Chapter 1

The Developmental Project to Report TIMSS 2003 Mathematics Achievement in Cognitive Domains

Overview of TIMSS

TIMSS 2003 is the third and most recently completed round of IEA's Trends in International Mathematics and Science Study, a very ambitious series of international assessments carried out in countries around the world to measure trends in mathematics and science learning at the fourth and eighth grades. Conducted first in 1995 and then again in 1999, the regular four-year cycle of TIMSS provides countries with an unprecedented opportunity to obtain comparative information about their students' achievement in mathematics and science. Forty-nine countries participated in TIMSS 2003, with 23 having participated in all three assessments and another 14 having participated in two rounds. In developing the instruments and procedures for TIMSS 2007, IEA is currently working with more than 60 countries.

The TIMSS 2003 Assessment Frameworks and International Reports

For TIMSS 2003, the frameworks underlying the mathematics and science assessments and questionnaires were updated through a major effort. In particular, the mathematics and science frameworks were organized along two dimensions – content domains and cognitive domains. With additional financial support from the US National

Science Foundation and the US National Center for Education Statistics, IEA's TIMSS & PIRLS International Study Center (ISC) worked with the participating countries to describe in detail the mathematics and science content to be assessed and to update the learning outcomes related to particular cognitive domains. The updated frameworks were published in the *TIMSS Assessment Frameworks and Specifications 2003, 2nd Edition* (Mullis, Martin, Smith, Garden, Gregory, Gonzalez, Chrostowski, and O'Connor, 2003).

For mathematics, the five content domains were number, algebra (called patterns and relationships at fourth grade), measurement, geometry, and data. Each content domain described the topic areas to be assessed within that domain, and each topic area was elaborated with objectives specific to the eighth and fourth grades. Four cognitive domains were described – Knowing Facts and Procedures, Using Concepts, Solving Routine Problems, and Reasoning – together with the skills and abilities making up each domain.

Developing the TIMSS 2003 tests was a cooperative venture involving all of the National Research Coordinators (NRCs), including field-testing the items with representative samples of students. The NRCs and the Science and Mathematics Item Review Committee (SMIRC) had several opportunities to review the items and scoring criteria. The resulting TIMSS 2003 mathematics tests contained 194 items at the eighth grade and 161 items at the fourth grade.

The international mathematics results from TIMSS 2003 were initially reported in the *TIMSS 2003 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades* (Mullis, Martin, Gonzalez and Chrostowski, 2004). This report contained overall mathematics achievement results for the participating countries as well as achievement in major content domains – number, algebra, measurement, geometry, and data. It also contained a rich array of information about the school and home contexts for learning mathematics including country-level information collected from the NRCs and considerable data from student, teacher, and school questionnaires.

History of the Developmental Project

Since the first round of TIMSS in 1995, IEA's TIMSS & PIRLS ISC has reported on students' mathematics achievement in content domains (e.g., algebra, geometry) and, as noted above, TIMSS 2003 was no exception. The TIMSS content domains are fairly consistently found in the curricula of the participating countries and the results provide an indication of curriculum areas on which students perform relatively better of worse, both within and across countries. For example, TIMSS 1995, 1999, and 2003 have shown that, on average, eighth-grade students in the United States perform relatively poorly on geometry items and relatively well on data items. For policymakers and educators, such information can prove useful in discussions about the curricular foci and overall learning goals of students across the country.

Developing reliable and valid achievement scales for cognitive domains can be challenging, since the differences among students across and within countries in their mathematics knowledge and problem-solving skills make it difficult to know which cognitive abilities students are using to solve a given mathematics item. Nevertheless, considerable work has been done in this area by national and international assessments, including IEA's Progress in International Reading Literacy Study (PIRLS), the OECD's Programme for International Student Assessment (PISA), and the US National Assessment of Educational Progress (NAEP). For example, for the 2004 IEA research conference in Cyprus, the TIMSS & PIRLS ISC reported international achievement in the processes of reading comprehension (Mullis, Martin, and Gonzalez, 2004) and PIRLS 2006 will institute achievement scales based on processes of comprehension.

Consistent with the growing practice of reporting achievement in various cognitive areas, countries participating in TIMSS also have expressed a need for comparative information about how students perform in the cognitive domains. To provide enhanced information from TIMSS 2003 and facilitate planning for TIMSS 2007, a number of participating countries supported a developmental project for IEA's TIMSS & PIRLS International Study Center to examine mathematics achievement by cognitive domains. Although focusing on mathematics as the first step, if successful the project was intended also to serve as a roadmap for achieving similar goals in science.

Led by the United States, with funding also provided by Chinese Taipei, Cyprus, New Zealand, Norway, Ontario, Quebec, Singapore, and Sweden, the developmental project involved several major activities. Prior to preparing this report of the results of the development study, IEA's TIMSS & PIRLS ISC first convened an international meeting of experts in mathematics and mathematics education to confirm the mapping of TIMSS 2003 mathematics items to cognitive domains. Then, IEA's TIMSS & PIRLS ISC conducted the various phases of the analytic work necessary to create the cognitive domain scale scores.

Mapping the TIMSS 2003 Mathematics Items to Cognitive Domains

The developmental project began with a special meeting of mathematics experts held in February 2005 in Amsterdam, with the purpose of examining the classification of items according to the cognitive domains articulated in the TIMSS 2003 mathematics framework. The 10 participants (see Appendix B) expressed great enthusiasm for the meeting goal – facilitating TIMSS reporting according to cognitive domains. Nevertheless, all members expressed reservations about using the cognitive domains as they stood.

In developing the TIMSS 2003 Assessment Framework for Mathematics, there were no plans to scale and report results by the cognitive domains. In updating the cognitive domains and the learning outcomes related to them, the major goal was to encourage item writers to be as creative as possible and develop items across a variety of cognitive skills and abilities. Although this approach appeared to be viable at the time, and most likely improved the quality of the items for TIMSS 2003, it did lead to some overlap across the four cognitive domains. For example, as demonstrated in assessment items, it was sometimes difficult to distinguish between "knowing facts and procedures" and "using concepts." This overlap made assigning items according to the four original categories very difficult for the members of the expert group. As a result, the expert group worked to use the existing framework as a basis for developing mutually exclusive cognitive domains for reporting the TIMSS 2003 results. The process was an iterative one involving independent classification of items and discussion. In classifying items, the expert group followed the guidelines of classifying items according to the cognitive process they thought most students would use.

Based on this process and final confirmatory rounds of classifying the TIMSS 2003 fourth- and eighth-grade items, the experts felt comfortable with three cognitive domains:

- Knowing Facts, Procedures, and Concepts,
- Applying Knowledge and Understanding,
- Reasoning.

The first domain, *knowing facts, procedures, and concepts*, covers what the student needs to know, while the second, *applying knowledge and conceptual understanding,* focuses on the ability of the student to apply what he or she knows to solve routine problems or answer questions. The third domain, *reasoning*, goes beyond the solution of routine problems to encompass unfamiliar situations, complex contexts, and multi-step problems.

Even though all the individuals who participated in the Amsterdam Cognitive Domains meeting felt that great progress had been made in establishing reliable and valid classifications for analysis and reporting, several additional confirmatory steps were taken. First, a second expert review was conducted as part of the first TIMSS 2007 SMIRC meeting held in April 2005. The SMIRC endorsed the work accomplished at the special Mathematics Cognitive Domains meeting and worked toward refining the classifications and their descriptions to better reflect the essence of the three cognitive domains. This resulted in an excellent foundation for scaling the TIMSS 2003 achievement data by cognitive domains.

Also, IEA's TIMSS & PIRLS ISC examined the distribution of the items within the three cognitive domains by item type, content domain, and difficulty to ensure that there was sufficient coverage of each of the newly defined domains. As described in Appendix B (and summarized in Exhibit B.1), there was a substantial number of items in each domain: 65 in knowing, 93 in applying, and 36 in reasoning at eighth grade; and 58 in knowing, 63 in applying, and 38 in reasoning at fourth grade. Within each domain, there was a good spread of item type (constructed-response or multiple-choice) at both grades, although as might be expected, relatively more of the knowing items were multiple choice and relatively more reasoning items constructed response. There also was a good spread of items across content domains within each of the three cognitive domains, although there was some unevenness in some areas. For example, it would have been preferable to have a higher proportion of number items in the reasoning domain at the eighth grade, and a higher proportion of patterns and relationship items in the knowing domain and measurement items in the reasoning domain at fourth grade. For TIMSS 2007, an effort has been made to address these issues in the assessment frameworks. Finally, there was a good range of item difficulty within each of the cognitive domains, with reasoning items most difficult, on average, as would be anticipated.

The Mathematics Cognitive Domains Framework for the TIMSS 2003 Development Project that was used as the basis of this report is found in Appendix A. It should be noted that this framework was further reviewed by the TIMSS 2007 National Research Coordinators at their second meeting in Amsterdam, June 2005, resulting in further refinements for TIMSS 2007 as published in the *TIMSS 2007 Assessment Frameworks* (Mullis, Martin, Ruddock, O'Sullivan, Arora, and Erberber, 2005).

The Scaling Methodology

The methodology used to create the mathematics cognitive domain scales was identical to that used to report mathematics achievement results and achievement in the mathematics content domains in the TIMSS 2003 International Reports (Mullis, Martin, Gonzalez & Chrostowski, 2004). TIMSS 2003 relied on item response theory scaling (IRT) to describe student achievement in mathematics overall, in the content domains, and in the cognitive domains. TIMSS created separate scales for mathematics overall, for each content domain, and for each cognitive domain at both fourth and eighth grades. The metric for the TIMSS overall mathematics scale was established originally in TIMSS 1995, with a mean of 500 and standard deviation of 100 across the countries participating in that first TIMSS assessment. This was done separately for fourth and eighth grades. To provide a mechanism for measuring changes in student achievement over time, the data from the TIMSS assessments in 1999 (eighth grade only) and 2003 (both grades) were linked to this scale. The international average score for the eighth-grade countries in 2003 was 467, and for the fourth-grade countries, 495. To facilitate comparisons across cognitive domains and with overall mathematics, and following the procedure used for the mathematics content scales in 2003, the three cognitive domain scales were set to have the same mean and standard deviation as the overall mathematics scales, i.e., a mean of 467 and standard deviation of 100 at the eighth grade, and a mean of 495 and standard deviation of 100 at the fourth grade. The methodology is summarized in Appendix B and is described in detail in the *TIMSS 2003 Technical Report* (Martin, Mullis & Chrostowski, 2004).

Summary of Overall Mathematics Achievement Nationally and by Gender for the TIMSS 2003 Countries

To provide a context for considering mathematics achievement at the fourth and eighth grades in the cognitive domains, the first page of Exhibit 1.1 presents mathematics achievement for all students and separately by gender for the 46 countries and four benchmarking entities that participated at the eighth grade in TIMSS 2003 and the second page presents mathematics achievement in the same way for the 25 countries and three benchmarking entities that participated at the fourth grade.[1] At each grade, countries are shown in decreasing order of average (mean) scale score, together with an indication of whether the country average was significantly higher or lower than the international average.[2] It should be noted that the results for the eighth and fourth grades are not directly comparable.[3]

To recap the overall mathematics achievement results, reported in full in the *TIMSS 2003 International Mathematics Report*, Singapore was the highest-performing country at both the fourth and eighth grades. At the eighth grade, the Republic of Korea, Hong Kong SAR, and Chinese Taipei outperformed all the other countries except Singapore. Japan also performed very well, as did Belgium (Flemish), the Netherlands, Estonia, and Hungary. At the fourth grade, in addition to Singapore, Hong Kong SAR, Japan, and Chinese Taipei also had higher achievement than the rest of the countries as did Belgium (Flemish). Belgium (Flemish), however, was outperformed by the Asian countries.

To aid in interpretation, Exhibit 1.1 also includes the years of formal schooling and average age of the students in each country. At the eighth grade, the aim was that the students assessed would have had eight years of formal schooling. Similarly, at the fourth grade, the aim was to assess students having had four years of formal schooling. This was the case for most participating countries, however, as shown in the *TIMSS 2003 International Mathematics Report*, the TIMSS 2003 countries had different policies about the age at which students begin formal schooling and about promotion and retention from grade

1 Details of target population coverage and sampling participation are presented in Appendix C for each country.

2 The international average of 467 at the eighth grade was obtained by averaging across the mean scores for each of the 46 participating countries. The mean scores for the four benchmarking participants were not included in calculating the average. Even though England worked diligently to meet the TIMSS sampling requirements and adjustments were made to make the results representative, it did not meet the school participation rates as specified in the guidelines and consequently its results are shown below a line. At the fourth grade, the international average of 495 was obtained by averaging across the mean scores for the 25 participating countries.

3 While the scales for the two grades are expressed in the same numerical units, they are not directly comparable in terms of being able to say how much achievement or learning at one grade equals how much achievement or learning at the other grade. Comparisons only can be made in terms of relative performance. Since the TIMSS scales were developed using IRT technology, like all such scales, the eighth- and fourth-grade scales cannot be described in absolute terms.

to grade. Thus, even though TIMSS devoted considerable effort to maximizing comparability across the grades tested there was some variation. Most notably, in the eighth-grade population, students in Norway, most of Slovenia, and parts of the Russian Federation had fewer years of formal schooling than their counterparts in other countries, while those in England, Scotland, New Zealand, and parts of Australia had more years of schooling. In the fourth-grade population, some students in Slovenia and parts of the Russian Federation had only three years of formal schooling, and students in England and Scotland as well as some in Australia and New Zealand had five years. Also, equivalence of chronological age does not necessarily mean that students have received the same number of year of formal schooling or studied the same curriculum. At the eighth grade, students were on average between 14 and 15 years old, but the range of policies and situations in the participating countries led to considerable variation. At the fourth grade, students in most countries were on average between 10 and 11 years old.

As can be seen in the right-hand portion of both pages of Exhibit 1.1, at both the eighth and fourth grades, the difference in overall mathematics performance by gender was negligible in many countries. The situation did vary by country, however. At the eighth grade, girls had significantly higher achievement in Singapore, Armenia, Serbia, Moldova, Cyprus, Macedonia, Jordan, Bahrain, and the Philippines. Boys had significantly higher achievement than girls in Belgium (Flemish), Hungary, the United States, Italy, Lebanon, Tunisia, Chile, Morocco, Ghana, the US state of Indiana, and the Canadian province of Quebec. At the fourth grade, girls had significantly higher average mathematics achievement in Singapore, Moldova, Armenia, and the Philippines. Boys had higher average achievement in the Netherlands, the United States, Cyprus, Italy, Scotland, and in the two Canadian provinces.

Exhibit 1.1: Distribution of Mathematics Achievement Overall and by Gender

MATHEMATICS Grade 8

Countries	Overall Average Scale Score	Years of Formal Schooling*	Average Age	Girls Average Scale Score	Boys Average Scale Score	Difference (Absolute Value)
Singapore	▲ 605 (3.6)	8	14.3	611 (3.3) ▲	601 (4.3)	10 (2.9)
⧓ Korea, Rep. of	▲ 589 (2.2)	8	14.6	586 (2.7)	592 (2.6)	5 (3.1)
† Hong Kong, SAR	▲ 586 (3.3)	8	14.4	587 (3.8)	585 (4.6)	2 (5.1)
Chinese Taipei	▲ 585 (4.6)	8	14.2	589 (4.9)	582 (5.2)	7 (4.2)
Japan	▲ 570 (2.1)	8	14.4	569 (4.0)	571 (3.6)	3 (6.4)
Belgium (Flemish)	▲ 537 (2.8)	8	14.1	532 (3.5)	542 (3.8) ▲	11 (4.8)
† Netherlands	▲ 536 (3.8)	8	14.3	533 (4.1)	540 (4.5)	7 (3.6)
Estonia	▲ 531 (3.0)	8	15.2	532 (3.4)	530 (3.3)	2 (3.0)
Hungary	▲ 529 (3.2)	8	14.5	526 (3.7)	533 (3.5) ▲	7 (3.2)
Malaysia	▲ 508 (4.1)	8	14.3	512 (4.7)	505 (4.5)	8 (4.2)
Latvia	▲ 508 (3.2)	8	15.0	511 (3.3)	506 (3.7)	6 (2.9)
Russian Federation	▲ 508 (3.7)	7 or 8	14.2	510 (3.5)	507 (4.4)	3 (2.8)
Slovak Republic	▲ 508 (3.3)	8	14.3	508 (3.4)	508 (4.0)	0 (3.5)
Australia	▲ 505 (4.6)	8 or 9	13.9	499 (5.8)	511 (5.8)	13 (7.0)
‡ United States	▲ 504 (3.3)	8	14.2	502 (3.4)	507 (3.5) ▲	6 (1.9)
1 Lithuania	▲ 502 (2.5)	8	14.9	503 (2.9)	499 (3.0)	5 (2.9)
Sweden	▲ 499 (2.6)	8	14.9	499 (3.0)	499 (2.7)	1 (2.2)
† Scotland	▲ 498 (3.7)	9	13.7	500 (4.3)	495 (3.8)	5 (3.5)
2 Israel	▲ 496 (3.4)	8	14.0	492 (3.3)	500 (4.5)	8 (4.0)
New Zealand	▲ 494 (5.3)	8.5 - 9.5	14.1	495 (4.8)	493 (7.0)	3 (5.7)
Slovenia	▲ 493 (2.2)	7 or 8	13.8	495 (2.6)	491 (2.6)	3 (2.8)
Italy	▲ 484 (3.2)	8	13.9	481 (3.0)	486 (3.9) ▲	6 (2.8)
Armenia	▲ 478 (3.0)	8	14.9	483 (3.3) ▲	473 (3.4)	10 (3.0)
1 Serbia	▲ 477 (2.6)	8	14.9	480 (2.9) ▲	473 (2.9)	7 (2.8)
Bulgaria	▲ 476 (4.3)	8	14.9	476 (5.5)	477 (4.3)	1 (4.7)
Romania	475 (4.8)	8	15.0	477 (5.1)	473 (5.0)	4 (3.3)
International Avg.	467 (0.5)	8	14.5	467 (0.6)	466 (0.6)	1 (0.6)
Norway	▼ 461 (2.5)	7	13.8	463 (2.7)	460 (3.0)	3 (2.8)
Moldova, Rep. of	460 (4.0)	8	14.9	465 (4.1) ▲	455 (4.8)	10 (3.5)
Cyprus	▼ 459 (1.7)	8	13.8	467 (1.9) ▲	452 (2.3)	16 (2.7)
2 Macedonia, Rep. of	▼ 435 (3.5)	8	14.6	439 (4.0) ▲	431 (3.9)	9 (3.5)
Lebanon	▼ 433 (3.1)	8	14.6	429 (3.6)	439 (3.9) ▲	10 (4.0)
Jordan	▼ 424 (4.1)	8	13.9	438 (4.6) ▲	411 (5.8)	27 (6.8)
Iran, Islamic Rep. of	▼ 411 (2.4)	8	14.4	417 (4.3)	408 (4.2)	9 (7.2)
1 Indonesia	▼ 411 (4.8)	8	14.5	411 (4.9)	410 (5.3)	1 (3.0)
Tunisia	▼ 410 (2.2)	8	14.8	399 (2.6)	423 (2.2) ▲	24 (1.9)
Egypt	▼ 406 (3.5)	8	14.4	407 (4.4)	406 (5.0)	1 (6.4)
Bahrain	▼ 401 (1.7)	8	14.1	417 (2.4) ▲	385 (2.4)	33 (3.3)
Palestinian Nat'l Auth.	▼ 390 (3.1)	8	14.1	394 (3.9)	386 (4.7)	8 (5.9)
Chile	▼ 387 (3.3)	8	14.2	379 (3.5)	394 (4.3) ▲	15 (4.5)
1 ‡ Morocco	▼ 387 (2.5)	8	15.2	381 (2.8)	393 (3.0) ▲	12 (3.1)
Philippines	▼ 378 (5.2)	8	14.8	383 (5.2) ▲	370 (5.8)	13 (3.4)
Botswana	▼ 366 (2.6)	8	15.1	368 (2.6)	365 (2.9)	3 (1.8)
Saudi Arabia	▼ 332 (4.6)	8	14.1	326 (7.9)	336 (5.5)	10 (9.7)
Ghana	▼ 276 (4.7)	8	15.5	266 (5.1)	283 (4.9) ▲	17 (3.1)
South Africa	▼ 264 (5.5)	8	15.1	262 (6.2)	264 (6.4)	3 (5.8)
‡ England	▲ 498 (4.7)	9	14.3	499 (5.3)	498 (5.8)	0 (6.0)
Benchmarking Participants						
Basque Country, Spain	▲ 487 (2.7)	8	14.1	490 (2.5)	484 (3.7)	6 (3.1)
Indiana State, US	▲ 508 (5.2)	8	14.5	502 (5.1)	514 (5.8) ▲	12 (3.4)
Ontario Province, Can.	▲ 521 (3.1)	8	13.8	520 (3.4)	522 (3.4)	2 (2.8)
Quebec Province, Can.	▲ 543 (3.0)	8	14.2	540 (3.7)	546 (3.3) ▲	7 (3.3)

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

▲ Significantly higher than other gender

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

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

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit C.2).

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Exhibit C.2).

‡ Did not satisfy guidelines for sample participation rates (see Exhibit C.2).

1 National Desired Population does not cover all of International Desired Population (see Exhibit C.1).

2 National Defined Population covers less than 90% of National Desired Population (see Exhibit C.1).

⧓ Korea tested the same cohort of students as other countries, but later in 2003, 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 1.1: Distribution of Mathematics Achievement Overall and by Gender

MATHEMATICS Grade 4

Countries	Average Scale Score	Years of Schooling*	Average Age	Girls Average Scale Score	Boys Average Scale Score	Difference (Absolute Value)
Singapore	▲ 594 (5.6)	4	10.3	599 (5.5) ▲	590 (6.2)	8 (3.9)
† Hong Kong, SAR	▲ 575 (3.2)	4	10.2	575 (3.4)	575 (3.4)	0 (2.3)
Japan	▲ 565 (1.6)	4	10.4	563 (1.8)	566 (2.1)	4 (2.3)
Chinese Taipei	▲ 564 (1.8)	4	10.2	564 (1.7)	564 (2.1)	1 (1.7)
Belgium (Flemish)	▲ 551 (1.8)	4	10.0	549 (1.8)	552 (2.5)	2 (2.5)
† Netherlands	▲ 540 (2.1)	4	10.2	537 (2.7)	543 (2.2) ▲	6 (2.4)
Latvia	▲ 536 (2.8)	4	11.1	536 (2.9)	536 (3.5)	1 (2.9)
1 Lithuania	▲ 534 (2.8)	4	10.9	535 (3.5)	536 (3.2)	1 (2.8)
Russian Federation	▲ 532 (4.7)	3 or 4	10.6	530 (5.4)	534 (4.7)	4 (3.5)
† England	▲ 531 (3.7)	5	10.3	530 (3.9)	532 (4.5)	2 (4.0)
Hungary	▲ 529 (3.1)	4	10.5	527 (3.8)	530 (3.3)	3 (3.4)
† United States	▲ 518 (2.4)	4	10.2	514 (2.4)	522 (2.7) ▲	8 (1.6)
Cyprus	▲ 510 (2.4)	4	9.9	505 (2.7)	514 (2.9) ▲	9 (2.8)
Moldova, Rep. of	504 (4.9)	4	11.0	510 (5.2) ▲	499 (5.1)	11 (3.5)
Italy	▲ 503 (3.7)	4	9.8	498 (4.1)	507 (3.7) ▲	9 (2.6)
† Australia	499 (3.9)	4 or 5	9.9	497 (4.5)	500 (4.3)	3 (4.0)
International Avg.	495 (0.8)	4	10.3	495 (0.8)	496 (0.8)	1 (0.7)
New Zealand	493 (2.2)	4.5 - 5.5	10.0	493 (2.7)	494 (2.4)	0 (2.9)
† Scotland	490 (3.3)	5	9.7	485 (3.2)	496 (4.4) ▲	11 (4.1)
Slovenia	▼ 479 (2.6)	3 or 4	9.8	477 (3.0)	481 (3.5)	5 (3.8)
Armenia	▼ 456 (3.5)	4	10.9	462 (3.7) ▲	450 (3.8)	12 (2.9)
ø Norway	▼ 451 (2.3)	4	9.8	449 (2.7)	454 (2.7)	5 (2.8)
Iran, Islamic Rep. of	▼ 389 (4.2)	4	10.4	394 (6.5)	386 (5.5)	8 (8.8)
Philippines	▼ 358 (7.9)	4	10.8	364 (9.2) ▲	352 (7.0)	12 (4.6)
Morocco	▼ 347 (5.1)	4	11.0	344 (6.1)	350 (5.1)	6 (4.7)
Tunisia	▼ 339 (4.7)	4	10.4	342 (5.0)	337 (4.9)	5 (2.8)
Benchmarking Participants						
Indiana State, US	▲ 533 (2.8)	4	9.5	532 (3.1)	534 (3.4)	2 (3.3)
Ontario Province, Can.	▲ 511 (3.8)	4	9.8	505 (3.6)	517 (4.7) ▲	11 (3.7)
Quebec Province, Can.	▲ 506 (2.4)	4	10.1	502 (2.7)	509 (2.8) ▲	7 (2.7)

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

▲ Significantly higher than other gender

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

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

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit C.2).

1 National Desired Population does not cover all of International Desired Population (see Exhibit C.1).

ø Norway: 4 years of formal schooling, but First Grade is called "First grade/Preschool."

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