Appendix A

Supporting Documentation

TIMSS 2007 Mathematics Framework

The content and cognitive domains were the foundation of the TIMSS 2007 fourth and eighth grade mathematics assessments. Exhibit A.1, shows the content and cognitive domains together with the target percentages designated in the TIMSS 2007 assessment framework for mathematics. The content domains differed for the fourth and eighth grades, reflecting the nature and difficulty of the mathematics widely taught at each grade.[1] There was more emphasis on number at the fourth grade than at the eighth grade. At the eighth grade, two of the four content domains were geometry and algebra, but since geometry and algebra generally are not taught as formal subjects in primary school, the geometry topics assessed at the fourth grade focused on geometric shapes and measures and introductory algebra concepts were included as part of number. At the fourth grade, the domain pertaining to data focused on reading and displaying data whereas at eighth grade it included more emphasis on interpretation of data and the fundamentals of probability (called "chance"). The cognitive domains were the same for both grades, encompassing a range of cognitive processes involved in working mathematically and solving problems through the primary and middle school years.

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1 Each content domain had several topic areas (e.g., "number" at eighth grade was further categorized by whole numbers; fractions and decimals; integers; and ratio, proportion, and percent). Each topic area was presented as a list of objectives covered in many participating countries, at either fourth grade or eighth grade as appropriate. For the complete framework for the TIMSS 2007 mathematics assessment, see Mullis, I.V.S., Martin, M.O., Ruddock, G.J., O'Sullivan, C.Y., Arora, A., & Erberber. E. (2005). *TIMSS 2007 assessment frameworks*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Exhibit A.1   **Overview of TIMSS 2007 Mathematics Framework**

TIMSS2007 Mathematics 4th & 8th Grades

Fourth-Grade Content Domains	Percentages
Number	50%
Geometric Shapes and Measures	35%
Data Display	15%

Eighth-Grade Content Domains	Percentages
Number	30%
Algebra	30%
Geometry	20%
Data and Chance	20%

Cognitive Domains	Percentages	
	Fourth Grade	Eighth Grade
Knowing	40%	35%
Applying	40%	40%
Reasoning	20%	25%

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Number of Items by Mathematics Content and Cognitive Domains

Exhibit A.2 shows the distribution of the TIMSS 2007 items by content and cognitive domain for fourth and eighth grades. The fourth grade assessment had 93 items in number, 60 items in geometric shapes and measures, and 26 data display items, for a total of 179 items. Each item also was categorized according to its cognitive domain, with 69 items in the knowing domain, 70 in the applying domain, and 40 in the reasoning domain. It can be seen that the percentages of score points for the content and cognitive domains were nearly identical to those designated in the mathematics assessment framework. A little more than half the items (96) were in multiple-choice format and the rest (83) were constructed-response items. The constructed-response items required students to generate and write their own answers. Some items required short answers while others demanded a more elaborate response. In scoring the assessment, correct answers to most questions (including all those in multiple-choice format) were worth 1 point. However, responses to questions seeking more elaborate responses were evaluated for partial credit, with a fully-correct answer being awarded 2 points. Thus, the total number of score points available for analyses (192) somewhat exceeds the number of items in the assessment.

In the eighth grade assessment, there were 63 number items, 64 algebra items, 47 geometry items, and 41 data and chance items, for a total of 215. Of these, 81 were classified as measuring knowing, 88 as measuring applying, and 46 as measuring reasoning skills. More than half the items (117) were multiple choice and the remainder (98) constructed response. Fifty-one percent of the score points on the eighth grade assessment came from constructed response items.

| Exhibit A.2 | **Distribution of Mathematics Items by Content Domain and Cognitive Domain** | | | | TIMSS2007 Mathematics 4th Grade |

Content Domain	Number of Multiple-choice Items	Number of Constructed-response Items	Total Number of Items	Total Number of Score Points[1]	Percentage of Score Points
Number	50	43	93	98	51
Geometric Shapes and Measures	32	28	60	65	34
Data Display	14	12	26	29	15
Total	96	83	179	192	100

Cognitive Domain	Number of Multiple-choice Items	Number of Constructed-response Items	Total Number of Items	Total Number of Score Points[1]	Percentage of Score Points
Knowing	45	24	69	73	38
Applying	37	33	70	75	39
Reasoning	14	26	40	44	23
Total	96	83	179	192	100

[1] In scoring the tests, correct answers to most items were worth one point. However, responses to some constructed-response items were evaluated for partial credit with a fully correct answer awarded two points. Thus, the number of score points exceeds the number of items in the test.

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| Exhibit A.2 | Distribution of Mathematics Items by Content Domain and Cognitive Domain (Continued) | | | | TIMSS2007 8th Mathematics Grade |

Content Domain	Number of Multiple-choice Items	Number of Constructed-response Items	Total Number of Items	Total Number of Score Points[1]	Percentage of Score Points
Number	35	28	63	72	30
Algebra	34	30	64	69	29
Geometry	31	16	47	50	21
Data and Chance	17	24	41	47	20
Total	117	98	215	238	100

Cognitive Domain	Number of Multiple-choice Items	Number of Constructed-response Items	Total Number of Items	Total Number of Score Points[1]	Percentage of Score Points
Knowing	54	27	81	83	35
Applying	48	40	88	98	41
Reasoning	15	31	46	57	24
Total	117	98	215	238	100

[1] In scoring the tests, correct answers to most items were worth one point. However, responses to some constructed-response items were evaluated for partial credit with a fully correct answer awarded two points. Thus, the number of score points exceeds the number of items in the test.

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Grades and Ages Assessed

At fourth grade, the TIMSS 2007 target population consisted of all students enrolled in the fourth year of formal schooling, counting from the first year of primary school as defined by UNESCO's International Standard Classification for Education (ISCED).[2] According to the ISCED classification, Level 1 corresponds to primary education or the first stage of basic education, and the first year of Level 1 should mark the beginning of formal instruction in reading, writing, and mathematics. Accordingly, the fourth year of Level 1 should be fourth grade in most countries. To avoid testing very young children, however, TIMSS has a policy that the average age of children in the grade tested should not be below 9.5 years old at the time of testing. At eighth grade, the TIMSS 2007 target population was all students enrolled in the eighth year of formal schooling, again counting from the first year of primary school. This should be the eighth grade in most countries. However, the average age of students should not be below 13.5 years old.

Exhibit A.3 presents, for each of the TIMSS 2007 participants, the name of the grade tested in TIMSS, the number of years of formal schooling, and the average age of the students when TIMSS was conducted. Although almost all students assessed by TIMSS were in the fourth grade and had had four years of formal schooling or were in the eighth grade and had had eight years of formal schooling (the exceptions were England, Malta, New Zealand, and Scotland where children at these grade levels would have been too young), there was some variation across participants in students' average age. Because the distribution of ages within a grade level is determined by the policy on age of entry to primary school and how this is implemented in practice, and by promotion and retention practices through the grades, the exhibit also provides a summary of each participant's policy on age of entry, the usual age of entry in practice, and an indication of whether or not participants have a policy on promotion and retention.

2   UNESCO Institute for Statistics. (1999). *Operational manual for ISCED-1997 (international standard classification of education)*. Paris: Author.

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Although most TIMSS participants require children to begin primary school when they are 6 or 7 years old, there are many variations on how this policy is implemented that have an impact on the age of the assessed population. For example, participants that require children to begin school in the calendar year in which they turn six generally had the youngest student populations in TIMSS—about 9.8 years old in fourth grade and 13.8 in eighth grade. Australia, Italy, Norway, Qatar, and Slovenia, as well as the Canadian provinces of Alberta, British Columbia, and Ontario follow this model. Requiring students to be six years old by September of the year in which they start school results in a population older by about four months on average, and an average of about 10.2 or 14.2 years, at fourth and eighth grades, respectively, at the time of the TIMSS testing. Examples of TIMSS participants following this approach include Austria, Chinese Taipei, the Czech Republic, the Slovak Republic, and the state of Minnesota and province of Quebec. Where students begin school in the calendar year in which they turn seven, which is the practice in several northern and eastern European countries such as Bulgaria, Denmark, Latvia, Lithuania, and Sweden, the TIMSS student population is older still—10.8 to 11.0 years old, on average.

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Exhibit A.3   Information About the Grades and Ages of Students Tested in TIMSS 2007

TIMSS2007 Mathematics · 4th & 8th Grades

Country	Grades 4 and 8		
	Policy on Age of Entry to Primary School*	Practice on Age of Entry to Primary School	Policy on Promotion/Retention
Algeria	Children must be 6 years old by December 31st of the academic year in which they enroll	6	●
Armenia	Children must be 6 years old by the end of June to begin in September	7	●
Australia	Age of entry requirement varies among the states and territories; generally children must start in the year in which they turn 6	5	○
Austria	Children must be 6 years old by September 1st, or upon special request, by March 1st the following year	6	●
Bahrain	Children must be 6 years old by the end of December	6	●
Bosnia and Herzegovina	Children must be 6 years old by December 31st	6	●
Botswana	Children must be 6 years old by June, although in rural or remote areas the entry age is flexible	6	●
Bulgaria	Children must be 7 years old in the calendar year, or 6 years old with parent/guardian permission	7	○
Chinese Taipei	Children must be 6 years old by September 1st	6	○
Colombia	Children must be 6 years old	6	●
Cyprus	Children must be 5 years, 8 months old by September 1st	5 years, 8 months	●
Czech Republic	Children must be 6 years old by September 1st	6	●
Denmark	Children must be 7 years old in the calendar year to begin August 1st	7	●
Egypt	Children must be 6 years old by October 1st	6	●
El Salvador	Children must be 7 years old by May of the academic year	7	●
England	Children must begin school at the start of the term following their 5th birthday	5	○
Georgia	Children must be 6 years old by the end of December	6	●
Germany	Children must be 6 years old by June 30th, or upon special request, by December 31st of that year	6	●
Ghana	Children must be 6 years old in the calendar year to begin in September	6	●
Hong Kong SAR	Children must be 5 years, 8 months old in September	6	●
Hungary	Children must be 6 years old by May 31st or upon special request, by December 31st to begin school in September	6 to 7	●
Indonesia	Children may enter at 6 years old, but must enter at 7 years old	6	●
Iran, Islamic Rep. of	Children must be 6 years old by September 20th to start school on September 21st of the same year	6	●
Israel	Children must be 6 years old; each year there is an announcement specifying the birth dates that are relevant to the requirement	6	●
Italy	Children must be 6 years old by December 31st, or by March 31st the following year with an examination	6	●
Japan	Children must be 6 years old by April 1st	6	●
Jordan	Children must be 5 years, 8 months old	5 years, 8 months	●
Kazakhstan	Children must be 6 years old by the end of August to begin in September	6 to 7	●
Korea, Rep. of	Children must be 6 years old, or 5 years old based on the guardian's decision	6	●
Kuwait	Children must be 5.5 years old by September 15th	6	–
Latvia	Children must be 7 years old during the calendar year	7	○
Lebanon	Children must be 6 years old	6	●
Lithuania	Children may begin school when they are 6 years old, and are required when they are 7	6 to 7 (more 7)	●
Malaysia	Children begin school during the calendar year of their 7th birthday	7	○
Malta	Children must be 5 years old by the end of December	5	●
Mongolia	Children must 7 years old, or in special cases, 8 years old	7 to 8	●
Morocco	Children must be 6 years old in September	6	●
Netherlands	Children usually begin primary school at age 6	6	○
New Zealand	Children must be in school by the time they are 6 years old, but they may start from their 5th birthday	5	●
Norway	Children begin school during the calendar year of their 6th birthday	6	●
Oman	Children must be 6 years old by September 1st	6	●
Palestinian Nat'l Auth.	Children must be 5 years, 8 months old by September 1st	5.5	●
Qatar	Children must be 6 years old at the end of September to begin school in September	6	●
Romania	Children are 6–7 years old, but there is no specific date regulation about the age of entry	7	●
Russian Federation	Children must be 6.5 years old	6 to 7	○
Saudi Arabia	Children must be 6 years old, or must turn 6 within 90 days of starting school	5 to 6	●
Scotland	Children can begin school between the ages of 4.5 and 6; those with a March–August birth date must start in the August following their 5th birthday; children with a September–February birth date may defer entry until the following year	4.5 to 5.5	○
Serbia	Children must be at least 6.5 years old and no older than 7.5 years old by September 1st to begin school in September	7	●
Singapore	Children must be 6 years old by January 1st of the year of admission	6	●
Slovak Republic	Children must be 6 years old by the end of August to begin school in September	6	●

● Yes
○ No

Background data provided by National Research Coordinators.

* Age of entry to primary school based on the beginning of ISCED Level 1 in UNESCO's International Standard Classification of Education (Operational Manual for ISCED-97).

** Represents years of schooling counting from the first year of ISCED Level 1.

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Exhibit A.3 **Information About the Grades and Ages of Students Tested in TIMSS 2007 (Continued)**

TIMSS2007 4th & 8th Grades
Mathematics

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

Grade 4			Grade 8			
Country's Name for Grade Tested	Years of Formal Schooling**	Average Age at Time of Testing	Country's Name for Grade Tested	Years of Formal Schooling**	Average Age at Time of Testing	Country
Four year primary	4	10.2	Second year of middle school	8	14.5	Algeria
Grade 4	4	10.6	Grade 8	8	14.9	Armenia
Year 4	4	9.9	Year 8	8	13.9	Australia
Fourth grade / Last grade of primary education	4	10.3				Austria
			Second intermediate	8	14.1	Bahrain
			Final grade (grade 8 and grade 9)	8 or 9	14.7	Bosnia and Herzegovina
			Form one	8	14.9	Botswana
			Grade 8	8	14.9	Bulgaria
Elementary school, grade 4	4	10.2	Junior high school, grade 8	8	14.2	Chinese Taipei
Fourth grade	4	10.4	Eigth grade	8	14.5	Colombia
			B Gymnasium	8	13.8	Cyprus
Grade 4	4	10.3	Grade 8	8	14.4	Czech Republic
Grade 4	4	11.0				Denmark
			Preparatory 2	8	14.1	Egypt
Fourth grade of basic education	4	11.0	Eighth grade of basic education	8	15.0	El Salvador
Year 5	5	10.2	Year 9	9	14.2	England
Grade 4	4	10.1	Grade 8	8	14.2	Georgia
Grade 4	4	10.4				Germany
			Junior secondary school II (JSS II)	8	15.8	Ghana
Primary 4	4	10.2	Secondary 2	8	14.4	Hong Kong SAR
Fourth grade	4	10.7	Eighth grade	8	14.6	Hungary
			Grade 8	8	14.3	Indonesia
Fourth grade of primary school	4	10.2	Third year in guidance school	8	14.2	Iran, Islamic Rep. of
			Eighth Grade	8	14.0	Israel
Grade 4 (IV class of primary school)	4	9.8	Grade 8 (III Media)	8	13.9	Italy
Fourth grade at the elementary school	4	10.5	Second grade at the lower secondary school	8	14.5	Japan
			Grade 8	8	14.0	Jordan
Fourth grade (1st stage of basic education)	4	10.6				Kazakhstan
			Grade 2 of middle school	8	14.3	Korea, Rep. of
Grade 5 (Primary)	4	10.2	Ninth grade (Intermediate)	8	14.4	Kuwait
Grade 4	4	11.0				Latvia
			Grade 8 of the basic educational level	8	14.4	Lebanon
Grade 4	4	10.8	Grade 8	8	14.9	Lithuania
			Form 2 (Grade 8)	8	14.3	Malaysia
			Form 3 (Grade 9)	9	14.0	Malta
Primary 4	4	10.6	Secondary 8	8	14.9	Mongolia
Grade 4 primary school	4	10.6	Second year collegial	8	14.8	Morocco
Grade 6 (the first year of kindergarten is grade 1)	4	10.2				Netherlands
Year 5 (year 1 is equivalent to kindergarten)	4.5–5.5	10.0				New Zealand
Grade 4	4	9.8	Grade 8	8	13.8	Norway
			Grade 8	8	14.3	Oman
			Eighth grade	8	14.0	Palestinian Nat'l Auth.
Fourth grade	4	9.7	Grade 8	8	13.9	Qatar
			Grade 8	8	15.0	Romania
Fourth grade	4	10.8	Eighth grade	7 or 8	14.6	Russian Federation
			Second year of middle school	8	14.4	Saudi Arabia
Primary 5 (P5)	5	9.8	Secondary 2 (S2)	9	13.7	Scotland
			Eighth grade	8	14.9	Serbia
Primary 4	4	10.4	Secondary 2	8	14.4	Singapore
Fourth grade	4	10.4				Slovak Republic

| Exhibit A.3 | Information About the Grades and Ages of Students Tested in TIMSS 2007 (Continued) | | TIMSS2007 Mathematics 4th & 8th Grades |

Country	Grades 4 and 8		
	Policy on Age of Entry to Primary School*	Practice on Age of Entry to Primary School	Policy on Promotion/ Retention
Slovenia	Children must be 6 years old by December 31st	6	●
Sweden	Children must begin during the calendar year they turn 7; upon parental request, children may start school the year they turn 6 or 8	7	○
Syrian Arab Republic	Children must be 5 years, 9 months old by January	6	●
Thailand	Children must be 6 years old by May 16th	5 to 7	○
Tunisia	Children must be 6 years old by the end of December of the year in which they enter school, or by the end of March if there are vacancies	6	●
Turkey	Children must be 6 years old by the end of September	6	●
Ukraine	Children begin school during the calendar year of their 7th birthday	7	●
United States	Policies vary by state	6	○
Yemen	Children must be 6 years old by October 1st of the related school year	6	●
Benchmarking Participants			
Alberta, Canada	Children must be 6 years old by June 1st to begin school the following September	5	○
Basque Country, Spain	Children begin school during the calendar year of their 6th birthday	6	●
British Columbia, Canada	Children must be 6 years old by December 31 of that school year	6	○
Dubai, UAE	Children must be 5.5 years old by October 1st	5 years, 8 months	○
Massachusetts, US	Children must be 6 years old during the calendar year (or younger if the school committee agrees) to start in September	5 or 6	○
Minnesota, US	Children must be in school by the time they are 7 years old	6	○
Ontario, Canada	Children who are 6 years old by the first school day in September are required to begin, but any student who is 6 by December 31st may also begin in September	6	○
Quebec, Canada	Children must be 6 years old by October 1st to begin in September	6	●

● Yes
○ No

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Exhibit A.3 **Information About the Grades and Ages of Students Tested in TIMSS 2007 (Continued)**

TIMSS2007 4th & 8th
Mathematics Grades

Grade 4			Grade 8			Country
Country's Name for Grade Tested	Years of Formal Schooling**	Average Age at Time of Testing	Country's Name for Grade Tested	Years of Formal Schooling**	Average Age at Time of Testing	
Grade 4	4	9.8	Grade 8	7 or 8	13.8	Slovenia
Grade 4	4	10.8	Grade 8	8	14.8	Sweden
			Grade 8	8	13.9	Syrian Arab Republic
			Middle school grade 2	8	14.3	Thailand
Fourth grade of basic school	4	10.2	Eighth year of basic school	8	14.5	Tunisia
			Eighth Grade	8	14.0	Turkey
Grade 4	4	10.3	Grade 8	8	14.2	Ukraine
Grade 4 of elementary school	4	10.3	Grade 8	8	14.3	United States
Grade 4	4	11.2				Yemen
						Benchmarking Participants
Grade 4	4	9.8				Alberta, Canada
			Second course of secondary compulsory education	8	14.1	Basque Country, Spain
Grade 4	4	9.8	Grade 8	8	13.9	British Columbia, Canada
Grade 4 or Grade 5	4	10.0	Grade 8 or Grade 9	8	14.2	Dubai, UAE
Fourth grade	4	10.3	Eighth grade	8	14.2	Massachusetts, US
Fourth grade	4	10.3	Eighth grade	8	14.3	Minnesota, US
Grade 4	4	9.8	Grade 8	8	13.8	Ontario, Canada
Second year of second cycle	4	10.1	Secondary II (cycle one)	8	14.2	Quebec, Canada

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Sample Implementation and Participation Rates

The TIMSS 2007 assessment was administered to scientifically-selected random samples of students from the target population in each country. Because the accuracy of the TIMSS results depends on the quality of the national samples, TIMSS worked with participating countries on all phases of sampling to ensure efficient sampling design and implementation. National coordinators were trained in how to select the school and student samples, and how to use the *WinW3S* sampling software provided by the IEA Data Processing and Research Center. Staff from Statistics Canada reviewed the national sampling plans, sampling data, sampling frames, and sample selections. The sampling documentation was used by the TIMSS & PIRLS International Study Center (in consultation with Statistics Canada and the sampling referee) to evaluate the quality of the samples.

In a few situations where it was not possible to test the entire international target population (i.e., all students enrolled in the fourth or eighth grade), countries were permitted to define a target population that excluded part of the international target population. Exhibit A.4 shows any differences in coverage between the international and national target populations. Almost all participants achieved 100% coverage, the exceptions at fourth grade being Georgia (tested only students taught in Georgian), Kazakhstan (students taught in Kazakh or Russian), Latvia (students taught in Latvian), and Lithuania (students taught in Lithuanian), and, at eighth grade, Georgia (tested only students taught in Georgian), Lithuania (students taught in Lithuanian), and Serbia (did not include Kosovo).

Within the target population, countries could define a population that excluded a small percentage (no more than 5%) of certain kinds of schools or students that would be very difficult or resource intensive to test (e.g., schools for students with special needs or schools that were very small or located in remote rural areas). Almost all countries kept their excluded students below the 5% limit. The only exceptions at the fourth grade were the United States and among benchmarking participants, the U.S. states of Massachusetts and Minnesota and the Canadian provinces of Alberta, British Columbia, Ontario and Quebec, which excluded more than 5 but less than 10 percent of their fourth grade populations. Exceptions at the eighth grade included Serbia and the United States, as well as Massachusetts, Minnesota, and Ontario, which excluded more than 5 but less than 10 percent of their eighth grade population, and Israel, British Columbia, and Quebec, which excluded more than 10 percent of their eighth-grade student population.

The basic design of the sample used in TIMSS 2007 was a two-stage stratified cluster design.[3] The first stage consisted of a sampling of schools, and the second stage of a sampling of intact classrooms from the target grade in the sampled schools. Schools were selected with probability proportional to size, and classrooms with equal probabilities. Most countries sampled 150 schools and one or two intact classrooms from each school.[4] This approach was designed to yield a representative sample of at least 4,500 students in each country.

3   See Joncas, M. (2008). TIMSS sampling design. In J.F. Olson, M.O. Martin, & I.V.S. Mullis (Eds.), *TIMSS 2007 technical report*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

4   For further detail, see Joncas, M. (2008). TIMSS 2007 sampling weights and participation rates. In J.F. Olson, M.O. Martin, & I.V.S. Mullis (Eds.), *TIMSS 2007 technical report*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

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Exhibit A.4   **Coverage of TIMSS 2007 Target Population**

TIMSS2007 4th Grade Mathematics

Country	International Target Population		Exclusions from National Target Population		
	Coverage	Notes on Coverage	School-level Exclusions	Within-sample Exclusions	Overall Exclusions
Algeria	100%		2.1%	0.0%	2.1%
Armenia	100%		2.7%	0.7%	3.4%
Australia	100%		1.3%	2.7%	4.0%
Austria	100%		1.3%	3.7%	5.0%
Chinese Taipei	100%		0.2%	2.5%	2.8%
Colombia	100%		1.3%	0.8%	2.1%
Czech Republic	100%		4.4%	0.5%	4.9%
Denmark	100%		2.0%	2.1%	4.1%
El Salvador	100%		1.4%	0.9%	2.3%
England	100%		1.6%	0.5%	2.1%
Georgia	85%	Students taught in Georgian	2.3%	2.5%	4.8%
Germany	100%		1.2%	0.2%	1.3%
Hong Kong SAR	100%		4.9%	0.5%	5.4%
Hungary	100%		2.6%	1.7%	4.4%
Iran, Islamic Rep. of	100%		2.9%	0.0%	3.0%
Italy	100%		0.1%	5.3%	5.3%
Japan	100%		0.4%	0.6%	1.1%
Kazakhstan	94%	Students taught in Kazakh or Russian	2.2%	3.1%	5.3%
Kuwait	100%		0.0%	0.0%	0.0%
Latvia	72%	Students taught in Latvian	4.2%	0.4%	4.6%
Lithuania	93%	Students taught in Lithuanian	2.2%	3.1%	5.4%
Morocco	100%		1.4%	0.0%	1.4%
Netherlands	100%		3.7%	1.0%	4.8%
New Zealand	100%		2.8%	2.6%	5.4%
Norway	100%		1.9%	3.3%	5.1%
Qatar	100%		1.5%	0.2%	1.8%
Russian Federation	100%		2.2%	1.5%	3.6%
Scotland	100%		2.6%	1.9%	4.5%
Singapore	100%		1.5%	0.0%	1.5%
Slovak Republic	100%		1.4%	1.9%	3.3%
Slovenia	100%		0.8%	1.3%	2.1%
Sweden	100%		2.0%	1.1%	3.1%
Tunisia	100%		2.7%	0.2%	2.9%
Ukraine	100%		0.6%	0.0%	0.6%
United States	100%		0.0%	9.2%	9.2%
Yemen	100%		1.9%	0.1%	2.0%
Benchmarking Participants					
Alberta, Canada	100%		2.0%	5.7%	7.6%
British Columbia, Canada	100%		2.2%	6.9%	9.2%
Dubai, UAE	100%		4.2%	1.2%	5.4%
Massachusetts, US	100%		0.0%	10.4%	10.4%
Minnesota, US	100%		0.0%	8.3%	8.3%
Ontario, Canada	100%		0.6%	5.7%	6.3%
Quebec, Canada	100%		2.1%	4.3%	6.4%

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

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Exhibit A.4   **Coverage of TIMSS 2007 Target Population (Continued)**

TIMSS2007
Mathematics 8th Grade

Country	International Target Population		Exclusions from National Target Population		
	Coverage	Notes on Coverage	School-level Exclusions	Within-sample Exclusions	Overall Exclusions
Algeria	100%		0.1%	0.0%	0.1%
Armenia	100%		2.7%	0.5%	3.3%
Australia	100%		0.6%	1.2%	1.9%
Bahrain	100%		1.4%	0.1%	1.5%
Bosnia and Herzegovina	100%		0.4%	1.1%	1.5%
Botswana	100%		0.0%	0.1%	0.1%
Bulgaria	100%		2.2%	1.3%	3.4%
Chinese Taipei	100%		0.1%	3.3%	3.3%
Colombia	100%		1.5%	0.1%	1.6%
Cyprus	100%		0.0%	2.5%	2.5%
Czech Republic	100%		4.3%	0.3%	4.6%
Egypt	100%		0.1%	0.4%	0.5%
El Salvador	100%		1.2%	1.6%	2.8%
England	100%		2.0%	0.3%	2.3%
Georgia	85%	Students taught in Georgian	2.3%	1.6%	3.9%
Ghana	100%		0.9%	0.0%	0.9%
Hong Kong SAR	100%		3.7%	0.1%	3.8%
Hungary	100%		2.6%	1.4%	3.9%
Indonesia	100%		3.4%	0.0%	3.4%
Iran, Islamic Rep. of	100%		0.5%	0.0%	0.5%
Israel	100%		14.5%	8.3%	22.8%
Italy	100%		0.0%	4.9%	5.0%
Japan	100%		0.6%	2.9%	3.5%
Jordan	100%		0.2%	1.8%	2.0%
Korea, Rep. of	100%		1.2%	0.5%	1.6%
Kuwait	100%		0.0%	0.3%	0.3%
Lebanon	100%		1.4%	0.0%	1.4%
Lithuania	92%	Students taught in Lithuanian	1.4%	2.7%	4.2%
Malaysia	100%		3.3%	0.0%	3.3%
Malta	100%		0.8%	2.1%	2.9%
Morocco	100%		0.1%	0.0%	0.1%
Norway	100%		0.9%	1.7%	2.6%
Oman	100%		0.3%	0.9%	1.2%
Palestinian Nat'l Auth.	100%		0.1%	0.9%	1.0%
Qatar	100%		0.6%	0.2%	0.8%
Romania	100%		1.5%	0.3%	1.8%
Russian Federation	100%		1.1%	1.2%	2.3%
Saudi Arabia	100%		0.4%	0.1%	0.5%
Scotland	100%		1.3%	0.4%	1.7%
Serbia	80%	Serbia without Kosovo	2.9%	3.9%	6.8%
Singapore	100%		1.8%	0.0%	1.8%
Slovenia	100%		0.9%	1.0%	1.9%
Sweden	100%		2.1%	1.6%	3.6%
Syrian Arab Republic	100%		0.6%	0.0%	0.6%
Thailand	100%		3.4%	0.0%	3.4%
Tunisia	100%		0.0%	0.0%	0.0%
Turkey	100%		2.1%	0.5%	2.6%
Ukraine	100%		0.2%	0.0%	0.2%
United States	100%		0.0%	7.9%	7.9%
Benchmarking Participants					
Basque Country, Spain	100%		1.2%	3.0%	4.2%
British Columbia, Canada	100%		2.8%	15.0%	17.7%
Dubai, UAE	100%		4.2%	0.8%	5.0%
Massachusetts, US	100%		0.0%	8.4%	8.4%
Minnesota, US	100%		0.0%	7.5%	7.5%
Ontario, Canada	100%		0.4%	5.8%	6.2%
Quebec, Canada	100%		1.5%	12.1%	13.6%

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

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Exhibits A.5 and A.6 present achieved sample sizes for schools and students, respectively.[5] Exhibit A.7 shows the participation rates for schools, students, and overall—both with and without the use of replacement schools. Most countries achieved the minimum acceptable participation rates— 85 percent of both the schools and students, or a combined rate (the product of school and student participation) of 75 percent—although, at the fourth grade, Denmark, Scotland, the United States, and Minnesota did so only after including replacement schools and have been annotated in the exhibits of this report. Although the Netherlands had an overall participation rate of 91 percent including replacement schools, its participation rate among schools before replacement (48%) was just below the required minimum of 50 percent, and so the Netherlands has been annotated accordingly. At the eighth grade, all participants except Morocco achieved the minimum acceptable participation rate, although England, Hong Kong SAR, Scotland, the United States, and Minnesota did so only after including replacement schools and were annotated in exhibits in this report. Morocco, with an overall participation rate of 55 percent, was annotated in report exhibits and placed below a line following the other countries. Mongolia did not provide the necessary documentation for sampling, data collection, and scoring activities so its achievement data are summarized in Appendix E.

Because an important goal of the TIMSS 2007 assessment was to measure changes in students' mathematics achievement since 1995, it was important to track any changes in population composition and coverage since then that might be related to student achievement. Exhibit A.8 presents, for each TIMSS participant, four attributes of the fourth grade populations sampled in 2007, 2003, and 1995 and the eighth grade populations sampled in 2007, 2003, 1999, and 1995: number of years of formal schooling, average student age at time of testing, percentage of students excluded from the assessment, and overall sampling participation rate (after replacement). Most countries and provinces were very similar with regard to these attributes across the three TIMSS cycles at fourth grade and four cycles at eighth grade, although there have been changes in some countries in the age and grade structure of the assessed populations, and in the exclusion rate.

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5   In cases where students were not given parental permission to participate, they were absent and included as such in Exhibits A.6 and A.7.

Although Australia, since 2003, has tested only fourth grade students for the fourth grade population and only eighth grade students for the eighth grade population, in 1995 the younger assessment population contained fourth grade students from some states and fifth grade students from other states, and similarly the older population contained a mixture of eighth and ninth grade students. Because of this, Australian students were somewhat older, on average, in 1995. The Russian Federation and Slovenia have undergone structural changes in the age at which children enter schools that are reflected in their samples. In 2003, the Russian fourth grade sample contained third-grade students from some regions and fourth-grade students from others, whereas all students were in fourth grade in 2007. At the eighth grade, there was still a mixture of seventh and eighth grade students in 2007, although with proportionally more eighth grade students, and correspondingly a higher average age. Slovenia is in transition towards having all children begin school at an earlier age so that they all will have four years of primary schooling at the fourth grade instead of three years, as was the case in 2003. At eighth grade, the transition was not complete in 2007.

Exhibit A.5   **School Sample Sizes**

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
Algeria	150	150	149	0	149
Armenia	150	148	143	5	148
Australia	230	229	226	3	229
Austria	199	197	194	2	196
Chinese Taipei	150	150	150	0	150
Colombia	150	143	132	10	142
Czech Republic	150	147	132	12	144
Denmark	150	150	105	32	137
El Salvador	150	148	146	2	148
England	160	159	131	12	143
Georgia	152	144	131	13	144
Germany	250	247	239	7	246
Hong Kong SAR	150	150	122	4	126
Hungary	150	145	135	9	144
Iran, Islamic Rep. of	240	224	224	0	224
Italy	170	170	155	15	170
Japan	150	150	145	3	148
Kazakhstan	150	141	140	1	141
Kuwait	150	150	149	0	149
Latvia	150	150	140	6	146
Lithuania	163	156	154	2	156
Morocco	226	224	184	0	184
Netherlands	150	148	72	69	141
New Zealand	220	220	213	7	220
Norway	150	150	131	14	145
Qatar	114	114	114	0	114
Russian Federation	206	206	206	0	206
Scotland	150	148	114	25	139
Singapore	177	177	177	0	177
Slovak Republic	184	184	181	3	184
Slovenia	150	150	138	10	148
Sweden	160	155	151	4	155
Tunisia	150	150	150	0	150
Ukraine	150	150	144	0	144
United States	300	290	202	55	257
Yemen	150	144	143	1	144
Benchmarking Participants					
Alberta, Canada	150	148	146	0	146
British Columbia, Canada	150	150	147	3	150
Dubai, UAE	143	132	97	0	97
Massachusetts, US	50	49	45	2	47
Minnesota, US	50	50	30	20	50
Ontario, Canada	200	197	179	9	188
Quebec, Canada	200	192	185	1	186

Exhibit A.5   **School Sample Sizes (Continued)**

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
Algeria	150	150	149	0	149
Armenia	150	148	143	5	148
Australia	230	228	228	0	228
Bahrain	74	74	74	0	74
Bosnia and Herzegovina	150	150	150	0	150
Botswana	150	150	150	0	150
Bulgaria	170	166	158	5	163
Chinese Taipei	150	150	150	0	150
Colombia	150	148	142	6	148
Cyprus	67	67	67	0	67
Czech Republic	150	147	135	12	147
Egypt	237	233	231	2	233
El Salvador	150	145	143	2	145
England	160	160	126	11	137
Georgia	152	135	131	4	135
Ghana	163	163	163	0	163
Hong Kong SAR	152	152	112	8	120
Hungary	150	145	133	11	144
Indonesia	150	149	149	0	149
Iran, Islamic Rep. of	220	208	208	0	208
Israel	150	150	140	6	146
Italy	170	170	159	11	170
Japan	150	150	144	2	146
Jordan	200	200	200	0	200
Korea, Rep. of	150	150	150	0	150
Kuwait	163	163	158	0	158
Lebanon	150	148	120	16	136
Lithuania	150	144	141	1	142
Malaysia	150	150	150	0	150
Malta	60	59	59	0	59
Morocco	205	205	131	0	131
Norway	150	150	133	6	139
Oman	150	146	146	0	146
Palestinian Nat'l Auth.	155	148	147	1	148
Qatar	67	67	66	0	66
Romania	150	150	149	0	149
Russian Federation	210	210	210	0	210
Saudi Arabia	167	166	165	0	165
Scotland	150	150	109	20	129
Serbia	150	147	147	0	147
Singapore	164	164	164	0	164
Slovenia	150	150	138	10	148
Sweden	160	159	158	1	159
Syrian Arab Republic	150	150	150	0	150
Thailand	150	150	134	16	150
Tunisia	150	150	150	0	150
Turkey	150	146	146	0	146
Ukraine	150	150	146	0	146
United States	300	287	197	42	239
Benchmarking Participants					
Basque Country, Spain	130	130	130	0	130
British Columbia, Canada	150	150	147	3	150
Dubai, UAE	122	115	88	0	88
Massachusetts, US	50	49	45	3	48
Minnesota, US	50	50	32	17	49
Ontario, Canada	200	191	168	8	176
Quebec, Canada	191	183	170	0	170

Exhibit A.6   **Student Sample Sizes**

TIMSS2007 4th Grade
Mathematics

Country	Within-school Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
Algeria	97%	4366	22	0	4344	121	4223
Armenia	96%	4253	0	0	4253	174	4079
Australia	95%	4511	78	105	4328	220	4108
Austria	98%	5158	18	156	4984	125	4859
Chinese Taipei	100%	4260	17	93	4150	19	4131
Colombia	98%	5320	349	40	4931	130	4801
Czech Republic	94%	4583	41	17	4525	290	4235
Denmark	94%	3907	59	89	3759	240	3519
El Salvador	98%	4467	202	0	4265	99	4166
England	93%	4784	128	33	4623	307	4316
Georgia	98%	4384	69	68	4247	139	4108
Germany	97%	5464	78	9	5377	177	5200
Hong Kong SAR	96%	3965	13	23	3929	138	3791
Hungary	97%	4221	22	26	4173	125	4048
Iran, Islamic Rep. of	99%	3939	53	2	3884	51	3833
Italy	97%	4912	20	256	4636	166	4470
Japan	97%	4677	7	20	4650	163	4487
Kazakhstan	100%	4063	22	39	4002	12	3990
Kuwait	85%	4468	439	0	4029	226	3803
Latvia	95%	4188	2	10	4176	268	3908
Lithuania	94%	4345	15	122	4208	228	3980
Morocco	96%	4282	215	0	4067	173	3894
Netherlands	97%	3608	152	9	3447	98	3349
New Zealand	96%	5347	104	86	5157	217	4940
Norway	95%	4462	21	143	4298	190	4108
Qatar	97%	7411	153	18	7240	221	7019
Russian Federation	98%	4659	36	42	4581	117	4464
Scotland	94%	4320	92	32	4196	267	3929
Singapore	96%	5235	26	1	5208	167	5041
Slovak Republic	97%	5269	47	64	5158	195	4963
Slovenia	95%	4664	10	57	4597	246	4351
Sweden	97%	4965	60	49	4856	180	4676
Tunisia	99%	4242	50	10	4182	48	4134
Ukraine	97%	4459	16	0	4443	151	4292
United States	95%	9000	140	543	8317	421	7896
Yemen	98%	6128	180	8	5940	129	5811
Benchmarking Participants							
Alberta, Canada	96%	4557	105	222	4230	193	4037
British Columbia, Canada	96%	4758	67	342	4349	196	4153
Dubai, UAE	91%	3421	19	4	3398	334	3064
Massachusetts, US	96%	1971	11	136	1824	77	1747
Minnesota, US	97%	2034	23	101	1910	64	1846
Ontario, Canada	95%	3903	34	194	3675	179	3496
Quebec, Canada	86%	4645	34	78	4533	648	3885

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Exhibit A.6   **Student Sample Sizes (Continued)**

TIMSS2007 8th
Mathematics Grade

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

Country	Within-school Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
Algeria	96%	5793	83	0	5710	263	5447
Armenia	96%	4898	0	0	4898	209	4689
Australia	93%	4549	84	37	4428	359	4069
Bahrain	97%	4434	61	5	4368	138	4230
Bosnia and Herzegovina	98%	4373	22	44	4307	87	4220
Botswana	99%	4310	63	2	4245	37	4208
Bulgaria	96%	4312	87	7	4218	199	4019
Chinese Taipei	99%	4164	25	53	4086	40	4046
Colombia	98%	5343	368	4	4971	98	4873
Cyprus	96%	4755	41	139	4575	176	4399
Czech Republic	95%	5182	41	12	5129	284	4845
Egypt	98%	6906	151	1	6754	172	6582
El Salvador	98%	4329	191	0	4138	75	4063
England	88%	4768	153	15	4600	575	4025
Georgia	97%	4533	139	48	4346	168	4178
Ghana	98%	5678	270	0	5408	114	5294
Hong Kong SAR	96%	3657	29	2	3626	156	3470
Hungary	97%	4321	21	30	4270	159	4111
Indonesia	97%	4419	95	0	4324	121	4203
Iran, Islamic Rep. of	98%	4140	95	0	4045	64	3981
Israel	94%	3708	12	183	3513	219	3294
Italy	96%	4873	40	231	4602	194	4408
Japan	93%	4656	31	6	4619	307	4312
Jordan	96%	5733	184	88	5461	210	5251
Korea, Rep. of	99%	4358	36	19	4303	63	4240
Kuwait	87%	4721	381	18	4322	231	4091
Lebanon	93%	4062	0	0	4062	276	3786
Lithuania	91%	4537	35	96	4406	415	3991
Malaysia	98%	4589	33	0	4556	90	4466
Malta	95%	5053	18	106	4929	259	4670
Morocco	85%	3731	134	0	3597	537	3060
Norway	93%	5085	17	78	4990	363	4627
Oman	99%	4894	57	36	4801	49	4752
Palestinian Nat'l Auth.	98%	4572	70	29	4473	95	4378
Qatar	97%	7558	128	17	7413	229	7184
Romania	97%	4447	119	12	4316	118	4198
Russian Federation	97%	4706	42	51	4613	141	4472
Saudi Arabia	95%	4515	1	3	4511	268	4243
Scotland	90%	4700	137	19	4544	474	4070
Serbia	98%	4246	16	78	4152	107	4045
Singapore	95%	4828	37	0	4791	192	4599
Slovenia	93%	4414	10	42	4362	319	4043
Sweden	94%	5712	87	58	5567	352	5215
Syrian Arab Republic	96%	5025	199	0	4826	176	4650
Thailand	99%	5579	89	0	5490	78	5412
Tunisia	98%	4258	84	0	4174	94	4080
Turkey	98%	4682	87	19	4576	78	4498
Ukraine	97%	4598	27	0	4571	147	4424
United States	93%	8447	202	272	7973	596	7377
Benchmarking Participants							
Basque Country, Spain	98%	2481	46	83	2352	56	2296
British Columbia, Canada	94%	4836	129	146	4561	305	4256
Dubai, UAE	88%	3625	17	6	3602	407	3195
Massachusetts, US	94%	2093	23	56	2014	117	1897
Minnesota, US	95%	1988	21	82	1885	108	1777
Ontario, Canada	95%	3842	43	171	3628	180	3448
Quebec, Canada	85%	4739	59	45	4635	679	3956

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Exhibit A.7   **Participation Rates (Weighted)**   TIMSS2007 **4**th Mathematics **Grade**

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
Algeria	99%	99%	100%	97%	97%	97%
Armenia	93%	100%	100%	96%	90%	96%
Australia	99%	100%	100%	95%	94%	95%
Austria	98%	99%	99%	98%	96%	97%
Chinese Taipei	100%	100%	100%	100%	100%	100%
Colombia	93%	99%	100%	98%	91%	97%
Czech Republic	89%	98%	100%	94%	83%	92%
Denmark	71%	91%	99%	94%	66%	85%
El Salvador	99%	100%	100%	98%	97%	98%
England	83%	90%	100%	93%	77%	84%
Georgia	92%	100%	100%	98%	90%	98%
Germany	96%	100%	100%	97%	93%	96%
Hong Kong SAR	81%	84%	100%	96%	78%	81%
Hungary	93%	99%	100%	97%	90%	96%
Iran, Islamic Rep. of	100%	100%	100%	99%	99%	99%
Italy	91%	100%	100%	97%	88%	97%
Japan	97%	99%	100%	97%	94%	95%
Kazakhstan	99%	100%	100%	100%	99%	100%
Kuwait	100%	100%	100%	85%	85%	85%
Latvia	93%	97%	100%	95%	89%	92%
Lithuania	99%	100%	100%	94%	93%	94%
Morocco	81%	81%	100%	96%	77%	77%
Netherlands	48%	95%	98%	97%	46%	91%
New Zealand	97%	100%	100%	96%	93%	96%
Norway	88%	97%	100%	95%	83%	92%
Qatar	100%	100%	100%	97%	97%	97%
Russian Federation	100%	100%	100%	98%	98%	98%
Scotland	77%	94%	100%	94%	72%	88%
Singapore	100%	100%	100%	96%	96%	96%
Slovak Republic	98%	100%	100%	97%	95%	97%
Slovenia	92%	99%	100%	95%	87%	93%
Sweden	98%	100%	100%	97%	94%	97%
Tunisia	100%	100%	100%	99%	99%	99%
Ukraine	96%	96%	100%	97%	93%	93%
United States	70%	89%	100%	95%	66%	84%
Yemen	99%	100%	100%	98%	97%	98%
Benchmarking Participants						
Alberta, Canada	99%	99%	100%	96%	94%	94%
British Columbia, Canada	98%	100%	100%	96%	94%	96%
Dubai, UAE	75%	75%	98%	91%	67%	67%
Massachusetts, US	92%	96%	100%	96%	88%	92%
Minnesota, US	53%	100%	100%	97%	52%	97%
Ontario, Canada	95%	96%	100%	95%	91%	92%
Quebec, Canada	97%	98%	100%	86%	83%	84%

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

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Exhibit A.7 **Participation Rates (Weighted) (Continued)**

TIMSS2007 8th
Mathematics Grade

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

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
Algeria	99%	99%	100%	96%	95%	95%
Armenia	94%	100%	100%	96%	90%	96%
Australia	100%	100%	100%	93%	93%	93%
Bahrain	100%	100%	100%	97%	97%	97%
Bosnia and Herzegovina	100%	100%	100%	98%	98%	98%
Botswana	100%	100%	100%	99%	99%	99%
Bulgaria	94%	98%	100%	96%	90%	94%
Chinese Taipei	100%	100%	100%	99%	99%	99%
Colombia	96%	100%	100%	98%	94%	98%
Cyprus	100%	100%	100%	96%	96%	96%
Czech Republic	92%	100%	100%	95%	87%	95%
Egypt	99%	100%	100%	98%	97%	98%
El Salvador	99%	100%	100%	98%	97%	98%
England	78%	86%	100%	88%	69%	75%
Georgia	97%	100%	100%	97%	95%	97%
Ghana	100%	100%	100%	98%	98%	98%
Hong Kong SAR	73%	79%	100%	96%	70%	75%
Hungary	92%	99%	100%	97%	89%	96%
Indonesia	100%	100%	100%	97%	97%	97%
Iran, Islamic Rep. of	100%	100%	100%	98%	98%	98%
Israel	94%	97%	100%	94%	88%	91%
Italy	93%	100%	100%	96%	89%	96%
Japan	96%	97%	100%	93%	90%	91%
Jordan	100%	100%	100%	96%	96%	96%
Korea, Rep. of	100%	100%	100%	99%	99%	99%
Kuwait	97%	97%	100%	87%	84%	84%
Lebanon	81%	92%	100%	93%	76%	85%
Lithuania	98%	99%	100%	91%	89%	90%
Malaysia	100%	100%	100%	98%	98%	98%
Malta	100%	100%	100%	95%	94%	94%
Morocco	65%	65%	100%	85%	55%	55%
Norway	88%	93%	100%	93%	82%	86%
Oman	100%	100%	100%	99%	99%	99%
Palestinian Nat'l Auth.	100%	100%	100%	98%	98%	98%
Qatar	100%	100%	100%	97%	97%	97%
Romania	99%	99%	100%	97%	97%	97%
Russian Federation	100%	100%	100%	97%	97%	97%
Saudi Arabia	99%	99%	100%	95%	94%	94%
Scotland	74%	86%	100%	90%	66%	77%
Serbia	100%	100%	100%	98%	98%	98%
Singapore	100%	100%	99%	95%	95%	95%
Slovenia	92%	99%	100%	93%	85%	92%
Sweden	100%	100%	100%	94%	93%	94%
Syrian Arab Republic	100%	100%	100%	96%	96%	96%
Thailand	90%	100%	100%	99%	88%	99%
Tunisia	100%	100%	100%	98%	98%	98%
Turkey	100%	100%	100%	98%	98%	98%
Ukraine	98%	98%	100%	97%	95%	95%
United States	68%	83%	99%	93%	63%	77%
Benchmarking Participants						
Basque Country, Spain	100%	100%	100%	98%	98%	98%
British Columbia, Canada	98%	100%	100%	94%	92%	94%
Dubai, UAE	79%	79%	99%	88%	69%	69%
Massachusetts, US	93%	98%	100%	94%	88%	92%
Minnesota, US	61%	98%	100%	95%	58%	93%
Ontario, Canada	90%	94%	100%	95%	86%	89%
Quebec, Canada	93%	93%	97%	85%	77%	77%

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In general, the exclusion rates do not exceed the TIMSS 2007 guidelines of 5 percent, and have not changed very much across assessments for most countries. Also, in most cases, the exclusion rates have decreased. However, the student exclusion rate was higher in 2007 than in previous assessments at eighth grade in Serbia, the United States, and the Canadian provinces of British Columbia and Quebec. For each assessment year in Exhibit 1.3 containing the trend results, exclusion rates over 5 percent were documented with footnote 2 and over 10 percent with footnote 3. At the fourth grade, those with a variation from assessment to assessment, included the United States, the state of Minnesota, and the provinces of Alberta and Quebec with a footnote 2 for 2007; the Russian Federation, Hungary, and Iran with a footnote 2 for 2003; England with a footnote 3 for 1995; Scotland with a footnote 2 for 1995; and the province of Ontario with a footnote 2 for 1995 and 2007. At the eighth grade, the United States and Serbia have a footnote 2 for 2007, Hungary and Iran have a footnote 2 for 2003, Italy a footnote 2 for 1999, the Russian Federation and Lithuania a footnote 2 for 1995, and England a footnote 3 for 1995. Among the benchmarking participants, the provinces of Quebec and British Columbia have a footnote 3 for 2007, the states of Massachusetts and Minnesota a footnote 2 for 2007, the province of Ontario a footnote 2 for 2003 and 2007, and the Basque Country in Spain a footnote 2 for 2003.

Exhibit A.8   **Trends in Student Populations**

Country	Years of Formal Schooling*			Average Age at Time of Testing			Overall Exclusion Rates			Overall Participation Rates (After Replacement)		
	2007	2003	1995	2007	2003	1995	2007	2003	1995	2007	2003	1995
Armenia	4	4		10.6	10.9		3.4%	2.9%		96%	90%	
Australia	4	4	4 or 5	9.9	9.9	10.2	4.0%	2.7%	1.8%	95%	85%	66%
Austria	4		4	10.3		10.5	5.0%		2.8%	97%		69%
Chinese Taipei	4	4		10.2	10.2		2.8%	3.1%		100%	99%	
Czech Republic	4		4	10.3		10.4	4.9%		4.1%	92%		86%
England	5	5	5	10.2	10.3	10.0	2.1%	1.9%	12.1%	84%	76%	83%
Hong Kong SAR	4	4	4	10.2	10.2	10.1	5.4%	3.8%	2.7%	81%	83%	83%
Hungary	4	4	4	10.7	10.5	10.4	4.4%	8.1%	3.8%	96%	93%	92%
Iran, Islamic Rep. of	4	4	4	10.2	10.4	10.5	3.0%	5.7%	1.3%	99%	98%	97%
Italy	4	4		9.8	9.8		5.3%	4.2%		97%	97%	
Japan	4	4	4	10.5	10.4	10.4	1.1%	0.8%	3.0%	95%	97%	92%
Latvia	4	4	4	11.0	11.1	10.5	4.6%	4.4%	2.1%	92%	88%	69%
Lithuania	4	4		10.8	10.9		5.4%	4.6%		94%	87%	
Morocco	4	4		10.6	11.0		1.4%	2.2%		77%	81%	
Netherlands	4	4	4	10.2	10.2	10.3	4.8%	5.2%	4.4%	91%	84%	59%
New Zealand	4.5 – 5.5	4.5 – 5.5	4.5 – 5.5	10.0	10.0	10.0	5.4%	4.0%	1.3%	96%	93%	95%
Norway	4	4	4	9.8	9.8	9.9	5.1%	4.4%	3.1%	92%	88%	91%
Russian Federation	4	3 or 4		10.8	10.6		3.6%	6.8%		98%	97%	
Scotland	5	5	5	9.8	9.7	9.7	4.5%	1.5%	6.7%	88%	77%	76%
Singapore	4	4	4	10.4	10.3	10.3	1.5%	0.0%	0.0%	96%	98%	98%
Slovenia	4	3 or 4	3	9.8	9.8	9.9	2.1%	1.3%	1.9%	93%	91%	77%
Tunisia	4	4		10.2	10.4		2.9%	0.9%		99%	99%	
United States	4	4	4	10.3	10.2	10.2	9.2%	5.1%	4.7%	84%	78%	80%
Benchmarking Participants												
Alberta, Canada	4		4	9.8		10.0	7.6%		–	94%		91%
Minnesota, US	4		4	10.3		10.3	8.3%		–	97%		–
Ontario, Canada	4	4	4	9.8	9.8	9.9	6.3%	4.8%	–	92%	90%	92%
Quebec, Canada	4	4	4	10.1	10.1	10.3	6.4%	3.6%	–	84%	91%	81%

*   Represents years of schooling counting from the first year of ISCED Level 1.
A dash (–) indicates comparable data are not available.

Exhibit A.8   **Trends in Student Populations (Continued)**

Country	Years of Formal Schooling*				Average Age at Time of Testing			
	2007	2003	1999	1995	2007	2003	1999	1995
Armenia	8	8			14.9	14.9		
Australia	8	8		8 or 9	13.9	13.9		14.2
Bahrain	8	8			14.1	14.1		
Botswana	8	8			14.9	15.1		
Bulgaria	8	8	8	8	14.9	14.9	14.8	14.0
Chinese Taipei	8	8	8		14.2	14.2	14.2	
Colombia	8			8	14.5			14.5
Cyprus	8	8	8	8	13.8	13.8	13.8	13.7
Czech Republic	8		8	8	14.4		14.4	14.4
Egypt	8	8			14.1	14.4		
England	9	9	9	9	14.2	14.3	14.2	14.0
Ghana	8	8			15.8	15.5		
Hong Kong SAR	8	8	8	8	14.4	14.4	14.2	14.2
Hungary	8	8	8	8	14.6	14.5	14.4	14.3
Indonesia	8	8	8		14.3	14.5	14.6	
Iran, Islamic Rep. of	8	8	8	8	14.2	14.4	14.6	14.6
Israel	8	8	8		14.0	14.0	14.1	
Italy	8	8	8		13.9	13.9	14.0	
Japan	8	8	8	8	14.5	14.4	14.4	14.4
Jordan	8	8	8		14.0	13.9	14.0	
Korea, Rep. of**	8	8	8	8	14.3	14.6	14.4	14.2
Lebanon	8	8			14.4	14.6		
Lithuania**	8	8	8.5	8	14.9	14.9	15.2	14.3
Malaysia	8	8	8		14.3	14.3	14.4	
Norway	8	8		8	13.8	13.8		13.9
Palestinian Nat'l Auth.	8	8			14.0	14.1		
Romania	8	8	8	8	15.0	15.0	14.8	14.6
Russian Federation	7 or 8	7 or 8	7 or 8	7 or 8	14.6	14.2	14.1	14.0
Scotland	9	9		9	13.7	13.7		13.7
Serbia	8	8			14.9	14.9		
Singapore	8	8	8	8	14.4	14.3	14.4	14.5
Slovenia	7 or 8	7 or 8		7	13.8	13.8		13.8
Sweden	8	8		8	14.8	14.9		14.9
Thailand	8		8		14.3		14.5	
Tunisia	8	8	8		14.5	14.8	14.8	
United States	8	8	8	8	14.3	14.2	14.2	14.2
Benchmarking Participants								
Basque Country, Spain	8	8			14.1	14.1		
British Columbia, Canada	8		8		13.9		13.9	
Massachusetts, US	8		8		14.2		14.1	
Minnesota, US	8			8	14.3			14.3
Ontario, Canada	8	8	8	8	13.8	13.8	13.9	14.0
Quebec, Canada	8	8	8	8	14.2	14.2	14.3	14.5

*   Represents years of schooling counting from the first year of ISCED Level 1.

**   Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year. Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

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

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Exhibit A.8   **Trends in Student Populations (Continued)**

TIMSS2007 8th Grade
Mathematics

Country	Overall Exclusion Rates				Overall Participation Rates (After Replacement)			
	2007	2003	1999	1995	2007	2003	1999	1995
Armenia	3.3%	2.9%			96%	89%		
Australia	1.9%	1.3%		0.8%	93%	83%		70%
Bahrain	1.5%	0.0%			97%	98%		
Botswana	0.1%	3.0%			99%	96%		
Bulgaria	3.4%	0.5%	4.6%	0.6%	94%	92%	84%	63%
Chinese Taipei	3.3%	4.8%	1.6%		99%	99%	93%	
Colombia	1.6%			3.8%	98%			86%
Cyprus	2.5%	2.5%	0.8%	0.0%	96%	96%	97%	97%
Czech Republic	4.6%		5.2%	4.9%	95%		96%	92%
Egypt	0.5%	3.4%			98%	97%		
England	2.3%	2.1%	5.0%	11.3%	75%	46%	77%	77%
Ghana	0.9%	0.9%			98%	93%		
Hong Kong SAR	3.8%	3.4%	0.8%	2.0%	75%	80%	75%	81%
Hungary	3.9%	8.5%	4.3%	3.8%	96%	94%	93%	87%
Indonesia	3.4%	0.4%	0.0%		97%	99%	97%	
Iran, Islamic Rep. of	0.5%	6.5%	4.4%	0.3%	98%	98%	98%	98%
Israel	22.8%	22.5%	16.1%		91%	94%	94%	
Italy	5.0%	3.6%	6.7%		96%	97%	97%	
Japan	3.5%	0.6%	1.3%	0.6%	91%	93%	89%	90%
Jordan	2.0%	1.3%	3.0%		96%	96%	99%	
Korea, Rep. of**	1.6%	4.9%	4.0%	3.8%	99%	98%	100%	95%
Lebanon	1.4%	1.4%			85%	91%		
Lithuania**	4.2%	2.6%	4.5%	6.6%	90%	84%	89%	83%
Malaysia	3.3%	4.0%	4.6%		98%	98%	99%	
Norway	2.6%	2.3%		2.2%	86%	85%		93%
Palestinian Nat'l Auth.	1.0%	0.5%			98%	99%		
Romania	1.8%	0.5%	3.7%	2.8%	97%	98%	97%	89%
Russian Federation	2.3%	5.5%	1.7%	6.3%	97%	96%	97%	95%
Scotland	1.7%	0.0%		2.2%	77%	76%		73%
Serbia	6.8%	2.9%			98%	96%		
Singapore	1.8%	0.0%	0.0%	4.6%	95%	97%	98%	95%
Slovenia	1.9%	1.4%		2.6%	92%	91%		77%
Sweden	3.6%	2.8%		0.9%	94%	87%		90%
Thailand	3.4%		3.3%		99%		99%	
Tunisia	0.0%	1.8%	0.1%		98%	98%	98%	
United States	7.9%	4.9%	3.9%	2.1%	77%	73%	85%	78%
Benchmarking Participants								
Basque Country, Spain	4.2%	5.8%			98%	98%		
British Columbia, Canada	17.7%		3.6%		94%		93%	
Massachusetts, US	8.4%		5.0%		92%		93%	
Minnesota, US	7.5%			–	93%			–
Ontario, Canada	6.2%	6.0%	5.1%	–	89%	89%	93%	90%
Quebec, Canada	13.6%	4.8%	1.3%	–	77%	85%	92%	89%

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Translation and Layout Verification

Participants were given detailed guidelines for translating the TIMSS 2007 instruments developed in English into their target language(s) and adapting them to be appropriate for their cultural contexts. They also were urged to work with an experienced translator who would be well suited to the task of working with the TIMSS materials. Because the goal was to create a set of instruments comparable to the originals in terms of difficulty and accessibility, the instruments were subjected to a stringent international translation verification process. Each participant was asked to submit the following materials for verification prior to both the field test and main data collection: items and directions; questionnaires for students, teachers, and schools; manuals; and scoring guides for constructed-response items, where necessary. Verifiers documented their suggestions, and the NRCs were responsible for reviewing the suggestions and revising the instruments. The verified instruments were used to generate the booklets and questionnaires in their final form and these were submitted to the TIMSS & PIRLS International Study Center for international layout verification. Participants who tested in English also were required to go through the verification steps. Although they had not translated the instruments, the materials were reviewed for national adaptations and comparable layout. Further information is provided in the *TIMSS 2007 Technical Report*.

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Survey Operations for Data Collection

Designing the survey operations for data collection was a collaborative effort between the TIMSS & PIRLS International Study Center, the IEA Secretariat, the IEA Data Processing and Research Center, and Statistics Canada. Data collection involved contacting schools and sampling classes, preparing materials for data collection, administering the assessment, conducting quality control, scoring the assessment, and creating the data files. Detailed information is provided in the *TIMSS 2007 Technical Report*. However, in brief, guidelines for each of these activities were described in an international set of materials, software, and manuals provided to each NRC, for example, manuals for the school coordinator, the test administrators, and the national quality control observers. The school coordinator was responsible for coordinating the testing, including arranging for test administrators, receiving the testing materials, and returning the completed materials to the national center. Within the schools, the assessment was conducted by the Test Administrator for each class, which involved distributing materials to the appropriate students, following the script for the administration, and timing the sessions accurately. During the test administrations, 10 percent of the schools were visited by an International Quality Control Monitor hired by the IEA Secretariat, and trained to verify the quality of the materials and adherence to the test administration procedures in each country. Additionally, countries were asked to conduct their own quality control procedures in another 10 percent of sampled schools, based on the international program.

Scoring the Constructed-response Items

Because more than half of the score points on the assessment came from constructed-response items, TIMSS 2007 had to develop procedures for reliably evaluating student responses within and across countries. To ensure reliable scoring procedures based on the TIMSS scoring rubrics, the TIMSS & PIRLS International Study Center prepared detailed guides containing the rubrics and explanations of how to implement them,

together with example student responses for the various rubric categories. These guides, along with training packets containing extensive examples of student responses for practice in applying the rubrics, were used as a basis for intensive training in scoring the constructed-response items. The training sessions were designed to help representatives of national centers, who would then be responsible for training personnel in their own countries to apply the scoring rubrics reliably.

To gather and document information about the within-country agreement among scorers, TIMSS arranged to have systematic sub-samples of at least 200 students' responses to each item scored independently by two scorers. Scoring reliability within countries was high – the percentage of exact agreement for score points, on average, across countries, was 98 percent at both fourth grade and eighth grades. Country-by-country results are provided in the *TIMSS 2007 Technical Report.*

While the double scoring of a sample of the student test booklets provided a measure of the consistency with which the constructed-response questions were scored within each country, TIMSS also took steps to ensure that those constructed-response items from the 2003 assessment that were used in 2007 as part of the trend measurement were scored in the same way in both assessments. In anticipation of this, countries that participated in TIMSS 2003 sent samples of scored student booklets from their 2003 assessment to the IEA Data Processing and Research Center, where they were electronically scanned and incorporated into custom-built presentation software for use in 2007. On average, the software contained about 8,000 student responses for each country. After being trained in using the scoring rubrics for these items, scorers scored half of the student responses, using the scoring software supplied by the DPC. The software then reported on their scoring accuracy for these student responses. Scorers with less than 85 percent exact agreement with the scores assigned to the responses in 2003 were retrained before proceeding. There was a high degree of scoring consistency across assessments, with 97 percent exact agreement, on average internationally, at both grades between the scores awarded in 2003 and

those given by the 2007 scorers. Detailed results for the trend countries are presented in the *TIMSS 2007 Technical Report.*

To monitor the consistency with which the scoring rubrics were applied across countries, TIMSS 2007 collected a sample of 3,600 student responses to 18 constructed-response mathematics items from across the assessment at the fourth grade and a sample of 4,000 responses to 20 items at the eighth grade from the countries that administered TIMSS in English. The set of fourth grade student responses was then sent to each TIMSS participant at the fourth grade that had scorers proficient in English, and all responses in the set were scored independently by two of these scorers. Similarly, the set of eighth grade student responses was sent to eighth grade participants to be independently scored by two English-proficient scorers. Agreement across countries was defined in terms of the percentage of these comparisons that were in exact agreement and was generally high—95 percent at fourth grade and 91 percent at eighth grade. Details may be found in the *TIMSS 2007 Technical Report.*

Test Reliability

As an indication of the reliability of the measurement of student achievement, TIMSS calculated a test reliability coefficient for each country. This coefficient is the median KR-20 reliability across the 14 test booklets. Reliabilities were generally high—0.8 to 0.9 in most countries. The median of the reliability coefficients across all countries was 0.83 at fourth grade 0.88 and at eighth grade. Details may be found in the *TIMSS 2007 Technical Report.*

Scaling the Achievement Data

The primary approach to reporting the TIMSS 2007 achievement data was based on item response theory (IRT) scaling methods.[6] Student mathematics and science achievement was summarized using 2- and 3-parameter IRT models for dichotomously-scored items (right or wrong), and generalized partial credit models for constructed response items with two available score points.[7] The IRT scaling method produces a score by averaging the responses of each student to the items that he or she took in a way that

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6   For a detailed description of the TIMSS 2007 scaling, see Foy, P., Galia, J., & Li, Isaac. (2008). Scaling the TIMSS 2007 mathematics and science assessment data. In J.F. Olson, M.O. Martin, & I.V.S. Mullis (Eds.), *TIMSS 2007 technical report*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

7   TIMSS first applied the 2- and 3-parameter scaling model approach in TIMSS 1999 and has used it ever since. However, achievement scaling in TIMSS 1995 was conducted originally using a 1-parameter model. To ensure compatibility with TIMSS 1999 and subsequent cycles of TIMSS, the 1995 fourth and eighth grade data were rescaled using the 2- and 3-parameter approach. This rescaling was described in Yamamoto, K. & Kulik, E. (2000). Scaling methods and procedures for the TIMSS mathematics and science scales. In M.O. Martin, K.D. Gregory, & S. Stemler, (Eds.), *TIMSS 1999 technical report*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College. The rescaled 1995 data have been used in all trend analyses.

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takes into account the difficulty and discriminating power of each item. The methodology used in TIMSS included refinements enabling reliable scores to be produced even though individual students responded to just one assessment booklet (each booklet contained about one-seventh of the TIMSS achievement items).

To allow more accurate estimation of summary statistics for student subpopulations, the TIMSS scaling made use of plausible-value technology: whereby five separate estimates of each student's score were generated on each scale, based on the student's responses to the items in the student's booklet, and on the student's background characteristics. The five score estimates are known as "plausible values," and the variability between them encapsulates the uncertainty inherent in the score estimation process. The IRT analysis provides a common scale on which performance can be compared across countries. In addition to providing a basis for estimating mean achievement, scale scores permit estimates of how students within countries vary and provide information on percentiles of performance.

Overall mathematics achievement scales were produced at both fourth and eighth grades, as were separate scales for each content domain (number, geometric shapes and measures, and data display at fourth grade and number, algebra, geometry, and data and chance at eighth grade) and each cognitive domain (knowing, applying, and reasoning at each grade level).

In order to measure trends in mathematics achievement across assessments, the TIMSS overall mathematics achievement scales were designed to provide reliable measures on a common scale spanning 1995, 1999, 2003, and 2007. The metric of the scales was established originally with the 1995 assessment. Treating all countries participating in TIMSS 1995 at each grade level equally, the TIMSS scale average across those countries was set to 500, and the standard deviation was set at 100. The average and standard deviation of the scale scores are arbitrary and do not affect scale interpretation. Since the countries varied in size, each country was weighted to contribute equally to the mean and standard deviation of the scale. To preserve the metric of the original 1995 scale for use with the 1999 data,

the 1999 eighth grade assessment was scaled using students from countries that participated in both 1995 and 1999. All mathematics items from 1995 and 1999 were included in this scaling, including about one-third of the items that were used in both assessments and formed the foundation for linking the 1995 and 1999 assessment data. When the link had been established, students from countries that participated in 1999 but not in 1995 were assigned scores on the TIMSS scale.

At the eighth grade, TIMSS developed the 2003 scale in the same way as in 1999, preserving the metric first with students from countries that participated in both 1999 and 2003, and then assigning scores on the basis of the scale to students tested in 2003 but not the earlier assessment. Because the 1995 student data had already been linked to the 1995 data, it was not necessary to include the 1995 data in the 1999–2003 calibration. At fourth grade, because there was no assessment in 1999, the 2003 and 1995 data were linked directly together using students from countries that participated in both assessments, and the students tested in 2003 but not 1995 were assigned scores on the basis of the scale. For TIMSS 2007, the same general procedure was followed at both grades, linking the data first for countries that participated in both 2003 and 2007, and then assigning scores on the basis of the scale to students tested in 2007 but not 2003. Because the TIMSS booklet design changed from 2003 to 2007, TIMSS conducted a bridge study in countries that participated at both years, which involved administering some of the 2003 student booklets to a sub-sample of the 2007 student sample. To account for any effect introduced by the booklet design change, the data collected in the bridging study were included in the 2003–2007 linking analysis. More information is provided in the *TIMSS 2007 Technical Report.*

To facilitate comparisons of countries' relative performance in the content domains (for example, do students perform relatively better in algebra than geometry?) and in the cognitive domains (for example, do students perform relatively better on applying items than on reasoning items?) TIMSS 2007 placed student achievement in each of the content

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and cognitive domains on the same scale by aligning its achievement distribution with the achievement distribution of the overall mathematics scale at each grade level. As a result, each content and cognitive scale had the same mean and standard deviation as the overall mathematics scale, eliminating statistically any existing differences in the difficulty of the items on the scales in the interest of making relative comparisons.

To give an indication of the difficulty of the TIMSS mathematics items at the fourth and eighth grades, Exhibit A.9 presents, for each TIMSS participant, the percentage of students responding correctly to each item, averaged across the items for each content and cognitive scale, as well as across mathematics overall. At the fourth grade, the average percent correct in the number (46%) and geometric shapes and measures (47%) domains was similar to the average percent correct overall (48%), while students performed somewhat better on the data display items (54%). Among cognitive domains, however, students performed better, on average, on items in the knowing (51%) and applying (49%) domains and found the items in the reasoning domain more difficult (38%). The fourth grade mathematics items were particularly difficult for Yemen, where the average percent correct across all items was just 14 percent. Because of concerns about the reliability of domain scales based on such low-achieving students, results on the mathematics content and cognitive scales were not reported for Yemen. In addition, students in Kuwait, Morocco, Qatar, and Tunisia had particular difficulty with the mathematics reasoning items, with average percent correct ranging from 10 to 14 percent. Again because of concerns about reliability, results on the mathematics reasoning scale were not reported for these countries.

At the eighth grade, performance in three of the content domains—number (40%), geometry (40%), and data and chance (40%)—was similar to overall mathematics performance (39%), while performance in algebra (36%) was somewhat lower. As at fourth grade, there were differences among cognitive domains, with students having highest performance (46% correct, on average) on the knowing domain items, next highest on the

| Exhibit A.9 | **Average Percent Correct in the Mathematics Content and Cognitive Domains** | TIMSS2007 4th Grade Mathematics |

Average Percent Correct

Country	Mathematics	Mathematics Content Domains			Mathematics Cognitive Domains		
		Number	Geometric Shapes and Measures	Data Display	Knowing	Applying	Reasoning
Algeria	27 (0.8)	27 (0.8)	27 (0.7)	26 (0.9)	33 (0.8)	26 (0.8)	19 (0.7)
Armenia	51 (1.0)	55 (1.0)	48 (1.1)	47 (1.1)	58 (1.1)	51 (1.0)	40 (1.0)
Australia	55 (0.8)	49 (0.8)	59 (0.8)	69 (1.0)	58 (0.8)	59 (0.8)	45 (0.9)
Austria	52 (0.5)	49 (0.5)	52 (0.5)	61 (0.6)	56 (0.5)	53 (0.5)	42 (0.6)
Chinese Taipei	69 (0.4)	70 (0.4)	64 (0.5)	79 (0.5)	74 (0.4)	70 (0.4)	60 (0.5)
Colombia	23 (0.7)	22 (0.6)	22 (0.8)	27 (1.2)	27 (0.7)	23 (0.8)	16 (0.6)
Czech Republic	47 (0.7)	44 (0.7)	48 (0.7)	56 (0.9)	49 (0.6)	50 (0.7)	39 (0.8)
Denmark	57 (0.7)	51 (0.7)	60 (0.6)	68 (0.9)	59 (0.6)	60 (0.7)	47 (0.7)
El Salvador	20 (0.4)	19 (0.3)	21 (0.5)	26 (0.8)	23 (0.4)	21 (0.5)	15 (0.4)
England	61 (0.7)	57 (0.8)	63 (0.7)	73 (0.7)	65 (0.7)	64 (0.7)	50 (0.8)
Georgia	38 (0.9)	41 (0.9)	34 (0.9)	36 (1.1)	44 (0.9)	39 (0.9)	27 (0.9)
Germany	57 (0.5)	54 (0.5)	57 (0.6)	68 (0.5)	59 (0.5)	61 (0.6)	48 (0.6)
Hong Kong SAR	77 (0.7)	75 (0.8)	76 (0.7)	84 (0.6)	81 (0.6)	79 (0.7)	66 (0.9)
Hungary	54 (0.8)	53 (0.8)	54 (0.8)	60 (1.1)	59 (0.8)	55 (0.8)	45 (1.0)
Iran, Islamic Rep. of	30 (0.6)	28 (0.7)	34 (0.6)	32 (0.8)	36 (0.7)	31 (0.7)	21 (0.6)
Italy	53 (0.8)	51 (0.8)	53 (0.8)	60 (0.9)	59 (0.7)	53 (0.8)	43 (0.8)
Japan	67 (0.5)	64 (0.6)	66 (0.5)	81 (0.5)	70 (0.5)	70 (0.5)	59 (0.6)
Kazakhstan	64 (1.7)	64 (1.7)	62 (1.8)	67 (1.7)	69 (1.6)	65 (1.8)	53 (1.7)
Kuwait	20 (0.4)	20 (0.4)	19 (0.3)	21 (0.5)	27 (0.4)	19 (0.4)	11 (0.3)
Latvia	60 (0.6)	58 (0.6)	57 (0.6)	70 (0.6)	62 (0.5)	62 (0.6)	51 (0.7)
Lithuania	58 (0.6)	57 (0.6)	55 (0.6)	68 (0.7)	59 (0.6)	63 (0.6)	49 (0.8)
Morocco	23 (0.7)	22 (0.7)	25 (0.6)	20 (0.9)	28 (0.6)	23 (0.8)	14 (0.7)
Netherlands	59 (0.5)	58 (0.6)	55 (0.6)	72 (0.7)	60 (0.5)	63 (0.6)	49 (0.7)
New Zealand	49 (0.5)	45 (0.6)	50 (0.6)	63 (0.6)	51 (0.6)	52 (0.6)	41 (0.6)
Norway	44 (0.6)	40 (0.6)	46 (0.7)	55 (0.8)	46 (0.6)	47 (0.7)	37 (0.7)
Qatar	18 (0.1)	17 (0.1)	17 (0.2)	19 (0.3)	23 (0.2)	17 (0.2)	10 (0.1)
Russian Federation	62 (1.1)	61 (1.0)	60 (1.1)	67 (1.4)	65 (1.0)	64 (1.2)	53 (1.3)
Scotland	50 (0.6)	45 (0.6)	52 (0.6)	64 (0.7)	53 (0.6)	53 (0.6)	39 (0.7)
Singapore	74 (0.8)	75 (0.9)	70 (0.8)	82 (0.7)	80 (0.7)	76 (0.8)	63 (1.1)
Slovak Republic	50 (0.9)	49 (0.9)	50 (1.0)	57 (1.2)	54 (1.0)	52 (1.0)	41 (0.9)
Slovenia	52 (0.4)	45 (0.4)	56 (0.5)	64 (0.6)	55 (0.4)	54 (0.5)	42 (0.6)
Sweden	51 (0.6)	46 (0.6)	51 (0.6)	68 (0.8)	51 (0.6)	54 (0.6)	45 (0.7)
Tunisia	21 (0.5)	22 (0.5)	21 (0.6)	19 (0.7)	26 (0.7)	21 (0.6)	13 (0.5)
Ukraine	44 (0.6)	45 (0.6)	41 (0.6)	48 (0.9)	49 (0.6)	45 (0.7)	35 (0.7)
United States	59 (0.6)	56 (0.7)	57 (0.7)	72 (0.6)	65 (0.6)	60 (0.6)	46 (0.7)
Yemen	14 (0.4)	15 (0.4)	13 (0.4)	12 (0.5)	18 (0.6)	13 (0.4)	8 (0.3)
International Avg.	48 (0.1)	46 (0.1)	47 (0.1)	54 (0.1)	51 (0.1)	49 (0.1)	38 (0.1)
Benchmarking Participants							
Alberta, Canada	52 (0.7)	46 (0.8)	53 (0.8)	70 (0.8)	53 (0.8)	55 (0.8)	45 (0.8)
British Columbia, Canada	52 (0.7)	47 (0.7)	52 (0.7)	68 (0.7)	54 (0.6)	54 (0.7)	44 (0.7)
Dubai, UAE	39 (0.4)	37 (0.4)	37 (0.5)	48 (0.6)	46 (0.4)	38 (0.4)	29 (0.5)
Massachusetts, US	69 (0.8)	68 (1.0)	67 (1.0)	79 (0.8)	74 (0.8)	71 (0.9)	59 (1.1)
Minnesota, US	65 (1.3)	62 (1.6)	65 (1.2)	76 (1.3)	70 (1.3)	67 (1.3)	52 (1.5)
Ontario, Canada	54 (0.7)	46 (0.8)	58 (0.8)	72 (0.8)	55 (0.8)	58 (0.8)	47 (0.8)
Quebec, Canada	55 (0.8)	52 (0.8)	56 (0.9)	67 (0.9)	59 (0.8)	57 (0.8)	46 (1.0)

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

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Exhibit A.9　**Average Percent Correct in the Mathematics Content and Cognitive Domains (Continued)**

TIMSS2007 **8**th
Mathematics Grade

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

Country	Average Percent Correct							
	Mathematics	Mathematics Content Domains				Mathematics Cognitive Domains		
		Number	Algebra	Geometry	Data and Chance	Knowing	Applying	Reasoning
Algeria	23 (0.2)	26 (0.3)	18 (0.3)	30 (0.4)	21 (0.3)	26 (0.3)	28 (0.3)	12 (0.2)
Armenia	47 (0.9)	49 (0.9)	53 (0.8)	47 (1.2)	33 (1.0)	56 (0.8)	47 (0.9)	32 (1.1)
Australia	47 (0.9)	50 (1.0)	38 (1.1)	46 (1.0)	57 (0.8)	53 (0.9)	48 (1.0)	37 (1.0)
Bahrain	28 (0.2)	26 (0.3)	26 (0.4)	30 (0.3)	30 (0.4)	33 (0.3)	28 (0.2)	19 (0.4)
Bosnia and Herzegovina	38 (0.6)	38 (0.6)	39 (0.7)	37 (0.7)	36 (0.6)	50 (0.7)	35 (0.5)	24 (0.6)
Botswana	22 (0.3)	23 (0.4)	22 (0.3)	19 (0.3)	24 (0.4)	29 (0.4)	21 (0.2)	13 (0.3)
Bulgaria	41 (1.0)	41 (1.0)	42 (1.1)	43 (1.0)	38 (1.0)	51 (1.2)	41 (1.0)	28 (1.0)
Chinese Taipei	71 (1.0)	70 (0.9)	73 (1.1)	73 (0.9)	68 (0.9)	76 (0.9)	71 (1.0)	62 (1.1)
Colombia	24 (0.5)	23 (0.6)	22 (0.5)	22 (0.6)	27 (0.8)	27 (0.5)	24 (0.5)	18 (0.5)
Cyprus	40 (0.4)	41 (0.4)	38 (0.5)	40 (0.5)	41 (0.4)	47 (0.4)	41 (0.4)	28 (0.5)
Czech Republic	49 (0.6)	53 (0.6)	41 (0.7)	49 (0.7)	54 (0.7)	57 (0.6)	49 (0.6)	37 (0.7)
Egypt	28 (0.5)	28 (0.5)	27 (0.6)	31 (0.6)	25 (0.4)	34 (0.6)	28 (0.5)	17 (0.4)
El Salvador	19 (0.3)	21 (0.5)	17 (0.3)	18 (0.4)	21 (0.5)	23 (0.5)	19 (0.3)	12 (0.3)
England	52 (1.2)	52 (1.2)	44 (1.2)	53 (1.2)	63 (1.3)	59 (1.1)	53 (1.3)	42 (1.3)
Georgia	30 (0.9)	32 (0.9)	31 (1.2)	32 (1.0)	25 (0.6)	40 (1.2)	29 (0.8)	18 (0.7)
Ghana	18 (0.4)	17 (0.5)	20 (0.5)	17 (0.4)	17 (0.4)	24 (0.5)	17 (0.4)	10 (0.3)
Hong Kong SAR	66 (1.3)	68 (1.4)	64 (1.4)	68 (1.4)	64 (1.3)	74 (1.3)	66 (1.4)	53 (1.5)
Hungary	53 (0.8)	55 (0.9)	47 (0.9)	53 (0.9)	57 (0.8)	61 (0.9)	52 (0.9)	41 (0.9)
Indonesia	27 (0.6)	29 (0.7)	25 (0.7)	28 (0.7)	28 (0.6)	34 (0.8)	28 (0.7)	17 (0.5)
Iran, Islamic Rep. of	28 (0.7)	27 (0.8)	26 (0.8)	32 (0.9)	29 (0.7)	34 (0.8)	28 (0.8)	20 (0.7)
Israel	41 (0.8)	43 (0.8)	39 (0.9)	36 (0.8)	44 (0.9)	50 (0.8)	40 (0.8)	28 (0.9)
Italy	43 (0.7)	45 (0.7)	36 (0.8)	47 (0.9)	49 (0.8)	50 (0.8)	44 (0.7)	32 (0.8)
Japan	66 (0.5)	63 (0.5)	62 (0.6)	69 (0.5)	71 (0.5)	71 (0.5)	65 (0.5)	57 (0.6)
Jordan	34 (0.7)	33 (0.7)	35 (0.8)	35 (0.8)	33 (0.7)	41 (0.9)	33 (0.7)	24 (0.6)
Korea, Rep. of	71 (0.5)	71 (0.6)	70 (0.6)	72 (0.5)	73 (0.5)	78 (0.5)	72 (0.6)	60 (0.6)
Kuwait	21 (0.3)	21 (0.3)	19 (0.3)	25 (0.4)	21 (0.4)	27 (0.3)	22 (0.3)	12 (0.3)
Lebanon	36 (0.8)	38 (0.9)	37 (0.9)	39 (0.9)	29 (0.9)	46 (1.0)	35 (0.9)	23 (0.7)
Lithuania	49 (0.6)	52 (0.6)	42 (0.7)	51 (0.7)	56 (0.6)	58 (0.7)	51 (0.6)	34 (0.6)
Malaysia	42 (1.2)	48 (1.2)	34 (1.1)	43 (1.4)	42 (1.0)	50 (1.3)	43 (1.2)	28 (1.0)
Malta	46 (0.2)	51 (0.3)	39 (0.3)	48 (0.3)	49 (0.4)	55 (0.3)	47 (0.3)	32 (0.4)
Norway	40 (0.5)	45 (0.5)	27 (0.5)	40 (0.5)	52 (0.7)	44 (0.5)	42 (0.5)	30 (0.6)
Oman	25 (0.4)	23 (0.4)	24 (0.5)	27 (0.5)	26 (0.5)	30 (0.5)	24 (0.4)	18 (0.4)
Palestinian Nat'l Auth.	25 (0.5)	25 (0.6)	23 (0.5)	28 (0.5)	24 (0.4)	30 (0.6)	25 (0.5)	17 (0.4)
Qatar	18 (0.1)	20 (0.2)	16 (0.2)	19 (0.2)	17 (0.2)	23 (0.2)	19 (0.2)	10 (0.2)
Romania	40 (0.9)	40 (0.9)	42 (1.0)	42 (0.9)	35 (0.8)	49 (1.0)	40 (0.9)	27 (0.8)
Russian Federation	51 (1.0)	52 (0.9)	51 (1.1)	51 (1.2)	47 (1.0)	61 (1.0)	51 (1.1)	36 (1.0)
Saudi Arabia	18 (0.2)	17 (0.3)	17 (0.3)	22 (0.3)	19 (0.3)	21 (0.3)	20 (0.3)	12 (0.2)
Scotland	45 (0.9)	47 (0.9)	37 (1.0)	46 (0.9)	55 (1.0)	52 (0.9)	45 (0.9)	35 (1.0)
Serbia	45 (0.7)	45 (0.7)	46 (0.9)	46 (0.9)	41 (0.8)	56 (0.8)	44 (0.8)	31 (0.8)
Singapore	70 (0.9)	74 (0.9)	67 (1.1)	70 (1.0)	70 (0.9)	76 (0.9)	72 (1.0)	59 (1.1)
Slovenia	48 (0.5)	50 (0.6)	42 (0.7)	48 (0.6)	53 (0.6)	56 (0.6)	49 (0.6)	36 (0.7)
Sweden	46 (0.5)	51 (0.5)	34 (0.6)	43 (0.6)	57 (0.8)	51 (0.5)	47 (0.6)	35 (0.7)
Syrian Arab Republic	26 (0.6)	25 (0.6)	26 (0.7)	31 (0.7)	25 (0.5)	32 (0.7)	28 (0.6)	16 (0.5)
Thailand	36 (1.1)	38 (1.2)	31 (1.2)	37 (1.2)	38 (0.9)	41 (1.2)	36 (1.1)	27 (1.1)
Tunisia	30 (0.5)	32 (0.5)	26 (0.6)	32 (0.5)	28 (0.5)	36 (0.6)	31 (0.5)	19 (0.4)
Turkey	35 (0.9)	34 (0.9)	34 (1.1)	33 (1.0)	38 (0.9)	43 (1.0)	33 (0.9)	25 (0.9)
Ukraine	40 (0.7)	40 (0.8)	38 (0.8)	41 (0.8)	40 (0.8)	49 (0.8)	40 (0.8)	25 (0.7)
United States	50 (0.7)	54 (0.7)	45 (0.8)	44 (0.7)	59 (0.8)	61 (0.7)	49 (0.8)	37 (0.8)
‡ Morocco	24 (0.5)	25 (0.6)	22 (0.5)	28 (0.5)	23 (0.7)	28 (0.6)	26 (0.5)	16 (0.4)
International Avg.	39 (0.1)	40 (0.1)	36 (0.1)	40 (0.1)	40 (0.1)	46 (0.1)	39 (0.1)	28 (0.1)
Benchmarking Participants								
Basque Country, Spain	47 (0.7)	52 (0.8)	41 (0.9)	43 (0.8)	52 (0.8)	56 (0.8)	46 (0.7)	35 (1.0)
British Columbia, Canada	50 (0.8)	56 (0.9)	42 (0.9)	46 (0.9)	59 (0.8)	58 (0.8)	51 (0.8)	39 (0.9)
Dubai, UAE	40 (0.5)	41 (0.6)	40 (0.6)	37 (0.6)	41 (0.7)	49 (0.6)	39 (0.6)	29 (0.5)
Massachusetts, US	60 (1.2)	63 (1.3)	56 (1.4)	55 (1.3)	68 (1.2)	69 (1.2)	59 (1.2)	49 (1.4)
Minnesota, US	57 (1.2)	61 (1.3)	49 (1.4)	51 (1.2)	67 (1.1)	66 (1.1)	56 (1.3)	42 (1.1)
Ontario, Canada	53 (0.9)	57 (1.0)	43 (0.9)	51 (1.1)	62 (1.0)	59 (0.9)	53 (0.9)	43 (1.0)
Quebec, Canada	55 (0.9)	59 (0.9)	47 (0.9)	55 (0.9)	60 (0.9)	62 (0.8)	56 (0.9)	42 (1.0)

‡　Did not satisfy guidelines for sample participation rates (see Exhibit A.7).

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

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applying items (39%), and lowest performance (28%) on the items in the reasoning domain. Students in a number of countries, including Algeria, Botswana, El Salvador, Ghana, Kuwait, Qatar, and Saudi Arabia, had particular difficulty with the mathematics reasoning items, with average percent correct ranging from 10 to 13 percent. Because of concerns about reliability, results on the mathematics reasoning scale were not reported for these countries.

Scale Anchoring Analysis

For the scale anchoring analysis, the students' achievement results from all the participating countries were pooled, so that the benchmark descriptions refer to all students achieving at that level. Thus, in determining performance in relation to the benchmarks, it does not matter what country a student is from, only how he or she performed on the test. Considering students' mathematics achievement scores, criteria were applied to identify the sets of items that students reaching each international benchmark were likely to answer correctly and that those at the next lower benchmark were unlikely to answer correctly.

For example, 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. Similarly, a multiple-choice item anchored at the High International Benchmark if at least 65 percent of students scoring at 550 answered the item correctly and fewer than 50 percent of students scoring at the Intermediate International Benchmark (475) answered it correctly. A multiple-choice item anchored at the Intermediate International Benchmark if at least 65 percent of students scoring at 475 answered correctly and fewer than 50 percent of students scoring at the Low Benchmark (400) answered it correctly. A multiple-choice item anchored at the Low Benchmark if at least 65 percent of students scoring at 400 answered correctly. Since constructed-response questions nearly eliminate guessing, the criterion for the constructed-response items

was simply 50 percent at the particular benchmark. Also, the analysis was conducted based on the percentage of students receiving full credit.

The sets of items identified by the scale anchoring analysis represented the accomplishments of students reaching each successively higher benchmark, and were used by the TIMSS 2007 Science and Mathematics Item Review Committee (SMIRC) and the TIMSS 2007 Mathematics and Science Coordinators to develop the benchmark descriptions. For each benchmark, the work of the panelists involved developing a short description for each anchor item that characterized the content knowledge and skills demonstrated by students answering it successfully. These item-by-item descriptions were then summarized by the SMIRC members to provide the more general statements of achievement at each of the benchmarks. The item-by-item descriptions and further details about the analysis can be found in the *TIMSS 2007 Technical Report*.

The descriptions of achievement at the benchmarks are based solely on student performance on the TIMSS 2007 items and do not purport to be comprehensive. There are undoubtedly other curriculum elements on which students at the various benchmarks would have been successful if they had been included in the assessment. Also, some students scoring below a benchmark may indeed know or understand some of the concepts that characterize a high level. Finally, describing mathematical concepts or familiarity with procedures was more straightforward than describing the cognitive behavior necessary to answer the item correctly. An item may require only simple recall for a student familiar with the item's content, but necessitate problem-solving strategies from a student unfamiliar with the material. The descriptions are based on what the panelists believed to be the way the great majority of students at the fourth or eighth grade could be expected to respond to the item.

Estimating Standard Errors

Because the statistics presented in this report are estimates of national performance based on samples of students—rather than on the values that could be calculated if every student in every country had answered every question—it is important to have measures for the degree of uncertainty of the estimates. The jackknife procedure was used to estimate the standard error associated with each statistic presented in this report.[8] As well as sampling error, the jackknife standard errors also include an error component due to variation between the five plausible values generated for each student. The use of confidence intervals (based on the standard errors) provides a way to make inferences about the population means and proportions in a manner that reflects the uncertainty associated with the sample estimates. An estimated sample statistic plus or minus two standard errors represents a 95 percent confidence interval for the corresponding population result.

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8   Procedures for computing jackknifed standard errors are presented in the scaling chapter by Foy, Galia, & Li in the *TIMSS 2007 Technical Report.*