Massachusetts, US	82 (2.2)	◊ ◊	69 (3.0) ▲	◊ ◊	95 (1.1)	◊ ◊	92 (1.7)	◊ ◊
Quebec, Canada	78 (1.8)	88 (1.1) ▼	93 (1.1) ▼	90 (2.6) ▼	97 (0.8)	99 (0.2) ▼	99 (0.4) ▼	99 (0.5) ▼
Minnesota, US	81 (2.0)	◊ ◊	◊ ◊	73 (3.4) ▲	97 (1.0)	◊ ◊	◊ ◊	94 (1.6)
Ontario, Canada	74 (1.8)	75 (1.7)	72 (1.6)	65 (1.7) ▲	95 (1.1)	97 (0.5)	96 (0.6)	91 (1.0) ▲
British Columbia, Canada	69 (1.5)	◊ ◊	75 (3.0)	◊ ◊	93 (0.9)	◊ ◊	94 (1.4)	◊ ◊
Basque Country, Spain	66 (1.9)	58 (2.2) ▲	◊ ◊	◊ ◊	92 (1.0)	91 (1.0)	◊ ◊	◊ ◊

▲ 2007 percent significantly higher
▼ 2007 percent significantly lower

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Fourth Grade: Achievement at the Advanced International Benchmark

At the fourth grade, half (50%) of the assessment items were devoted to assessing the *number* content domain, including understanding of place value, ways of representing numbers, and the relationships between numbers. According to the *TIMSS 2007 Mathematics Framework*, students should have developed number sense and computational fluency, be able to use numbers and operations to solve problems, and be familiar with a range of number patterns. Within the *geometric shapes and measures* domain (35% of the assessment), students should be able to identify and analyze the properties and characteristics of lines, angles, and a variety of geometric figures, including two- and three-dimensional shapes, and to provide explanations based on geometric relationships. This domain also included understanding informal coordinate systems and using spatial visualization skills. The *data display* content domain (15%) included understanding how to organize data that have been collected and how to display it in graphs as well as reading and interpreting various data displays. Students at the fourth grade should be able to compare characteristics of data and to draw conclusions based on data displays. Within each of the content domains, students were expected to demonstrate knowledge as well as application and reasoning skills.

Exhibit 2.4 describes fourth-grade performance at the advanced international benchmark. Students achieving at or above this benchmark demonstrated fluency with many framework topics. They applied mathematical understanding and knowledge in a variety of relatively complex problem situations involving fractions and decimals, number sentences, linear relationships, a range of two- and three-dimensional geometric shapes, and various representations of data. They typically demonstrated success on the knowledge and skills represented by this benchmark, as well as those demonstrated at the high, intermediate, and low benchmarks.

At the fourth grade, pre-algebraic concepts and skills are part of the TIMSS 2007 assessment. The framework specifies that students should be exploring number patterns, investigating the relationships between their

Exhibit 2.4 **Description of the TIMSS 2007 Advanced International Benchmark (625) of Mathematics Achievement**

TIMSS2007 Mathematics 4th Grade

Advanced International Benchmark – 625

Summary

Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning. They can apply proportional reasoning in a variety of contexts. They demonstrate a developing understanding of fractions and decimals. They can select appropriate information to solve multi-step word problems. They can formulate or select a rule for a relationship. Students can apply geometric knowledge of a range of two- and three-dimensional shapes in a variety of situations. They can organize, interpret, and represent data to solve problems.

Students can solve a variety of multi-step word problems involving whole numbers. They can apply proportional reasoning in a variety of contexts. They show some understanding of divisibility and factors. Students at this level demonstrate a developing understanding of fractions and decimals. They can determine equivalent fractions represented in a variety of ways, including explaining why two representations show the same fraction. Given a fraction, they can identify a larger fraction with a different denominator. They can identify the smallest among a set of one- and two-place decimals and use their knowledge of decimals to solve two-step problems.

Students show understanding of missing numbers in number sentences. For example, they can identify the number that satisfies a number sentence involving addition with two terms on each side and the missing first number in a subtraction sentence. They can construct and use two-step rules for linear relationships between the first and second numbers in a set of ordered pairs.

Students can apply geometric knowledge of a range of two- and three-dimensional shapes in a variety of situations. They can estimate the length of a curved line in non-standard units. Students can use maps drawn to scale to solve problems, including locating a point between two specified points and estimating distance. They can draw a perpendicular line that meets given conditions. Students can use their knowledge of perimeter to solve a multi-step problem. Students can determine the areas of simple figures. For example, they can find the area of a figure composed of squares and half squares, determine the area of an isosceles triangle on a grid, and calculate the area of a rectangle. They can identify and use properties of rectangles. Students can relate two- and three-dimensional shapes, recognize properties of common solids, and determine the number of cubes that fill a given rectangular box. They show some understanding of rotation in a plane. For example, they can identify the position of a shape after a quarter-turn and a half-turn rotation in a plane.

Students can organize, interpret, and represent data to solve problems. They can organize data and complete a tally chart to represent the data. They can solve problems that involve relating and interpreting values from two different types of graphs. They can draw a conclusion from data in a table and justify their conclusion.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

terms and finding or using the rules that generate them. Exhibit 2.5 presents a number pattern item likely to be answered correctly by students performing at the advanced benchmark. In Example Item 1, students were shown a linear relationship between pairs of numbers and asked to write the two-step rule that described how to get the second number from the first number. Internationally across countries, this was among the most difficult items in the TIMSS 2007 assessment. On average, 15 percent of the students received full credit for their responses. In Hong Kong SAR and Japan, 38 to 39 percent of fourth grade students wrote the correct rule, and in the benchmarking state of Massachusetts, 47 percent answered it correctly.

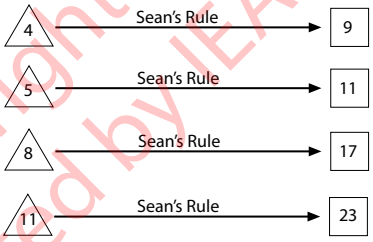
In the data display domain at the fourth grade, students are expected to use information from data displays to answer questions that go beyond directly reading the data displayed (e.g., combine data, perform computations based on the data, draw conclusions, and make predictions). One such item likely to be answered by students reaching the advanced level is shown in Exhibit 2.6. Example Item 2 is a multiple-choice item asking students to use data from two different data displays to solve a problem. On average internationally, 32 percent of the students answered this item correctly. In Singapore and Hong Kong SAR, 63 percent answered it correctly.

Exhibit 2.5 TIMSS 2007 Advanced International Benchmark (625) of Mathematics Achievement – Example Item 1

TIMSS2007 Mathematics 4th Grade

Content Domain: Number

Description: Writes two-step rule for a linear relationship between pairs of numbers.



Sean used the same rule to get the number in the □ from the number in the △. What was the rule?

Answer: You double the number and add one

Example: 2×4=8
8+1=9

The answer shown illustrates the type of student response that was given full credit

Country	Percent Full Credit	
Hong Kong SAR	39 (2.7)	▲
Japan	38 (2.1)	▲
Singapore	36 (2.1)	▲
Armenia	35 (2.9)	▲
Chinese Taipei	33 (2.4)	▲
England	28 (2.3)	▲
1 Kazakhstan	28 (4.2)	▲
Hungary	28 (2.4)	▲
Russian Federation	23 (3.1)	▲
2 † United States	23 (1.4)	▲
1 Latvia	22 (2.3)	▲
Italy	22 (1.7)	▲
Australia	20 (3.1)	
† Scotland	17 (1.7)	
† Denmark	17 (2.1)	
New Zealand	17 (1.6)	
International Avg.	15 (0.3)	
Germany	13 (1.2)	
‡ Netherlands	13 (2.0)	
1 Lithuania	13 (1.7)	
Slovak Republic	13 (2.0)	
Austria	11 (1.6)	▼
Ukraine	11 (1.5)	▼
Norway	9 (1.4)	▼
1 Georgia	8 (1.6)	▼
Slovenia	8 (0.8)	▼
Sweden	7 (1.3)	▼
Czech Republic	6 (1.0)	▼
Algeria	6 (1.2)	▼
Iran, Islamic Rep. of	5 (1.1)	▼
Morocco	4 (2.0)	▼
Tunisia	3 (0.5)	▼
◆◆ Kuwait	1 (0.4)	▼
Qatar	1 (0.2)	▼
Colombia	1 (0.4)	▼
Yemen	0 (0.2)	▼
El Salvador	0 (0.0)	▼
Benchmarking Participants		
2 Massachusetts, US	47 (3.5)	▲
2 † Minnesota, US	32 (4.1)	▲
2 Alberta, Canada	15 (1.8)	
◆◆ ‡ Dubai, UAE	14 (1.7)	
2 British Columbia, Canada	13 (1.5)	
2 Ontario, Canada	12 (2.3)	
2 Quebec, Canada	8 (1.5)	▼

Percent significantly higher than international average ▲
Percent significantly lower than international average ▼

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A).
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).
1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).
2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).
◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

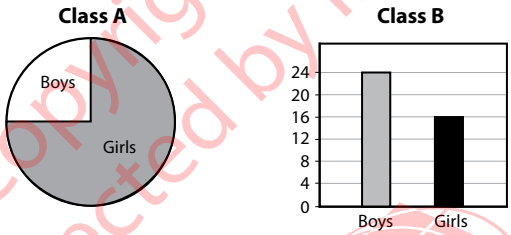
Exhibit 2.6 TIMSS 2007 Advanced International Benchmark (625) of Mathematics Achievement – Example Item 2

TIMSS2007 Mathematics 4th Grade

Content Domain: Data Display

Description: Uses data from two different graph types to solve a problem.

Class A and B each have 40 students.



There are more girls in Class A than in Class B. How many more?

● 14
Ⓑ 16
Ⓒ 24
Ⓓ 30

Country	Percent Correct	
Singapore	63 (2.3)	▲
Hong Kong SAR	63 (2.3)	▲
[1] Kazakhstan	51 (3.7)	▲
Chinese Taipei	47 (2.5)	▲
[1] Lithuania	46 (2.1)	▲
‡ Netherlands	44 (2.6)	▲
Russian Federation	42 (3.0)	▲
Japan	41 (2.2)	▲
England	40 (2.5)	▲
Slovak Republic	39 (2.1)	▲
[2] † United States	38 (1.8)	▲
Hungary	37 (2.9)	
Sweden	37 (2.0)	▲
[1] Latvia	37 (2.5)	
Australia	36 (2.2)	
Slovenia	35 (2.1)	
Germany	35 (1.9)	
† Denmark	34 (2.6)	
† Scotland	34 (2.3)	
Austria	34 (2.1)	
Armenia	33 (2.7)	
International Avg.	32 (0.4)	
Ukraine	32 (2.1)	
New Zealand	32 (1.6)	
Norway	31 (2.3)	
Czech Republic	31 (2.6)	
[1] Georgia	26 (2.7)	▼
Italy	26 (2.2)	▼
Algeria	21 (1.9)	▼
Morocco	15 (2.0)	▼
Iran, Islamic Rep. of	15 (1.8)	▼
Tunisia	14 (1.7)	▼
Qatar	13 (1.1)	▼
👀 Kuwait	12 (1.5)	▼
Yemen	9 (1.3)	▼
El Salvador	9 (1.4)	▼
Colombia	9 (1.5)	▼
Benchmarking Participants		
[2] Massachusetts, US	51 (3.2)	▲
[2] † Minnesota, US	48 (2.8)	▲
[2] Ontario, Canada	39 (2.7)	▲
[2] Alberta, Canada	38 (2.4)	▲
[2] British Columbia, Canada	35 (2.1)	
[2] Quebec, Canada	30 (2.8)	
👀 ‡ Dubai, UAE	23 (2.5)	▼

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

▲ Percent significantly higher than international average
▼ Percent significantly lower than international average

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A).
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).
1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).
2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).
👀 Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Fourth Grade: Achievement at the High International Benchmark

Exhibit 2.7 describes performance at the high benchmark. Students reaching this level demonstrated some competency with many of the topics in the framework. For example, in the number domain they applied their knowledge and understanding to solve problems involving whole numbers, including division. They also demonstrated understanding of place value, simple fractions, and how to extend a pattern to find a later specified term. They had some geometric knowledge about angles and triangles as well as distances, perimeters, and areas, and displayed some spatial visualization skills. They could interpret and use data in tables and graphs to solve problems.

Exhibit 2.8 presents a constructed-response item assessing whole number computation. Example Item 3, involving subtraction with three digits, illustrates one type of item typically answered correctly by students reaching the high benchmark. Internationally, 42 percent of students, on average, were able to provide a correct response. Eighty percent or more of the students provided the correct answer in Chinese Taipei, Hong Kong SAR, Singapore, the Russian Federation, Kazakhstan, and Japan.

Example Item 4 shown in Exhibit 2.9 is an example of a data display problem likely to be answered by students reaching the high benchmark. In this constructed-response item, students were asked to use data interpretation and representation skills to complete a bar graph. Internationally on average, 38 percent of the students drew the bar that correctly completed the graph. At least half the students completed the bar graph correctly in 12 countries and the two U.S. states.

Exhibit 2.7 **Description of the TIMSS 2007 High International Benchmark (550) of Mathematics Achievement**

TIMSS2007 Mathematics 4th Grade

High International Benchmark – 550

Summary

Students can apply their knowledge and understanding to solve problems. Students can solve multi-step word problems involving operations with whole numbers. They can use division in a variety of problem situations. They demonstrate understanding of place value and simple fractions. Students can extend patterns to find a later specified term and identify the relationship between ordered pairs. Students show some basic geometric knowledge. They can interpret and use data in tables and graphs to solve problems.

Students at this level can solve multi-step word problems involving operations with whole numbers. They can use division in a variety of problem situations, including those that involve number sentences. They can solve word problems involving a range of measures (e.g., time, capacity, and temperature). They can use their understanding of place value to solve problems. For example, they can identify the missing digit in a number given its place value, the sum closest to a given value, and appropriately rounded numbers. They can read unlabelled gradations on a scale and solve a word problem involving measures and proportional reasoning.

Students at this level demonstrate understanding of simple fractions and two-place decimals. For example, they can add and subtract fractions with the same denominator, find a fractional part of a set of objects, recognize simple equivalent fractions, order unit fractions, write a number between two consecutive whole numbers, and identify the two-place decimal closest to a given whole number.

Students can extend patterns to find a later specified term and identify the relationship between ordered pairs. For example, they can identify and use two-step rules relating the first number to the second number in ordered pairs.

Students can apply knowledge of right angles to draw and identify them. They can find distances between points, perimeters of simple figures, and areas of right triangles on a grid. They can recognize a net of a cube and visualize hidden cubes in a stack. Students can state simple properties of triangles. They can compose shapes to make other simple shapes that meet specified conditions. Students have basic knowledge of reflections in a plane.

Students can interpret and use data in tables and graphs to solve problems. For example, they can compare data from two tables to draw conclusions. They can read a part symbol on a pictograph. They can complete and label a bar graph based on data in a tally chart, complete the scale of a bar graph, and complete a bar graph to show a specified comparison.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Exhibit 2.8 TIMSS 2007 High International Benchmark (550) of Mathematics Achievement – Example Item 3

TIMSS2007 Mathematics 4th Grade

Content Domain: Number

Description: Determines the missing digit to give a specified difference in a three-digit subtraction problem.

$$\begin{array}{r} 942 \\ -5\square 7 \\ \hline 415 \end{array}$$

Mano did the subtraction problem above for homework but spilled some of his drink on it. One digit could not be read. His answer of 415 was correct. What is the missing digit?

Answer: 2

The answer shown illustrates the type of student response that was given full credit

Country	Percent Full Credit	
Chinese Taipei	88 (1.6)	▲
Hong Kong SAR	85 (1.9)	▲
Singapore	85 (1.4)	▲
Russian Federation	84 (1.8)	▲
1 Kazakhstan	83 (3.1)	▲
Japan	80 (1.8)	▲
1 Lithuania	71 (2.3)	▲
1 Latvia	71 (2.6)	▲
Ukraine	68 (2.3)	▲
Armenia	66 (3.0)	▲
1 Georgia	60 (2.7)	▲
Hungary	51 (2.8)	▲
Slovak Republic	50 (2.3)	▲
Italy	49 (2.1)	▲
International Avg.	42 (0.4)	
Germany	41 (2.2)	
Czech Republic	41 (2.6)	
2 † United States	41 (1.8)	
Austria	41 (2.4)	
Slovenia	31 (2.0)	▼
‡ Netherlands	31 (2.6)	▼
Iran, Islamic Rep. of	29 (2.2)	▼
† Denmark	28 (2.5)	▼
England	28 (2.1)	▼
Colombia	25 (2.1)	▼
† Scotland	25 (2.2)	▼
Australia	22 (2.6)	▼
Sweden	18 (1.7)	▼
New Zealand	18 (1.6)	▼
Norway	18 (1.9)	▼
Tunisia	18 (1.8)	▼
Algeria	16 (1.9)	▼
Morocco	14 (1.7)	▼
El Salvador	13 (1.6)	▼
◆◆ Kuwait	10 (1.4)	▼
Yemen	7 (1.3)	▼
Qatar	5 (0.8)	▼
Benchmarking Participants		
2 Massachusetts, US	52 (3.8)	▲
2 † Minnesota, US	45 (3.9)	
2 Quebec, Canada	42 (2.9)	
◆◆ ‡ Dubai, UAE	32 (2.9)	▼
2 British Columbia, Canada	31 (2.2)	▼
2 Alberta, Canada	26 (2.4)	▼
2 Ontario, Canada	22 (2.8)	▼

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

▲ Percent significantly higher than international average
▼ Percent significantly lower than international average

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A).
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).
1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).
2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).
◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

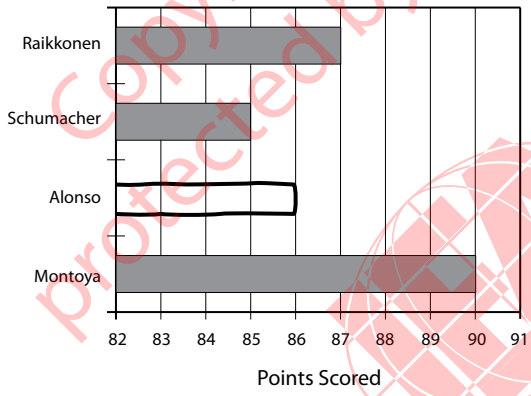
Exhibit 2.9 TIMSS 2007 High International Benchmark (550) of Mathematics Achievement – Example Item 4

TIMSS2007 Mathematics 4th Grade

Content Domain: Data Display

Description: Completes a bar graph to show a specified comparison.

This graph shows the points obtained by 4 drivers in the car racing championship. Montoya is in first place. Alonso is in third place. Draw a bar which shows how many points Alonso has scored.



The answer shown illustrates the type of student response that was given full credit

Country	Percent Full Credit	
Hong Kong SAR	77 (1.9)	▲
Chinese Taipei	72 (1.8)	▲
Japan	71 (2.0)	▲
Singapore	70 (2.1)	▲
1 Kazakhstan	63 (3.7)	▲
‡ Netherlands	55 (2.5)	▲
Sweden	54 (2.5)	▲
1 Latvia	54 (2.8)	▲
Australia	52 (3.0)	▲
England	52 (2.5)	▲
2 † United States	51 (1.7)	▲
Russian Federation	50 (3.2)	▲
† Denmark	48 (2.7)	▲
1 Lithuania	47 (2.9)	▲
Austria	46 (2.4)	▲
Hungary	45 (3.0)	▲
† Scotland	44 (2.4)	▲
New Zealand	42 (1.9)	▲
Slovenia	41 (2.1)	
Germany	40 (2.3)	
Slovak Republic	38 (2.3)	
International Avg.	38 (0.4)	
Italy	36 (2.0)	
Armenia	35 (2.5)	
Ukraine	32 (2.6)	▼
Czech Republic	30 (2.5)	▼
Norway	30 (2.1)	▼
1 Georgia	23 (2.7)	▼
Algeria	12 (1.6)	▼
Morocco	10 (1.7)	▼
Iran, Islamic Rep. of	10 (1.5)	▼
◆◆ Kuwait	9 (1.4)	▼
Colombia	8 (1.4)	▼
El Salvador	6 (0.9)	▼
Tunisia	4 (1.0)	▼
Qatar	4 (0.6)	▼
Yemen	1 (0.4)	▼
Benchmarking Participants		
2 Massachusetts, US	54 (2.8)	▲
2 † Minnesota, US	53 (2.7)	▲
2 Ontario, Canada	47 (2.6)	▲
2 Alberta, Canada	45 (2.7)	▲
2 British Columbia, Canada	44 (2.1)	▲
2 Quebec, Canada	42 (3.3)	
◆◆ ‡ Dubai, UAE	31 (2.2)	▼

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

▲ Percent significantly higher than international average
▼ Percent significantly lower than international average

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

Fourth Grade: Achievement at the Intermediate International Benchmark

Exhibit 2.10 shows the description of performance at the intermediate benchmark. Students reaching this benchmark applied basic mathematics knowledge to straightforward situations. For example, they were able to order, add, subtract, and multiply whole numbers. They also identified basic fractions and extended patterns from the first several terms to the next terms. They demonstrated familiarity with a range of two-dimensional shapes and could read and interpret different representations of the same data.

Example Item 5 at the intermediate benchmark is from the domain of geometric shapes and measures. Among the topics in this domain, students were expected to be able to draw angles, know and use elementary properties of geometric figures, and use coordinate systems. For example, as shown in Exhibit 2.11, students were given two adjacent sides of a rectangle on a grid and asked to draw the other two sides. On average across countries, more than half the students (54%) completed the rectangle correctly. The fourth graders in Hong Kong SAR outperformed the other participants, with 90 percent providing correct drawings. However, students in Japan, Chinese Taipei, the Russian Federation, the Czech Republic, and the Canadian province of Quebec also did well (more than 70% correct completions).

Exhibit 2.10 **Description of the TIMSS 2007 Intermediate International Benchmark (475) of Mathematics Achievement**

TIMSS2007 Mathematics 4th Grade

Intermediate International Benchmark – 475

Summary

Students can apply basic mathematical knowledge in straightforward situations. Students at this level demonstrate an understanding of whole numbers. They can extend simple numeric and geometric patterns. They are familiar with a range of two-dimensional shapes. They can read and interpret different representations of the same data.

Students at this level demonstrate an understanding of whole numbers. For example, they can order, add, subtract, and multiply whole numbers. They can identify the appropriate operations to solve multiplication and subtraction problems. Students can add and subtract one-place decimals and can identify an expression that represents a situation involving multiplication. They can identify the fraction that represents a given part-whole situation and select information to solve a simple proportion problem.

Students show understanding of patterns. They can extend patterns from the first several terms of numeric or geometric sequences to determine the next terms. They recognize multiples of single-digit numbers.

Students can order a set of angles by size and recognize that the area does not change when parts of a figure are rearranged. Students are familiar with a range of two-dimensional shapes. For example, they can name common geometrical shapes in a picture and draw shapes satisfying given conditions. They can identify a three-dimensional object given the pictorial representation of its faces as well as recognize and draw a line of symmetry. They can describe the movement from one position on a grid to another and identify a pattern generated by a quarter-turn clockwise.

Students can interpret information in bar charts and tables to solve simple problems. They can read and interpret different representations of the same data. For example, they can match data in pie charts to tables and bar graphs. Given verbal descriptions of data or problem situations, they can use that information to complete bar graphs and a two-by-two table. They can also use information to identify the number of symbols needed to complete a pictograph when the symbol represents more than one unit.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

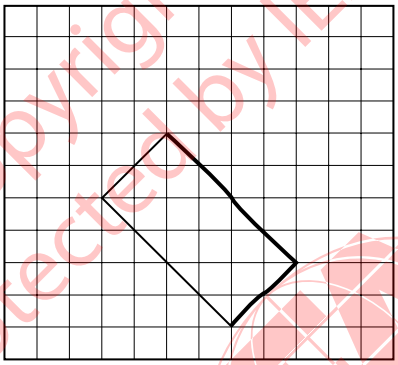
Exhibit 2.11 TIMSS 2007 Intermediate International Benchmark (475) of Mathematics Achievement – Example Item 5

TIMSS2007 Mathematics 4th Grade

Content Domain: Geometric Shapes and Measures

Description: Draws a rectangle given two adjacent sides.

Here are two sides of a rectangle. Draw the other two sides.



The answer shown illustrates the type of student response that was given full credit

Country	Percent Full Credit	
Hong Kong SAR	90 (1.4)	▲
Japan	78 (1.8)	▲
Chinese Taipei	77 (1.9)	▲
Russian Federation	75 (2.8)	▲
Czech Republic	72 (2.2)	▲
England	70 (1.9)	▲
Singapore	69 (2.3)	▲
Australia	68 (3.3)	▲
Slovak Republic	67 (2.5)	▲
Sweden	66 (2.0)	▲
† Denmark	66 (2.6)	▲
1 Kazakhstan	65 (4.6)	▲
Germany	62 (2.1)	▲
Hungary	62 (2.5)	▲
New Zealand	61 (1.8)	▲
‡ Netherlands	60 (2.6)	▲
Austria	60 (2.2)	▲
Armenia	58 (2.5)	
1 Lithuania	57 (2.6)	
Slovenia	57 (2.1)	
2 † United States	55 (1.7)	
† Scotland	55 (2.4)	
International Avg.	54 (0.4)	
Italy	54 (2.2)	
Iran, Islamic Rep. of	52 (2.9)	
Ukraine	50 (2.3)	
1 Georgia	46 (3.3)	▼
Norway	45 (2.7)	▼
Morocco	40 (2.9)	▼
Tunisia	31 (2.3)	▼
Colombia	27 (3.1)	▼
◆◆ Kuwait	24 (2.0)	▼
Algeria	24 (2.1)	▼
Qatar	16 (1.2)	▼
El Salvador	13 (1.5)	▼
Yemen	5 (1.0)	▼
1 Latvia	– –	
Benchmarking Participants		
2 Quebec, Canada	71 (2.5)	▲
2 Massachusetts, US	67 (2.9)	▲
2 Ontario, Canada	67 (2.4)	▲
2 † Minnesota, US	64 (3.4)	▲
2 British Columbia, Canada	58 (2.3)	
2 Alberta, Canada	50 (2.6)	
◆◆ ‡ Dubai, UAE	37 (2.5)	▼

Percent significantly higher than international average ▲
Percent significantly lower than international average ▼

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

A dash (–) indicates comparable data are not available.

Example Item 6 presented in Exhibit 2.12 is a word problem involving subtraction of two-digit whole numbers in a measurement context. It represents the type of item in the number domain likely to be answered correctly by students reaching the intermediate benchmark. Presented in a constructed-response format, 60 percent of the students, internationally on average, were able to provide the correct answer for the cat's weight. Students in Chinese Taipei outperformed all other participants, with 95 percent providing the correct response.

To illustrate the range of achievement at each benchmark, Exhibit 2.13 presents Example Item 7 concerning place value. This was an easier item for students at the intermediate benchmark and for students overall. On average internationally, 71 percent of students identified a three-digit number based on its description in units, tens, and hundreds. Fourteen countries and 3 benchmarking participants had at least 80 percent of their students selecting the correct answer.

Exhibit 2.12 TIMSS 2007 Intermediate International Benchmark (475) of Mathematics Achievement – Example Item 6

TIMSS2007 Mathematics 4th Grade

Content Domain: Number

Description: Solves a measurement word problem involving subtraction of two-digit numbers.

Al wanted to find how much his cat weighed. He weighed himself and noted that the scale read 57 kg. He then stepped on the scale holding his cat and found that it read 62 kg.

What was the weight of the cat in kilograms?

Answer: 5 kilograms

The answer shown illustrates the type of student response that was given full credit

Country	Percent Full Credit	
Chinese Taipei	95 (1.2)	▲
Singapore	87 (1.3)	▲
Russian Federation	86 (1.8)	▲
Hong Kong SAR	86 (1.7)	▲
1 Kazakhstan	85 (2.6)	▲
‡ Netherlands	85 (1.9)	▲
Japan	83 (2.0)	▲
1 Lithuania	81 (1.8)	▲
Austria	80 (2.1)	▲
Germany	80 (1.6)	▲
1 Latvia	80 (2.2)	▲
Czech Republic	76 (2.1)	▲
† Denmark	75 (2.2)	▲
Hungary	73 (2.4)	▲
Slovenia	69 (2.2)	▲
Italy	68 (2.0)	▲
Ukraine	68 (2.4)	▲
Norway	67 (2.4)	▲
Sweden	66 (2.4)	▲
Armenia	65 (2.5)	▲
† Scotland	64 (2.7)	
England	63 (2.2)	
Australia	61 (2.4)	
Slovak Republic	60 (2.3)	
International Avg.	60 (0.3)	
2 † United States	60 (1.7)	
1 Georgia	59 (2.7)	
New Zealand	53 (2.1)	▼
Iran, Islamic Rep. of	43 (2.7)	▼
Tunisia	28 (2.3)	▼
Algeria	23 (2.3)	▼
El Salvador	21 (1.7)	▼
Morocco	19 (2.1)	▼
Colombia	18 (2.1)	▼
◆◆ Kuwait	12 (1.5)	▼
Qatar	9 (1.0)	▼
Yemen	5 (1.1)	▼
Benchmarking Participants		
2 Massachusetts, US	76 (2.9)	▲
2 Quebec, Canada	70 (2.9)	▲
2 † Minnesota, US	68 (2.6)	▲
2 British Columbia, Canada	63 (2.5)	
2 Alberta, Canada	60 (2.4)	
2 Ontario, Canada	58 (3.1)	
◆◆ ‡ Dubai, UAE	44 (1.7)	▼

▲ Percent significantly higher than international average
▼ Percent significantly lower than international average

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A).
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).
1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).
2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).
◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.13 TIMSS 2007 Intermediate International Benchmark (475) of Mathematics Achievement – Example Item 7

TIMSS2007 Mathematics 4th Grade

Content Domain: Number

Description: Identifies a three-digit number described in units, tens, and hundreds.

Which number equals 3 ones + 2 tens + 4 hundreds?

Ⓐ 432

● 423

Ⓒ 324

Ⓓ 234

Country	Percent Correct	
Chinese Taipei	89 (1.4)	▲
‡ Netherlands	88 (1.8)	▲
Singapore	86 (1.5)	▲
Germany	84 (1.5)	▲
England	84 (1.8)	▲
Japan	83 (1.6)	▲
Hungary	82 (2.2)	▲
Russian Federation	82 (1.8)	▲
Hong Kong SAR	81 (2.0)	▲
1 Latvia	81 (2.2)	▲
Slovak Republic	81 (1.7)	▲
† Denmark	80 (2.0)	▲
Austria	80 (1.7)	▲
Sweden	80 (1.6)	▲
2 † United States	79 (1.4)	▲
◆◆ Kuwait	76 (1.8)	▲
Algeria	75 (2.2)	▲
1 Lithuania	73 (2.1)	
† Scotland	73 (2.3)	
Slovenia	73 (2.0)	
1 Kazakhstan	73 (3.3)	
Czech Republic	71 (2.3)	
International Avg.	71 (0.4)	
New Zealand	70 (2.0)	
Italy	69 (2.2)	
Norway	68 (2.4)	
Ukraine	67 (2.4)	
Australia	67 (2.5)	
Iran, Islamic Rep. of	67 (2.4)	
Morocco	65 (2.8)	▼
Qatar	60 (1.3)	▼
Tunisia	59 (2.6)	▼
Armenia	53 (2.5)	▼
1 Georgia	50 (3.0)	▼
Yemen	48 (2.4)	▼
El Salvador	20 (2.0)	▼
Colombia	20 (2.0)	▼
Benchmarking Participants		
2 Massachusetts, US	88 (2.1)	▲
2 † Minnesota, US	87 (3.0)	▲
2 Quebec, Canada	86 (1.6)	▲
2 Alberta, Canada	76 (2.0)	▲
2 Ontario, Canada	73 (2.6)	
2 British Columbia, Canada	73 (2.1)	
◆◆ ‡ Dubai, UAE	67 (2.4)	

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Percent significantly higher than international average ▲
Percent significantly lower than international average ▼

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

Fourth Grade: Achievement at the Low International Benchmark

Exhibit 2.14 presents the description of student achievement at the low benchmark. At this benchmark students demonstrated some basic mathematical knowledge, including adding and subtracting with whole numbers. They were familiar with simple number sentences. Within the domain of geometric shapes and measures, they knew about triangles and informal coordinate systems. They could read information from simple bar graphs and tables.

Example Item 8 presented in Exhibit 2.15 assesses a topic within the geometric shapes and measures domain that includes assessing students' ability to classify and compare geometric figures (e.g., by shape, size, or properties). This constructed-response item involving triangles was likely to be answered correctly by students reaching the low level. With an international average of 72 percent, it was relatively easy for students in many countries. In 24 countries, the two U.S. states, and the four Canadian provinces, at least three-fourths (75% or more) of the students indicated the correct triangles in the figure.

Exhibit 2.14 **Description of the TIMSS 2007 Low International Benchmark (400) of Mathematics Achievement**

TIMSS2007 Mathematics 4th Grade

Low International Benchmark – 400

Summary

Students have some basic mathematical knowledge. Students demonstrate an understanding of adding and subtracting with whole numbers. They demonstrate familiarity with triangles and informal coordinate systems. They can read information from simple bar graphs and tables.

Students at this level demonstrate an understanding of adding and subtracting with whole numbers. For example, they can add a four-digit and a three-digit whole number. They are familiar with numbers into the thousands. Students are familiar with simple number sentences. For example, they can find the missing number in a number sentence involving multiplication by a one-digit whole number.

Students can recognize a pair of parallel lines. They can identify two triangles with the same size and shape in a complex figure. They recognize the inverse relationship between size of a unit and the number of units needed to cover an area. They can locate positions using informal coordinates (e.g., A3 on a map or game board). Students can read information from simple bar graphs and tables.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

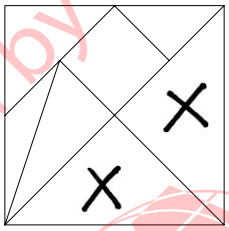
Exhibit 2.15 TIMSS 2007 Low International Benchmark (400) of Mathematics Achievement – Example Item 8

TIMSS2007 Mathematics 4th Grade

Content Domain: Geometric Shapes and Measures

Description: Identifies two triangles with the same size and shape in a complex figure.

The square is cut into 7 pieces. Put an X on each of the 2 triangles that are the same size and shape.



The answer shown illustrates the type of student response that was given full credit

Country	Percent Full Credit	
Hong Kong SAR	91 (1.2)	▲
Slovenia	91 (1.3)	▲
1 Lithuania	89 (1.3)	▲
† Denmark	88 (1.8)	▲
† Scotland	88 (1.4)	▲
England	88 (1.4)	▲
Singapore	88 (1.4)	▲
Japan	87 (1.4)	▲
Italy	87 (1.5)	▲
Sweden	86 (1.6)	▲
Australia	85 (1.9)	▲
2 † United States	85 (1.0)	▲
Slovak Republic	84 (1.9)	▲
Norway	84 (1.9)	▲
Czech Republic	83 (1.8)	▲
Austria	82 (2.1)	▲
Chinese Taipei	81 (1.9)	▲
Hungary	81 (2.1)	▲
1 Latvia	81 (2.1)	▲
Russian Federation	81 (2.6)	▲
New Zealand	81 (1.4)	▲
‡ Netherlands	79 (2.0)	▲
1 Kazakhstan	77 (2.2)	▲
Germany	76 (1.8)	▲
Armenia	74 (2.2)	
International Avg.	72 (0.3)	
Ukraine	67 (2.3)	▼
Colombia	59 (2.8)	▼
1 Georgia	59 (2.9)	▼
Iran, Islamic Rep. of	58 (2.7)	▼
El Salvador	50 (2.6)	▼
Algeria	44 (2.3)	▼
◆◆ Kuwait	40 (2.5)	▼
Morocco	39 (2.3)	▼
Tunisia	38 (2.2)	▼
Qatar	32 (1.5)	▼
Yemen	13 (1.5)	▼
Benchmarking Participants		
2 † Minnesota, US	90 (2.6)	▲
2 Ontario, Canada	90 (1.7)	▲
2 British Columbia, Canada	86 (1.7)	▲
2 Massachusetts, US	85 (2.6)	▲
2 Alberta, Canada	83 (1.9)	▲
2 Quebec, Canada	80 (2.3)	▲
◆◆ ‡ Dubai, UAE	67 (2.6)	

Percent significantly higher than international average ▲
Percent significantly lower than international average ▼

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

Eighth Grade: Achievement at the Advanced International Benchmark

At the eighth grade, TIMSS 2007 assessed four content domains with each given similar weight—number (30%), algebra (30%), geometry (20%), and data and chance (20%). According to the *TIMSS 2007 Mathematics Framework*, within the *number* domain, students should have developed computational fluency with fractions and decimals. They also should have developed an understanding of how operations relate to one another, and extended their understanding to operations with integers. By the eighth grade students, should be able to move flexibly among equivalent fractions, decimals, and percents and use proportional reasoning to solve problems. In *algebra*, students should have developed an understanding of linear relationships and the concept of variable. They are expected to use and simplify algebraic formulas, solve linear equations, inequalities, pairs of simultaneous equations involving two variables, and use a range of functions. They should be able to solve problems using algebraic models and to explain relationships involving algebraic concepts. In *geometry*, the focus is on using geometric properties and their relationships to solve problems. It also includes understanding coordinate representations and using spatial visualization skills to move between two- and three-dimensional shapes and their representations. The *data and chance* domain includes describing and comparing characteristics of data (shape, spread, and central tendency). Students should be able to use data to draw conclusions and make predications, and understand issues related to misinterpretation of data. Eighth grade students should understand elementary probability in terms of the likelihood of familiar events and use data from experiments to predict the chance of a given outcome.

Within each content domain, students needed to draw on a range of cognitive skills and go beyond the solution of routine problems to encompass unfamiliar situations, complex contexts, and multi-step problems. At the eighth grade, calculator use was permitted but not required. Because the availability of calculators varies widely, it would not be equitable to require calculator use when students in some countries may never have used them.

Similarly, however, it is not equitable to deprive students of the use of a familiar tool. The TIMSS 2007 guidelines emphasized giving students the best opportunity to operate in settings that mirrored their classroom experience. If students were used to having calculators for their classroom activities, then countries were encouraged to have students use them during the assessment. On the other hand, if students were not used to having calculators or not permitted to use them, then countries need not have permitted their use. Every effort was made to ensure that the test questions did not advantage or disadvantage students either way—with or without calculators.

Exhibit 2.16 describes performance at the Advanced International Benchmark. Students achieving at or above the advanced benchmark demonstrated fluency with many of the most complex topics in the mathematics framework. For example, they could organize and draw conclusions from information, make generalizations, and solve non-routine problems involving numeric, algebraic, and geometric concepts. They could use data from several sources to solve multi-step problems.

Exhibit 2.16 **Description of the TIMSS 2007 Advanced International Benchmark (625) of Mathematics Achievement**

TIMSS2007 Mathematics 8th Grade

Advanced International Benchmark – 625

Summary

Students can organize and draw conclusions from information, make generalizations, and solve non-routine problems. They can solve a variety of ratio, proportion, and percent problems. They can apply their knowledge of numeric and algebraic concepts and relationships. Students can express generalizations algebraically and model situations. They can apply their knowledge of geometry in complex problem situations. Students can derive and use data from several sources to solve multi-step problems.

Students can solve a variety of ratio, proportion, and percent problems. For example, they can identify equivalent ratios and determine the ratio of two parts of a whole. Given a number and the ratio of two of its parts, students can find the values of the parts. Given the dimensions of two rectangles, they can express the ratio of their areas. They can determine the percent reduction. They can apply their understanding of fractions in abstract situations. For example, given two points on a number line representing unspecified fractions, students can identify the point that represents their product.

Students demonstrate facility with algebraic representations. They can express generalizations either algebraically or in words. For example, they can express the nth term in number patterns. They can identify algebraic expressions that model situations in word problems and diagrams. They can add three simple algebraic expressions with different numerical denominators, subtract expressions, and identify the sum of three consecutive whole numbers given the middle number in general terms.

They can solve a variety of problems involving equations, formulas, and functions. For example, they can solve a linear inequality involving fractions, evaluate formulas, solve linear equations with negative terms, and write an equation to model a situation. They can identify the linear equation that is satisfied by two ordered pairs.

Students can combine knowledge of geometric figures to solve problems that involve more than one step. This knowledge involves parallel lines, similar triangles, the sum of angles in a triangle, interior and exterior angles, and angle bisectors. Students can describe figures in different orientations.

Students also can use their knowledge of geometric figures to solve a wide range of problems about length and area. For example, they can find the area of a triangle inscribed in a square and the area of a trapezoid inscribed in a rectangle. They can use the Pythagorean theorem to find the area of a triangle and the perimeter of a trapezoid. They can draw a new rectangle based on a given rectangle and find its area. They can use their knowledge of the area of a circle and of average rate to solve a problem. Students can combine information about lengths of segments on a line to solve a distance problem.

Students can derive and use information from several sources to solve multi-step problems. They can predict outcomes from data. They demonstrate understanding of the meaning of averages and can determine the median. Students can interpolate and extrapolate data from tables and graphs.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Exhibit 2.17 shows the type of item likely to be answered correctly by students reaching the Advanced International Benchmark. Example Item 1 is a word problem that can be expressed as two linear equations with two variables. Students were asked to show their work. Although the example student response illustrates an algebraic approach to solving the problem, using algebra was not required to receive full credit. Still, this was among one of the most difficult items in the eighth grade assessment. On average, 18 percent of the students across countries received full credit for their responses. The country-by-country results, however, give an indication of why the Asian countries outperformed the other participating countries at the eighth grade. Two-thirds (68%) of the students in Chinese Taipei and Korea solved this problem as did more than half the students in Singapore (59%) and Hong Kong SAR (53%).

Example Item 2 in Exhibit 2.18 is from the geometry domain. It required students to use the properties of isosceles and right triangles to find the measure of an angle. Internationally on average, 32 percent of the eighth grade students selected the correct answer. Once again, the Asian countries had higher achievement by a considerable margin, with 69 to 75 correct. The next best result was 50 percent correct for Armenia. The remaining countries with above average performance included England, Malta, Lebanon, Hungary, and the Canadian province of Quebec.

Exhibit 2.17 TIMSS 2007 Advanced International Benchmark (625) of Mathematics Achievement – Example Item 1

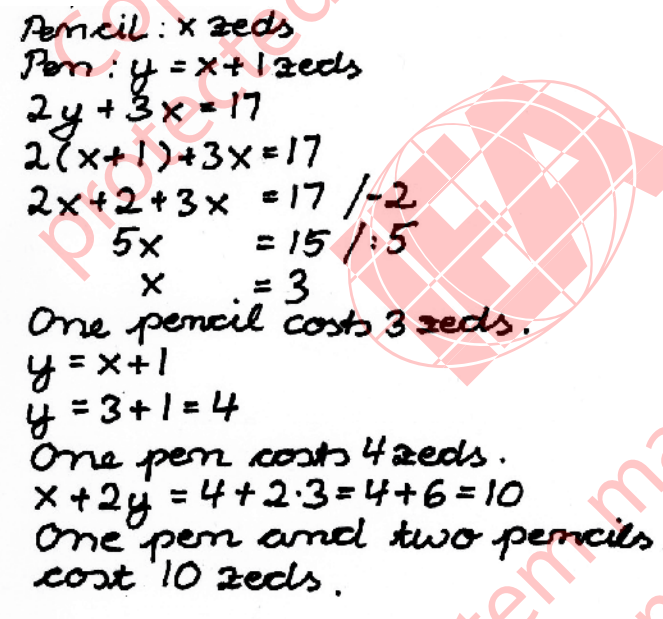
TIMSS2007 Mathematics 8th Grade

Content Domain: Algebra

Description: Solves a word problem that can be expressed as two linear equations with two variables.

Joe knows that a pen costs 1 zed more than a pencil.
His friend bought 2 pens and 3 pencils for 17 zeds.
How many zeds will Joe need to buy 1 pen and 2 pencils?

Show your work.



The answer shown illustrates the type of student response that was given full credit

Country	Percent Full Credit	
Chinese Taipei	68 (2.3)	▲
Korea, Rep. of	68 (2.1)	▲
Singapore	59 (1.9)	▲
† Hong Kong SAR	53 (2.8)	▲
Japan	42 (1.9)	▲
2 † United States	37 (2.0)	▲
Australia	36 (2.6)	▲
† England	34 (2.5)	▲
Sweden	34 (1.8)	▲
Slovenia	30 (2.0)	▲
† Scotland	29 (1.9)	▲
Czech Republic	25 (2.1)	▲
Hungary	24 (2.2)	▲
3 Israel	24 (2.5)	▲
Malta	21 (1.6)	▲
Armenia	21 (2.6)	
Italy	19 (1.9)	
Russian Federation	19 (1.6)	
Norway	18 (1.7)	
Turkey	18 (2.0)	
International Avg.	18 (0.2)	
Bulgaria	17 (1.8)	
1 Lithuania	15 (1.7)	
1 2 Serbia	15 (1.7)	
Romania	14 (1.8)	
Malaysia	14 (1.7)	▼
Thailand	13 (1.4)	▼
Cyprus	11 (1.4)	▼
Ukraine	11 (1.2)	▼
Colombia	9 (1.0)	▼
1 Georgia	8 (1.8)	▼
Indonesia	8 (1.3)	▼
Bosnia and Herzegovina	8 (1.4)	▼
Tunisia	6 (0.9)	▼
Lebanon	5 (1.1)	▼
Jordan	5 (1.0)	▼
Oman	4 (0.8)	▼
Bahrain	4 (0.8)	▼
Iran, Islamic Rep. of	3 (0.8)	▼
Saudi Arabia	3 (0.8)	▼
Syrian Arab Republic	3 (0.7)	▼
El Salvador	2 (0.4)	▼
Algeria	2 (0.6)	▼
Egypt	2 (0.5)	▼
◆◆ Kuwait	2 (0.6)	▼
Botswana	2 (0.5)	▼
Qatar	2 (0.4)	▼
Ghana	1 (0.5)	▼
Palestinian Nat'l Auth.	1 (0.7)	▼
‡ Morocco	2 (1.3)	▼
Benchmarking Participants		
2 Massachusetts, US	48 (2.6)	▲
2 † Minnesota, US	47 (3.5)	▲
3 British Columbia, Canada	39 (2.3)	▲
2 Ontario, Canada	38 (3.1)	▲
3 Quebec, Canada	32 (2.2)	▲
Basque Country, Spain	22 (2.4)	
◆◆ ‡ Dubai, UAE	16 (2.0)	

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

▲ Percent significantly higher than international average
▼ Percent significantly lower than international average

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

‡ Did not satisfy guidelines for sample participation rates (see Appendix A).

1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

3 National Defined Population covers less than 90% of National Target Population (but at least 77%, see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

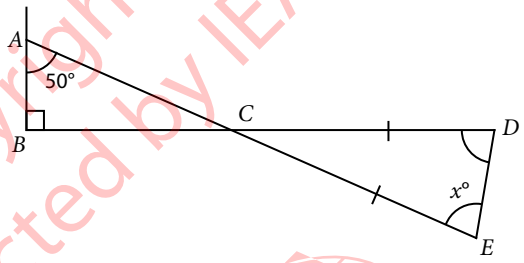
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.18 TIMSS 2007 Advanced International Benchmark (625) of Mathematics Achievement – Example Item 2

TIMSS2007 Mathematics 8th Grade

Content Domain: Geometry

Description: Uses properties of isosceles and right triangles to find the measure of an angle.



In this diagram, $CD = CE$.
What is the value of x?

Ⓐ 40
Ⓑ 50
Ⓒ 60
● 70

Country	Percent Correct	
Singapore	75 (1.7)	▲
Chinese Taipei	73 (2.2)	▲
Korea, Rep. of	73 (1.8)	▲
Japan	71 (1.9)	▲
† Hong Kong SAR	69 (2.8)	▲
Armenia	50 (2.7)	▲
† England	42 (2.8)	▲
Malta	40 (1.7)	▲
Lebanon	40 (3.0)	▲
Hungary	38 (2.6)	▲
Bulgaria	36 (2.6)	
Thailand	36 (2.1)	
Malaysia	36 (2.7)	
1 Lithuania	35 (2.1)	
Norway	34 (2.3)	
Russian Federation	34 (2.3)	
3 Israel	33 (2.4)	
Turkey	32 (2.1)	
International Avg.	32 (0.3)	
Australia	32 (2.8)	
Italy	31 (2.3)	
Sweden	31 (2.0)	
† Scotland	31 (2.0)	
1 2 Serbia	30 (2.2)	
Jordan	29 (2.0)	
Tunisia	28 (2.2)	
Egypt	28 (2.2)	
Ukraine	28 (2.0)	▼
Cyprus	28 (2.0)	▼
Czech Republic	27 (1.7)	▼
2 † United States	26 (1.4)	▼
Slovenia	25 (2.4)	▼
1 Georgia	25 (2.9)	▼
Romania	24 (2.4)	▼
Algeria	23 (1.7)	▼
Bosnia and Herzegovina	22 (1.8)	▼
Iran, Islamic Rep. of	21 (2.1)	▼
Indonesia	19 (2.0)	▼
Oman	19 (1.7)	▼
Saudi Arabia	18 (1.9)	▼
Palestinian Nat'l Auth.	18 (1.6)	▼
◆◆ Kuwait	17 (1.5)	▼
Bahrain	17 (1.4)	▼
Qatar	17 (1.2)	▼
Colombia	17 (1.4)	▼
El Salvador	16 (1.5)	▼
Syrian Arab Republic	16 (1.8)	▼
Botswana	15 (1.5)	▼
Ghana	14 (1.5)	▼
‡ Morocco	19 (1.7)	▼
Benchmarking Participants		
3 Quebec, Canada	49 (3.0)	▲
2 Ontario, Canada	37 (2.7)	
2 Massachusetts, US	35 (4.2)	
2 † Minnesota, US	34 (2.9)	
3 British Columbia, Canada	34 (2.1)	
Basque Country, Spain	30 (2.9)	
◆◆ ‡ Dubai, UAE	22 (2.4)	▼

▲ Percent significantly higher than international average
▼ Percent significantly lower than international average

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A).
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).
‡ Did not satisfy guidelines for sample participation rates (see Appendix A).
1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).
2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).
3 National Defined Population covers less than 90% of National Target Population (but at least 77%, see Appendix A).
◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Eighth Grade: Achievement at the High International Benchmark

Exhibit 2.19 describes performance at the High International Benchmark. Students reaching this level applied their understanding and knowledge in a variety of relatively complex situations. They were able to relate fractions, decimals, and percents and operate with negative integers. They demonstrated the ability to work with algebraic expressions and linear equations, and used their knowledge of geometric properties to solve problems. They were able to compare and integrate several sets of data, and to solve simple problems involving outcomes and probabilities.

Example Item 3 in Exhibit 2.20 shows the type of algebra problem likely to be solved by students reaching the high benchmark. This word problem involving the solving of a linear equation was answered correctly, on average, by 34 percent of the students across countries. At least half the students solved the problem correctly in Chinese Taipei (75%), Korea (71%), Hong Kong SAR (67%), Japan (65%), Armenia (63%), Serbia (57%), the United States (57%), Singapore (56%), the Russian Federation (53%), Lithuania (50%), and the two U.S. states of Massachusetts and Minnesota (69 and 62%, respectively).

Exhibit 2.21 presents an item from the data and chance domain exemplifying the high benchmark. More specifically, Example Item 4 assesses students' ability to read, organize, and display data using various types of graphs, in this case a bar graph and a pie chart. Students needed to draw the bar graph in its entirety to receive full credit, a task completed by 27 percent of students, on average internationally. Students in Korea (76%) and Singapore (75%) responded correctly to this constructed-response item.

Exhibit 2.19 **Description of the TIMSS 2007 High International Benchmark (550) of Mathematics Achievement**

TIMSS2007 Mathematics 8th Grade

High International Benchmark – 550

Summary

Students can apply their understanding and knowledge in a variety of relatively complex situations. They can relate and compute with fractions, decimals, and percents, operate with negative integers, and solve word problems involving proportions. Students can work with algebraic expressions and linear equations. Students use knowledge of geometric properties to solve problems, including area, volume, and angles. They can interpret data in a variety of graphs and table and solve simple problems involving probability.

Students can solve relatively complex problems, including those involving proportions and percents. Students can relate fractions, decimals, and percents to each other. They can compute with fractions and negative integers. Students show understanding of scales, number lines, and exponents. They can identify the prime factorization of a given number.

Students can solve simple algebraic problems. Students can extend sequences given in numeric and geometric forms, and find later specified terms. They also can simplify an algebraic expression by combining like terms, identify equivalent expressions, and evaluate an expression involving parentheses and negative terms. Students can identify an algebraic expression that corresponds to a simple situation, add algebraic expressions, and recognize the product of two algebraic expressions in one variable that involves exponents.

Students can solve a linear equation in one variable, identify the solution to a pair of simultaneous linear equations, and identify the quantity that satisfies two inequalities represented on a balance. They can identify the linear equation that describes the relationship between ordered pairs given in a table or shown on a graph. They can use a formula to determine the value of one variable given the value of the other.

Students can solve problems involving perimeter, area, and volume. For example, they can find the perimeter of a square given its area and find the area of an irregular figure formed by rectangles. Students can find the number of cubes needed to fill a hole in a given shape, identify a net of a cube, and calculate the volume of a rectangular prism given its net.

Students can use properties of lines, angles, and triangles to solve problems involving measures of angles. Students can produce a drawing that meets given angle specifications. They can recognize rotations and reflections, visualize a figure cut from a folded piece of paper, and draw the missing half of a symmetrical figure.

Students can solve simple problems involving outcomes and probabilities. They can calculate means. They can read and interpret data in pie graphs, line graphs, and bar graphs to solve problems. They can construct pie charts representing given data. They can compare and integrate several sets of data to determine which meet given conditions.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Exhibit 2.20 TIMSS 2007 High International Benchmark (550) of Mathematics Achievement – Example Item 3

TIMSS2007 Mathematics 8th Grade

Content Domain: Algebra

Description: Solves a linear equation given in a word problem.

In Zedland, total shipping charges to ship an item are given by the equation $y = 4x + 30$, where x is the weight in grams and y is the cost in zeds. If you have 150 zeds, how many grams can you ship?

Ⓐ 630

Ⓑ 150

Ⓒ 120

● 30

Country	Percent Correct	
Chinese Taipei	75 (2.0)	▲
Korea, Rep. of	71 (1.8)	▲
† Hong Kong SAR	67 (2.9)	▲
Japan	65 (2.1)	▲
Armenia	63 (2.7)	▲
1 2 Serbia	57 (2.9)	▲
2 † United States	57 (2.2)	▲
Singapore	56 (1.7)	▲
Russian Federation	53 (3.1)	▲
1 Lithuania	50 (2.5)	▲
Bulgaria	47 (2.4)	▲
Romania	44 (2.8)	▲
Malta	41 (1.7)	▲
Ukraine	39 (2.5)	▲
Hungary	39 (2.2)	▲
Czech Republic	39 (2.5)	▲
† England	39 (2.8)	
Bosnia and Herzegovina	37 (2.6)	
Slovenia	36 (2.2)	
Jordan	35 (2.5)	
Turkey	35 (2.1)	
Cyprus	35 (1.9)	
Lebanon	34 (2.6)	
International Avg.	34 (0.3)	
3 Israel	32 (2.5)	
Ghana	26 (1.9)	▼
† Scotland	26 (2.4)	▼
Australia	26 (2.0)	▼
Indonesia	26 (1.9)	▼
Thailand	26 (2.3)	▼
Bahrain	25 (2.0)	▼
1 Georgia	25 (2.7)	▼
Italy	24 (2.0)	▼
Malaysia	24 (2.1)	▼
Egypt	24 (1.9)	▼
Botswana	23 (1.7)	▼
Sweden	23 (1.5)	▼
Oman	23 (2.1)	▼
Iran, Islamic Rep. of	21 (2.2)	▼
Syrian Arab Republic	19 (1.9)	▼
Colombia	19 (1.5)	▼
Tunisia	19 (1.8)	▼
El Salvador	17 (1.7)	▼
Palestinian Nat'l Auth.	16 (1.8)	▼
Algeria	16 (1.4)	▼
◆◆ Kuwait	15 (1.5)	▼
Saudi Arabia	14 (1.9)	▼
Qatar	12 (1.1)	▼
Norway	10 (1.1)	▼
‡ Morocco	15 (2.9)	▼
Benchmarking Participants		
2 Massachusetts, US	69 (2.8)	▲
2 † Minnesota, US	62 (3.3)	▲
3 Quebec, Canada	44 (2.9)	▲
2 Ontario, Canada	42 (2.5)	▲
3 British Columbia, Canada	42 (2.7)	▲
◆◆ ‡ Dubai, UAE	39 (2.5)	▲
Basque Country, Spain	36 (3.1)	

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

▲ Percent significantly higher than international average

▼ Percent significantly lower than international average

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

‡ Did not satisfy guidelines for sample participation rates (see Appendix A).

1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

3 National Defined Population covers less than 90% of National Target Population (but at least 77%, see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

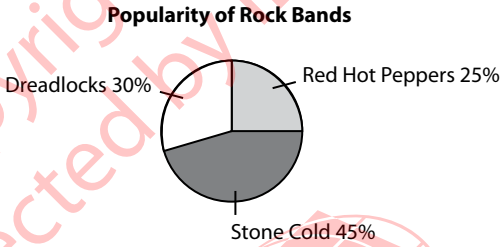
Exhibit 2.21 TIMSS 2007 High International Benchmark (550) of Mathematics Achievement – Example Item 4

TIMSS2007 Mathematics 8th Grade

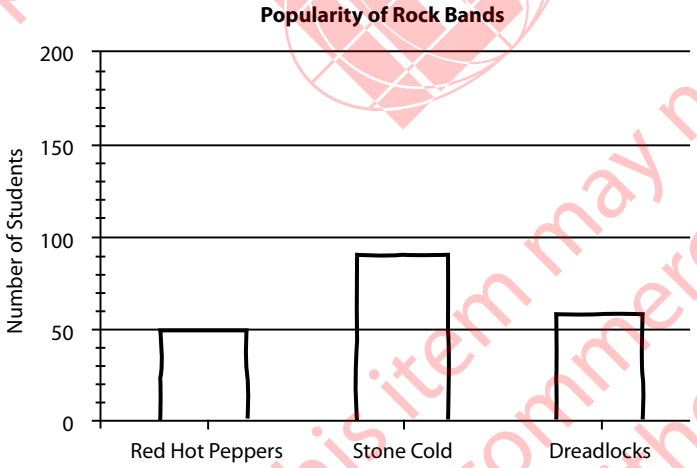
Content Domain: Data and Chance

Description: Uses the information in a pie chart showing percentages to draw a bar chart.

The results of a survey of 200 students are shown in the pie chart.



Make a bar chart showing the number of students in each category in the pie chart.



The answer shown illustrates the type of student response that was given full credit

Country	Percent Full Credit	
Korea, Rep. of	76 (2.0)	▲
Singapore	75 (1.7)	▲
Chinese Taipei	70 (2.1)	▲
Japan	68 (1.8)	▲
† Hong Kong SAR	66 (2.6)	▲
Sweden	56 (2.2)	▲
1 Lithuania	51 (2.4)	▲
Hungary	48 (2.6)	▲
Czech Republic	45 (2.4)	▲
† England	45 (2.7)	▲
Slovenia	44 (2.5)	▲
Norway	41 (2.1)	▲
2 † United States	40 (1.9)	▲
Malta	40 (1.9)	▲
Australia	38 (2.7)	▲
† Scotland	38 (2.3)	▲
Russian Federation	35 (2.5)	▲
Malaysia	35 (2.4)	▲
Cyprus	33 (2.3)	▲
3 Israel	31 (2.4)	
Romania	29 (2.7)	
International Avg.	27 (0.3)	
1 2 Serbia	27 (2.8)	
Italy	27 (1.9)	
Thailand	26 (2.2)	
Ukraine	24 (2.2)	
Bulgaria	23 (2.5)	
Jordan	22 (2.0)	▼
Turkey	17 (1.7)	▼
Lebanon	15 (2.0)	▼
1 Georgia	15 (2.6)	▼
Indonesia	14 (1.3)	▼
Bosnia and Herzegovina	13 (2.0)	▼
Armenia	12 (1.8)	▼
Iran, Islamic Rep. of	11 (1.5)	▼
Colombia	10 (1.8)	▼
Egypt	10 (1.3)	▼
Bahrain	9 (1.2)	▼
Tunisia	8 (1.1)	▼
Palestinian Nat'l Auth.	8 (1.3)	▼
Botswana	7 (0.9)	▼
Syrian Arab Republic	7 (1.1)	▼
Oman	6 (1.0)	▼
El Salvador	4 (0.8)	▼
Qatar	4 (0.6)	▼
Saudi Arabia	3 (0.9)	▼
Algeria	3 (0.8)	▼
◆◆ Kuwait	3 (0.8)	▼
Ghana	2 (0.6)	▼
‡ Morocco	9 (1.9)	▼
Benchmarking Participants		
2 † Minnesota, US	61 (4.2)	▲
3 Quebec, Canada	61 (2.9)	▲
2 Massachusetts, US	59 (3.7)	▲
3 British Columbia, Canada	50 (2.3)	▲
2 Ontario, Canada	48 (3.3)	▲
Basque Country, Spain	45 (2.7)	▲
◆◆ ‡ Dubai, UAE	21 (3.1)	

Percent significantly higher than international average ▲
Percent significantly lower than international average ▼

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

‡ Did not satisfy guidelines for sample participation rates (see Appendix A).

1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

3 National Defined Population covers less than 90% of National Target Population (but at least 77%, see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Eighth Grade: Achievement at the Intermediate International Benchmark

Exhibit 2.22 describes students' performance at the Intermediate International Benchmark. Students reaching this benchmark were able to apply basic mathematical knowledge in relatively straightforward situations. For example, they solved one-step word problems involving addition and multiplication of decimals, and worked with familiar fractions. They demonstrated understanding of simple algebraic relationships, properties of triangles, and basic geometric concepts. They read and interpreted graphs and tables, and recognized basic notions of likelihood.

Exhibit 2.23 presents Example Item 5 from the number domain. This item about representations of fractions was typically answered correctly by students at the intermediate benchmark. Students needed to recognize that of the circular models presented, the only one showing less than ½ best represents the fractional part shown in a rectangle as 5/12. On average internationally, 63 percent of the eighth-grade students answered correctly. The Korean students were the top-performers with 89 percent answering correctly.

Example Item 6 presented in Exhibit 2.24 also illustrates the type of item likely to be answered correctly by students reaching the intermediate benchmark. Students were asked to use the properties of an isosceles triangle to identify the point on the grid that completes the triangle. More than half (57%) did so, on average internationally. Slovenia joined Chinese Taipei, Korea, Japan, and Hong Kong SAR in having at least 80 percent of their students answer correctly.

Exhibit 2.22 **Description of the TIMSS 2007 Intermediate International Benchmark (475) of Mathematics Achievement**

TIMSS2007 Mathematics 8th Grade

Intermediate International Benchmark – 475

Summary

Students can apply basic mathematical knowledge in straightforward situations. They can add and multiply to solve one-step word problems involving whole numbers and decimals. They can work with familiar fractions. They understand simple algebraic relationships. They demonstrate understanding of properties of triangles and basic geometric concepts. They can read and interpret graphs and tables. They recognize basic notions of likelihood.

Students can apply basic mathematical knowledge in straightforward situations. For example, they can solve word problems involving addition and multiplication of decimals. They can find equivalent ratios and proportions. Students understand that the whole is 100 percent and can approximate the quantity remaining after an amount is reduced by a given percent. They have basic understanding of simple exponential notation and negative integers.

Students show some understanding of decimals and fractions. For example, they can solve word problems involving decimals. They can round two-place decimals to whole numbers. They can select the smallest fraction from a set of commonly used fractions. They can identify a circular model of a fraction that best approximates a given rectangular model of the same fraction.

Students at this level know the meaning of simple algebraic expressions and have some knowledge of linear equations. They can extend number patterns to the next few terms.

Students can use knowledge of basic geometric properties to solve problems involving triangles. For example, they can draw a triangle with an area twice that of a given rectangle. The can locate points on grids and complete a two-dimensional drawing of a three-dimensional object.

Students can locate and interpret data presented in tables, bar graphs, pie graphs, and line graphs. For example, they can select the pie graph that represents data in a table of percentages. Given two straight line graphs, they can select the one that models a situation described in words as well as interpret the graphs and use their intersection to solve a problem. They have some understanding of the likelihood of an event.

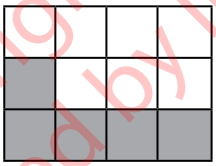
SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Exhibit 2.23 TIMSS 2007 Intermediate International Benchmark (475) of Mathematics Achievement – Example Item 5

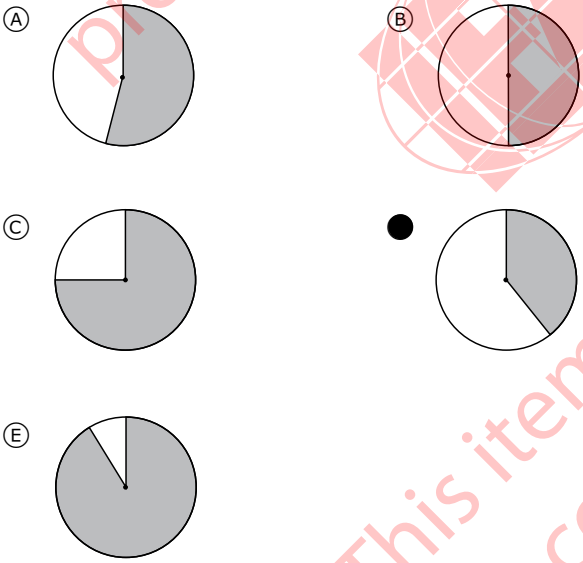
TIMSS2007 Mathematics 8th Grade

Content Domain: Number

Description: Identifies a circular model of a fraction that best approximates a given rectangular model of the same fraction.



Which circle has approximately the same fraction of its area shaded as the rectangle above?



Country	Percent Correct	
Korea, Rep. of	89 (1.3)	▲
Japan	85 (1.8)	▲
† Hong Kong SAR	82 (2.3)	▲
Chinese Taipei	81 (1.7)	▲
2 † United States	81 (1.3)	▲
Singapore	81 (1.7)	▲
Sweden	77 (1.8)	▲
† England	77 (2.2)	▲
Hungary	77 (2.2)	▲
Australia	75 (2.3)	▲
Czech Republic	74 (1.9)	▲
1 Lithuania	74 (2.3)	▲
Malaysia	74 (2.0)	▲
† Scotland	74 (2.0)	▲
Norway	73 (2.2)	▲
Russian Federation	73 (2.2)	▲
Slovenia	72 (2.2)	▲
Malta	72 (1.6)	▲
Italy	70 (2.3)	▲
Cyprus	70 (2.0)	▲
Thailand	68 (1.9)	▲
3 Israel	66 (2.6)	
Turkey	64 (2.4)	
Ukraine	63 (2.4)	
International Avg.	63 (0.3)	
Romania	62 (2.8)	
Bahrain	61 (2.0)	
Tunisia	61 (2.3)	
1 2 Serbia	60 (2.7)	
Bulgaria	59 (3.0)	
◆◆ Kuwait	56 (2.0)	▼
Iran, Islamic Rep. of	55 (2.2)	▼
Lebanon	55 (3.0)	▼
Colombia	54 (2.9)	▼
Algeria	54 (1.8)	▼
Bosnia and Herzegovina	53 (2.6)	▼
Indonesia	52 (2.3)	▼
Syrian Arab Republic	51 (2.3)	▼
1 Georgia	51 (3.7)	▼
Jordan	48 (2.2)	▼
El Salvador	47 (2.2)	▼
Oman	46 (2.1)	▼
Armenia	46 (2.8)	▼
Qatar	44 (1.8)	▼
Egypt	44 (2.3)	▼
Saudi Arabia	41 (2.3)	▼
Botswana	41 (1.7)	▼
Palestinian Nat'l Auth.	41 (2.4)	▼
Ghana	34 (2.3)	▼
‡ Morocco	56 (3.0)	▼
Benchmarking Participants		
2 † Minnesota, US	84 (1.9)	▲
2 Massachusetts, US	80 (2.7)	▲
3 British Columbia, Canada	80 (1.6)	▲
3 Quebec, Canada	79 (2.2)	▲
Basque Country, Spain	77 (2.9)	▲
2 Ontario, Canada	75 (2.1)	▲
◆◆ ‡ Dubai, UAE	60 (2.0)	

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Percent significantly higher than international average ▲
Percent significantly lower than international average ▼

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

‡ Did not satisfy guidelines for sample participation rates (see Appendix A).

1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

3 National Defined Population covers less than 90% of National Target Population (but at least 77%, see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

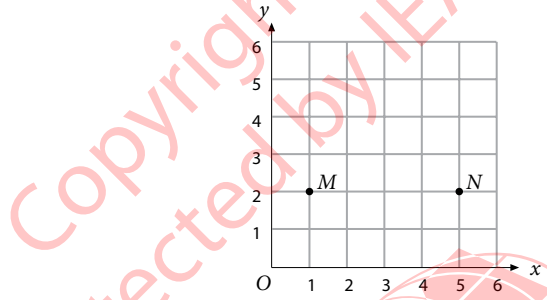
TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Exhibit 2.24 TIMSS 2007 Intermediate International Benchmark (475) of Mathematics Achievement – Example Item 6

TIMSS2007 Mathematics 8th Grade

Content Domain: Geometry

Description: Uses properties of an isosceles triangle to identify the coordinates of a point on a grid.



Two points M and N are shown in the figure above. John is looking for a point P such that MNP is an isosceles triangle. Which of these points could be point P?

- (A) (3,5)
- (B) (3,2)
- (C) (1,5)
- (D) (5,1)

Country	Percent Correct	
Chinese Taipei	86 (1.5)	▲
Korea, Rep. of	82 (1.6)	▲
Japan	81 (1.6)	▲
† Hong Kong SAR	80 (2.6)	▲
Slovenia	80 (2.2)	▲
1 Lithuania	78 (1.9)	▲
Singapore	77 (2.0)	▲
Russian Federation	77 (2.3)	▲
Hungary	74 (2.1)	▲
Malaysia	73 (1.8)	▲
† Scotland	68 (2.1)	▲
Ukraine	68 (2.4)	▲
1 2 Serbia	67 (2.8)	▲
Malta	65 (1.5)	▲
Lebanon	65 (2.9)	▲
3 Israel	64 (2.9)	▲
† England	63 (2.2)	▲
Czech Republic	63 (2.3)	▲
◆◆ Kuwait	63 (2.6)	▲
Romania	62 (2.6)	▲
Italy	61 (2.1)	
Bahrain	59 (2.1)	
Indonesia	59 (2.5)	
Oman	59 (2.0)	
Bulgaria	58 (2.8)	
Syrian Arab Republic	58 (2.4)	
Egypt	58 (2.0)	
International Avg.	57 (0.3)	
Norway	56 (2.3)	
Bosnia and Herzegovina	55 (2.5)	
Thailand	55 (2.2)	
Jordan	54 (2.5)	
Armenia	53 (2.9)	
Australia	51 (2.3)	▼
Cyprus	51 (2.1)	▼
Algeria	50 (2.0)	▼
Iran, Islamic Rep. of	49 (2.5)	▼
Sweden	48 (2.0)	▼
Saudi Arabia	46 (2.3)	▼
2 † United States	45 (1.6)	▼
1 Georgia	41 (3.0)	▼
Palestinian Nat'l Auth.	41 (2.1)	▼
Turkey	38 (2.0)	▼
Qatar	38 (1.5)	▼
El Salvador	33 (1.9)	▼
Colombia	30 (2.1)	▼
Botswana	30 (1.7)	▼
Tunisia	26 (1.9)	▼
Ghana	26 (1.6)	▼
‡ Morocco	45 (3.1)	▼
Benchmarking Participants		
3 Quebec, Canada	60 (2.7)	
2 Ontario, Canada	50 (3.2)	▼
◆◆ ‡ Dubai, UAE	50 (2.6)	▼
3 British Columbia, Canada	50 (2.3)	▼
2 Massachusetts, US	49 (3.5)	▼
Basque Country, Spain	49 (2.7)	▼
2 † Minnesota, US	46 (3.6)	▼

▲ Percent significantly higher than international average

▼ Percent significantly lower than international average

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

‡ Did not satisfy guidelines for sample participation rates (see Appendix A).

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2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

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◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Eighth Grade: Achievement at the Low International Benchmark

Exhibit 2.25 describes performance at the low benchmark. The few items that anchored at this level provided some evidence that students have an elementary knowledge of whole numbers and decimals, operations, and basic graphs.

Example Items 7 and 8 are presented in Exhibits 2.26 and 2.27, respectively. They illustrate the types of items likely to be answered correctly by students reaching the low benchmark. Example Item 7 is a word problem that can be solved through proportional reasoning with whole numbers. On average internationally, this multiple-choice item was answered correctly by 79 percent of the students. Example Item 8 in the data and chance domain asked students to match the data in a line graph with the data in a table. The temperatures in the table rise and fall from day to day, and students needed to recognize that only one line graph has this up and down pattern. Seventy-two percent answered correctly, on average internationally.

On Example Item 8, Slovenia and Lithuania joined Korea, Japan, Singapore, and Chinese Taipei in having 90 percent or more of students answer correctly, along with the two U.S. states, the Canadian provinces of Quebec and Ontario, and the Basque Country of Spain. Seven more countries and the Canadian province of British Columbia followed closely with 87 to 89 percent correct.

Exhibit 2.25 **Description of the TIMSS 2007 Low International Benchmark (400) of Mathematics Achievement**

TIMSS2007 Mathematics 8th Grade

Low International Benchmark – 400

Summary

Students have some knowledge of whole numbers and decimals, operations, and basic graphs.

The few items at this level provide some evidence that students have an elementary understanding of whole numbers and decimals and can do basic computations. They can select a bar graph or line graph that displays a given set of data and can complete a simple bar graph.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Exhibit 2.26 TIMSS 2007 Low International Benchmark (400) of Mathematics Achievement – Example Item 7

TIMSS2007 Mathematics 8th Grade

Content Domain: Number

Description: Solves a word problem involving a proportion with unit ratio.

On a school trip there was 1 teacher for every 12 students. If 108 students went on the trip, how many teachers were on the trip?

Ⓐ 7
Ⓑ 8
● 9
Ⓓ 10

Country	Percent Correct	
Korea, Rep. of	97 (0.6)	▲
Singapore	95 (1.0)	▲
1 Lithuania	95 (0.9)	▲
Chinese Taipei	95 (1.0)	▲
Japan	94 (1.0)	▲
† Hong Kong SAR	94 (1.4)	▲
Hungary	93 (1.1)	▲
Czech Republic	93 (1.5)	▲
Russian Federation	92 (1.5)	▲
2 † United States	91 (1.0)	▲
Malaysia	90 (1.4)	▲
1 2 Serbia	89 (1.5)	▲
Italy	89 (1.2)	▲
Slovenia	89 (1.2)	▲
Australia	88 (1.6)	▲
Sweden	87 (1.2)	▲
Lebanon	86 (1.8)	▲
Malta	86 (1.4)	▲
Bosnia and Herzegovina	85 (1.6)	▲
Ukraine	85 (1.5)	▲
Norway	84 (1.9)	▲
† England	83 (1.8)	▲
Cyprus	82 (1.6)	
Thailand	81 (1.7)	
3 Israel	81 (2.1)	
Armenia	80 (1.8)	
† Scotland	80 (1.9)	
Romania	80 (2.3)	
Bulgaria	79 (2.3)	
International Avg.	79 (0.3)	
Algeria	79 (1.6)	
Indonesia	78 (2.0)	
Tunisia	78 (2.0)	
Iran, Islamic Rep. of	77 (2.0)	
Turkey	77 (2.0)	
1 Georgia	77 (3.6)	
Jordan	76 (2.1)	
Egypt	72 (2.1)	▼
Palestinian Nat'l Auth.	65 (2.2)	▼
Syrian Arab Republic	64 (2.5)	▼
Oman	64 (2.1)	▼
Colombia	62 (1.7)	▼
El Salvador	61 (2.3)	▼
Bahrain	61 (2.0)	▼
Botswana	56 (2.1)	▼
Qatar	53 (1.7)	▼
Ghana	51 (1.8)	▼
Saudi Arabia	48 (2.6)	▼
◆◆ Kuwait	41 (2.0)	▼
‡ Morocco	69 (2.5)	▼
Benchmarking Participants		
2 † Minnesota, US	94 (1.6)	▲
3 Quebec, Canada	94 (1.1)	▲
2 Massachusetts, US	92 (1.8)	▲
Basque Country, Spain	91 (1.8)	▲
2 Ontario, Canada	91 (1.7)	▲
3 British Columbia, Canada	90 (1.5)	▲
◆◆ ‡ Dubai, UAE	78 (1.5)	

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

▲ Percent significantly higher than international average
▼ Percent significantly lower than international average

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

‡ Did not satisfy guidelines for sample participation rates (see Appendix A).

1 National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

2 National Defined Population covers 90% to 95% of National Target Population (see Appendix A).

3 National Defined Population covers less than 90% of National Target Population (but at least 77%, see Appendix A).

◆◆ Kuwait and Dubai, UAE tested the same cohort of students as other countries, but later in 2007, at the beginning of the next school year.

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

Exhibit 2.27 TIMSS 2007 Low International Benchmark (400) of Mathematics Achievement – Example Item 8

TIMSS2007 Mathematics 8th Grade

Content Domain: Data and Chance

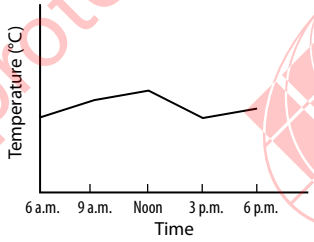
Description: Given a table of values for two variables, selects the line graph that could represent the given data.

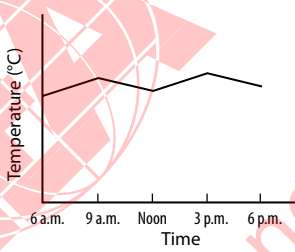
The table shows the temperatures at various times on a certain day.

Time	6 a.m.	9 a.m.	Noon	3 p.m.	6 p.m.
Temperature °C	12	17	14	18	15

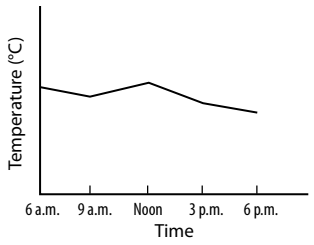
A graph, without a temperature scale, is drawn. Of the following, which could be the graph that shows the information given in the table?

Ⓐ

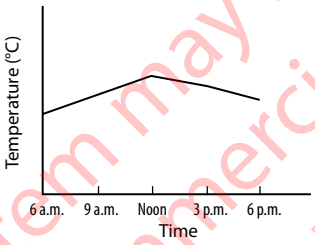




Ⓒ



Ⓓ



Country	Percent Correct	
Korea, Rep. of	97 (0.7)	▲
Japan	96 (0.8)	▲
Singapore	93 (1.1)	▲
Chinese Taipei	92 (1.1)	▲
[1] Lithuania	90 (1.4)	▲
Slovenia	90 (1.4)	▲
[2] † United States	89 (1.0)	▲
Malaysia	89 (1.3)	▲
Sweden	89 (1.2)	▲
Czech Republic	88 (1.3)	▲
Hungary	88 (1.6)	▲
† Hong Kong SAR	87 (1.6)	▲
Australia	87 (1.7)	▲
Russian Federation	85 (1.8)	▲
Italy	84 (1.4)	▲
† Scotland	83 (1.6)	▲
Malta	82 (1.4)	▲
† England	81 (2.1)	▲
[1] [2] Serbia	81 (1.9)	▲
Lebanon	79 (2.3)	▲
Norway	77 (1.8)	▲
Ukraine	77 (2.2)	▲
Cyprus	74 (1.8)	
Thailand	73 (1.9)	
Colombia	73 (2.2)	
Bulgaria	72 (2.3)	
International Avg.	72 (0.3)	
[3] Israel	71 (2.3)	
Bosnia and Herzegovina	70 (2.3)	
Iran, Islamic Rep. of	66 (2.2)	▼
Romania	66 (2.5)	▼
Armenia	66 (2.7)	▼
Indonesia	66 (2.2)	▼
Botswana	65 (1.8)	▼
[1] Georgia	65 (3.4)	▼
Tunisia	63 (2.4)	▼
Bahrain	62 (2.2)	▼
Turkey	61 (2.3)	▼
Jordan	61 (2.2)	▼
Oman	57 (2.1)	▼
El Salvador	55 (2.5)	▼
Egypt	52 (2.4)	▼
Algeria	51 (1.9)	▼
Palestinian Nat'l Auth.	50 (2.8)	▼
◆◆ Kuwait	47 (2.2)	▼
Syrian Arab Republic	47 (2.1)	▼
Saudi Arabia	45 (2.3)	▼
Ghana	43 (2.1)	▼
Qatar	40 (1.6)	▼
‡ Morocco	56 (3.6)	▼
Benchmarking Participants		
[2] † Minnesota, US	94 (1.5)	▲
[3] Quebec, Canada	91 (1.5)	▲
[2] Ontario, Canada	91 (2.0)	▲
[2] Massachusetts, US	90 (1.6)	▲
Basque Country, Spain	90 (1.8)	▲
[3] British Columbia, Canada	89 (1.3)	▲
◆◆ ‡ Dubai, UAE	72 (2.9)	

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Percent significantly higher than international average ▲
Percent significantly lower than international average ▼

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

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Appendix A).

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[1] National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).

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