CHAPTER 3

3

Average Achievement in the Mathematics Content Areas

Chapter 3 presents results by the major content areas in mathematics to provide information about the possible effects of curricular variation on average achievement. Average performance and trends are provided for five content areas: fractions and number sense; measurement; data representation, analysis, and probability; geometry; and algebra.

The TIMSS 1999 mathematics assessment was designed to allow as fair comparisons as possible among participating countries.[1] The test measured achievement on content covered in most systems up to and including the eighth grade. Nevertheless, curriculum data collected as part of TIMSS 1995 and TIMSS 1999 indicate differences among countries in the grade level at which particular topics are introduced and in the teaching emphases given some topics. In addition, within countries there can be variation among teachers in the relative emphasis given particular topics. Chapter 3 presents results by major content areas in mathematics to provide information about the possible effects of this curricular variation on average achievement.

The TIMSS 1999 mathematics test for the eighth grade was designed to enable reporting by five content areas in accordance with the TIMSS mathematics framework.[2] These areas, with their main topics, are:

- **Fractions and number sense**

  Includes whole numbers, fractions and decimals, integers, exponents, estimation and approximation, proportionality

- **Measurement**

  Includes standard and non-standard units, common measures, perimeter, area, volume, estimation of measures

- **Data representation, analysis, and probability**

  Includes representing and interpreting tables, charts, and graphs; range, mean; informal likelihood, simple numerical probability

- **Geometry**

  Includes points, lines, planes, angles, visualization, triangles, polygons, circles, transformations, symmetry, congruence, similarity, constructions

- **Algebra**

  Includes number patterns, representation of numerical situations, solving simple linear equations, operations with expressions, representations of relations and functions.

Chapter 3 presents average achievement for the five major content areas covered by the TIMSS 1999 mathematics test. Gender differences in each content area are shown, and trends in achievement between 1995 and 1999 are presented for those countries that participated in both TIMSS assessments.

1 Please see Appendix A for more information about the test development process. Appendix C provides an analysis of the match between the test and curriculum in different TIMSS 1999 countries and the effect of this match on the results.

2 Proportionality was included as a reporting category in TIMSS 1995, but only 11 items were classified in this content area. To improve the stability of trend comparisons with TIMSS 1995 and for TIMSS 1999 reporting, these items were allocated to other content categories for which they were suitable, mainly fractions and number sense.

How Does Achievement Differ Across Mathematics Content Areas?

3.1 Exhibit 3.1 presents average achievement in each of the five mathematics content areas. Countries are displayed in decreasing order of achievement for each content area, and symbols indicate whether a country's performance is statistically significantly above or below the international average. To allow comparison of the relative performance of each country in each content area, the international average for each content area was scaled to be 487, the same as the overall international average.

Differences in average achievement between the highest- and lowest-performing countries were greatest for fractions and number sense (308 scale-score points) and least for data representation, analysis, and probability (220 scale-score points). The six countries scoring highest in the overall mathematics assessment – Singapore, Korea, Chinese Taipei, Hong Kong, Japan, and Belgium (Flemish) – were also the highest-scoring countries (though not always in the same rank order) in each of the major content areas. Correspondingly, countries scoring lowest on the overall test tended to have low average performance across all five content areas.

In contrast to the consistency in performance across content areas displayed by the higher- and lower-performing countries overall, performance varied substantially for some middle-performing countries. For example, the United States performed significantly above the international average in fractions and number sense; data representation, analysis, and probability; and algebra. In contrast, however, it performed similarly to the international average in measurement and geometry (a shift in ranking from 16th in data representation, analysis, and probability to 27th in geometry).

Exhibits B.1 through B.5 in Appendix B compare average achievement among individual countries for each of the content areas, respectively. The exhibits show whether or not the differences in average achievement between pairs of countries are statistically significant.

Exhibit 3.1 Overleaf

Exhibit 3.1 Average Achievement in Mathematics Content Areas

Fractions and Number Sense
Average Scale Score

(61 items)

		Average Scale Score
Singapore	▲	608 (5.6)
Hong Kong, SAR [†]	▲	579 (4.5)
Chinese Taipei	▲	576 (4.2)
Korea, Rep. of	▲	570 (2.7)
Japan	▲	570 (2.6)
Belgium (Flemish) [†]	▲	557 (3.1)
Netherlands [†]	▲	545 (7.1)
Canada	▲	533 (2.5)
Malaysia	▲	532 (4.7)
Finland	▲	531 (3.8)
Slovenia	▲	527 (3.7)
Hungary	▲	526 (4.2)
Slovak Republic	▲	525 (4.8)
Australia	▲	519 (4.3)
Russian Federation	▲	513 (6.4)
United States	▲	509 (4.2)
Czech Republic	▲	507 (4.8)
Bulgaria	●	503 (6.6)
England [†]	●	497 (3.8)
Latvia (LSS) [1]	●	496 (3.7)
New Zealand	●	493 (5.0)
International Avg.		**487 (0.7)**
Cyprus	●	481 (3.0)
Lithuania [1‡]	●	479 (4.3)
Israel [2]	▽	472 (4.4)
Thailand	●	471 (5.3)
Italy	▽	471 (5.0)
Moldova	▽	465 (4.2)
Romania	▽	458 (5.7)
Tunisia	▽	443 (2.8)
Iran, Islamic Rep.	▽	437 (4.5)
Macedonia, Rep. of	▽	437 (4.7)
Jordan	▽	432 (3.2)
Turkey	▽	430 (4.3)
Indonesia	▽	406 (4.1)
Chile	▽	403 (4.9)
Philippines	▽	378 (6.3)
Morocco	▽	335 (3.6)
South Africa	▽	300 (6.0)

Scale: 200 500 800

Measurement
Average Scale Score

(24 items)

		Average Scale Score
Singapore	▲	599 (6.3)
Korea, Rep. of	▲	571 (2.8)
Hong Kong, SAR [†]	▲	567 (5.8)
Chinese Taipei	▲	566 (3.4)
Japan	▲	558 (2.4)
Belgium (Flemish) [†]	▲	549 (4.0)
Hungary	▲	538 (3.5)
Netherlands [†]	▲	538 (5.8)
Slovak Republic	▲	537 (3.3)
Czech Republic	▲	535 (5.0)
Australia	▲	529 (4.9)
Russian Federation	▲	527 (6.0)
Slovenia	▲	523 (3.7)
Canada	▲	521 (2.4)
Finland	▲	521 (4.7)
Malaysia	▲	514 (4.6)
England [†]	▲	507 (3.8)
Latvia (LSS) [1]	▲	505 (3.5)
Italy	●	501 (5.0)
Bulgaria	●	497 (6.6)
New Zealand	●	496 (5.3)
Romania	●	491 (4.9)
International Avg.		**487 (0.7)**
United States	●	482 (3.9)
Moldova	●	479 (4.9)
Cyprus	▽	471 (4.0)
Lithuania [1‡]	▽	467 (4.0)
Thailand	▽	463 (6.2)
Israel [2]	▽	457 (5.1)
Macedonia, Rep. of	▽	451 (5.2)
Tunisia	▽	442 (3.1)
Jordan	▽	438 (4.4)
Turkey	▽	436 (6.5)
Chile	▽	412 (4.9)
Iran, Islamic Rep.	▽	401 (4.7)
Indonesia	▽	395 (5.1)
Philippines	▽	355 (6.2)
Morocco	▽	348 (3.5)
South Africa	▽	329 (4.8)

Scale: 200 500 800

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲ Country average significantly higher than international average

● Country average not significantly different from international average

▽ Country average significantly lower than international average

Significance tests adjusted for multiple comparisons

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

1 National Desired Population does not cover all of International Desired Population (see Exhibit A.5). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

2 National Defined Population covers less than 90% of National Desired Population (see Exhibit A.5).

‡ Lithuania tested the same cohort of students as other countries, but later in 1999, 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.

Data Representation, Analysis, and Probability
Average Scale Score

(21 items)

Korea, Rep. of	▲	576 (4.2)
Singapore	▲	562 (6.2)
Chinese Taipei	▲	559 (5.1)
Japan	▲	555 (2.3)
Hong Kong, SAR [†]	▲	547 (5.4)
Belgium (Flemish) [†]	▲	544 (3.8)
Netherlands [†]	▲	538 (7.9)
Slovenia	▲	530 (4.2)
Finland	▲	525 (3.8)
Australia	▲	522 (6.3)
Slovak Republic	▲	521 (4.6)
Canada	▲	521 (4.5)
Hungary	▲	520 (5.9)
Czech Republic	▲	513 (5.9)
England [†]	●	506 (8.0)
United States	▲	506 (5.2)
Russian Federation	●	501 (4.8)
New Zealand	●	497 (5.0)
Latvia (LSS) [1]	●	495 (4.8)
Lithuania [1‡]	●	493 (3.6)
Bulgaria	●	493 (6.1)
Malaysia	●	491 (4.0)
International Avg.	●	**487 (0.7)**
Italy	●	484 (4.5)
Thailand	●	476 (4.0)
Cyprus	▽	472 (4.6)
Israel [2]	▽	468 (5.1)
Romania	▽	453 (4.7)
Moldova	▽	450 (5.7)
Tunisia	▽	446 (5.1)
Turkey	▽	446 (3.3)
Macedonia, Rep. of	▽	442 (6.2)
Jordan	▽	436 (7.8)
Iran, Islamic Rep.	▽	430 (6.0)
Chile	▽	429 (3.8)
Indonesia	▽	423 (4.4)
Philippines	▽	406 (3.5)
Morocco	▽	383 (3.5)
South Africa	▽	356 (3.8)

Scale: 200 500 800

Geometry
Average Scale Score

(21 items)

Japan	▲	575 (5.1)
Korea, Rep. of	▲	573 (3.9)
Singapore	▲	560 (6.7)
Chinese Taipei	▲	557 (5.8)
Hong Kong, SAR [†]	▲	556 (4.9)
Belgium (Flemish) [†]	▲	535 (4.1)
Slovak Republic	▲	527 (7.3)
Bulgaria	▲	524 (5.9)
Latvia (LSS) [1]	▲	522 (5.6)
Russian Federation	▲	522 (6.0)
Netherlands [†]	▲	515 (5.5)
Czech Republic	▲	513 (5.5)
Canada	▲	507 (4.7)
Slovenia	●	506 (6.2)
Australia	●	497 (5.7)
Malaysia	●	497 (4.4)
Lithuania [1‡]	●	496 (5.8)
Finland	●	494 (6.0)
Hungary	●	489 (4.3)
International Avg.	●	**487 (0.7)**
Romania	●	487 (6.4)
Thailand	●	484 (4.4)
Cyprus	●	484 (4.6)
Tunisia	●	484 (4.4)
Italy	●	482 (5.6)
Moldova	●	481 (5.0)
New Zealand	●	478 (4.2)
United States	●	473 (4.4)
England [†]	▽	471 (4.2)
Israel [2]	▽	462 (5.4)
Macedonia, Rep. of	▽	460 (6.1)
Jordan	▽	449 (7.1)
Iran, Islamic Rep.	▽	447 (2.9)
Indonesia	▽	441 (5.1)
Turkey	▽	428 (5.7)
Chile	▽	412 (5.4)
Morocco	▽	407 (2.2)
Philippines	▽	383 (3.4)
South Africa	▽	335 (6.6)

Scale: 200 500 800

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲ Country average significantly higher than international average

● Country average not significantly different from international average

▽ Country average significantly lower than international average

Significance tests adjusted for multiple comparisons

Algebra
Average Scale Score

(35 items)

Country		Average Scale Score
Chinese Taipei	▲	586 (4.4)
Korea, Rep. of	▲	585 (2.7)
Singapore	▲	576 (6.2)
Japan	▲	569 (3.3)
Hong Kong, SAR †	▲	569 (4.5)
Belgium (Flemish) †	▲	540 (4.6)
Hungary	▲	536 (4.1)
Russian Federation	▲	529 (4.9)
Slovak Republic	▲	525 (4.6)
Slovenia	▲	525 (2.9)
Canada	▲	525 (2.4)
Netherlands †	▲	522 (7.7)
Australia	▲	520 (5.1)
Czech Republic	▲	514 (4.0)
Bulgaria	▲	512 (5.1)
United States	▲	506 (4.1)
Malaysia	▲	505 (4.8)
Latvia (LSS) 1	○	499 (4.3)
England †	○	498 (4.9)
Finland	▲	498 (3.1)
New Zealand	○	497 (4.7)
International Avg.	○	**487 (0.7)**
Lithuania 1‡	○	487 (3.7)
Italy	○	481 (3.6)
Romania	○	481 (5.2)
Israel 2	○	479 (4.5)
Cyprus	▽	479 (1.6)
Moldova	○	477 (3.7)
Macedonia, Rep. of	▽	465 (4.0)
Thailand	▽	456 (4.9)
Tunisia	▽	455 (2.7)
Jordan	▽	439 (5.3)
Iran, Islamic Rep.	▽	434 (4.9)
Turkey	▽	432 (4.6)
Indonesia	▽	424 (5.7)
Chile	▽	399 (4.3)
Morocco	▽	353 (4.7)
Philippines	▽	345 (5.8)
South Africa	▽	293 (7.7)

Scale: 200 500 800

▲ Country average significantly higher than international average

○ Country average not significantly different from international average

▽ Country average significantly lower than international average

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

In Which Content Areas Are Countries Relatively Strong or Weak?

3.2

Exhibit 3.2 profiles the relative performance in mathematics content areas within each country, highlighting any variation in performance. For each country, Exhibit 3.2 displays the difference between average performance in each content area and average performance overall. The profiles reveal that many countries performed relatively better or worse in several content areas than they did overall. For example, it can be seen that Australia performed better in measurement than on the test as a whole, but worse in geometry.

Differences in relative performance may be related to one or more of a number of factors, such as emphases in intended curricula or widely used textbooks, strengths or weaknesses in curriculum implementation, and the grade level at which topics are introduced. Differences in the match between the implemented curriculum and content measured by the test may also be a factor.[3]

Looking across countries, algebra was the content area least likely to feature either relatively strong or relatively weak performance. Even where there was variation, countries with disparate cultures and mathematical traditions made up both the group of countries relatively strong in algebra (Chinese Taipei, Hungary, Israel, Macedonia, and the United States) and the group that was relatively weak (Finland, the Philippines, and South Africa).

The profiles of relative performance also reveal more variation across the content areas in some countries than in others. Average achievement across content areas showed considerable variation in several countries. For example, in Morocco, the Philippines, and South Africa, differences of approximately two-thirds of a standard deviation between the highest and lowest content area averages occurred. On the other hand, there were only a small number of scale points of difference between highest and lowest content area means for countries such as Belgium (Flemish), Cyprus, Japan, Jordan, Korea, the Slovak Republic, and Turkey. For the latter countries, the data indicate a greater balance in mathematics content covered by the end of the eighth grade.

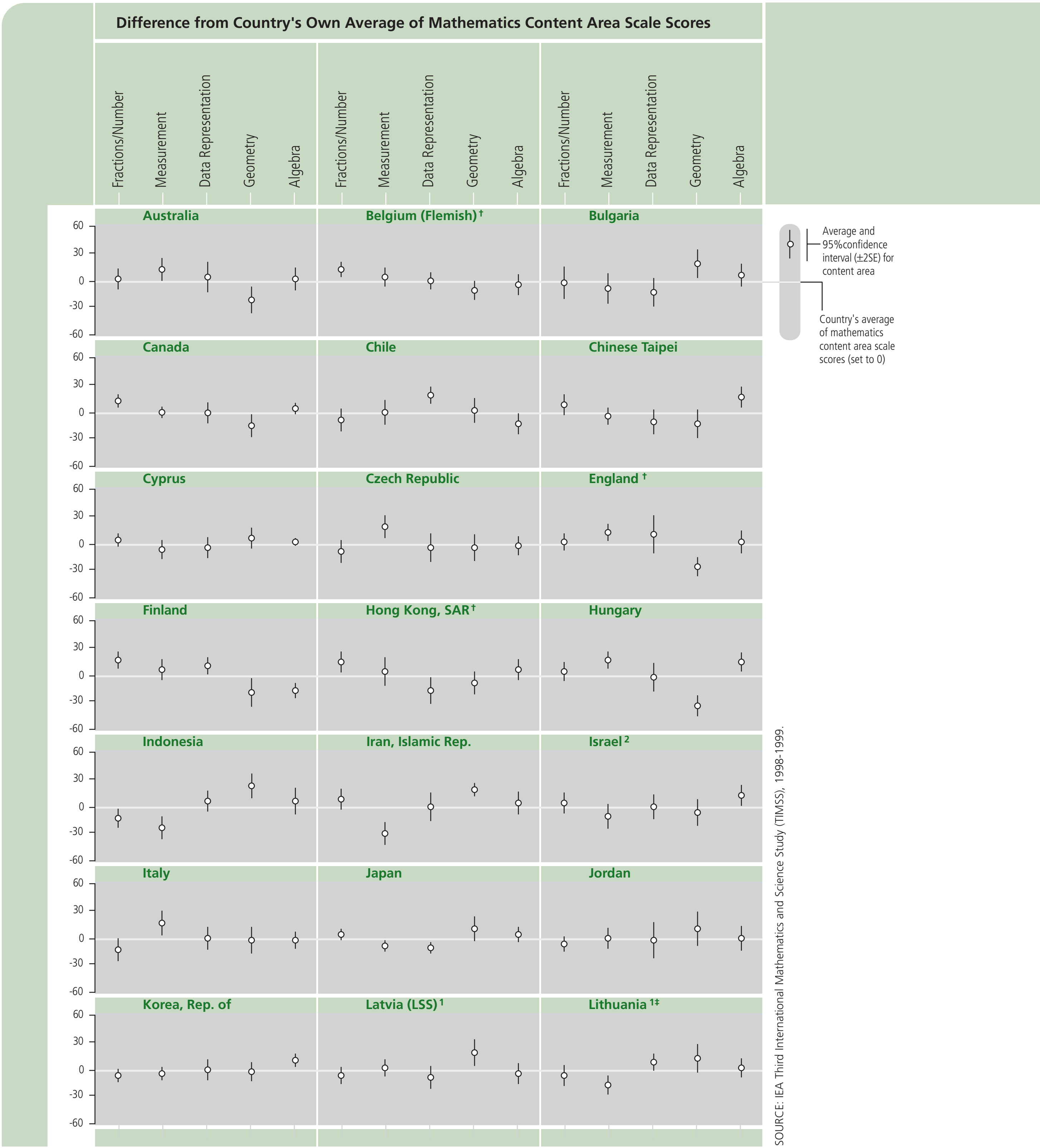
For some countries, national patterns of relative strengths and weaknesses profiled in Exhibit 3.2 are reflected in strengths and weaknesses relative to other countries (shown in Exhibit 3.1). For example, the Australian results show lower performance in geometry relative to

3 See Appendix C for information about the extent to which the TIMSS 1999 tests were judged to be relevant to the curriculum of the participating countries.

other content areas; geometry is also the only content area in which Australia did not perform significantly above the international average. In general, however, the within-country variations are difficult to discern in the results internationally across countries, particularly for countries with high or low performance.

Exhibit 3.2 Overleaf

Exhibit 3.2 Profiles of Relative Performance in Mathematics Content Areas

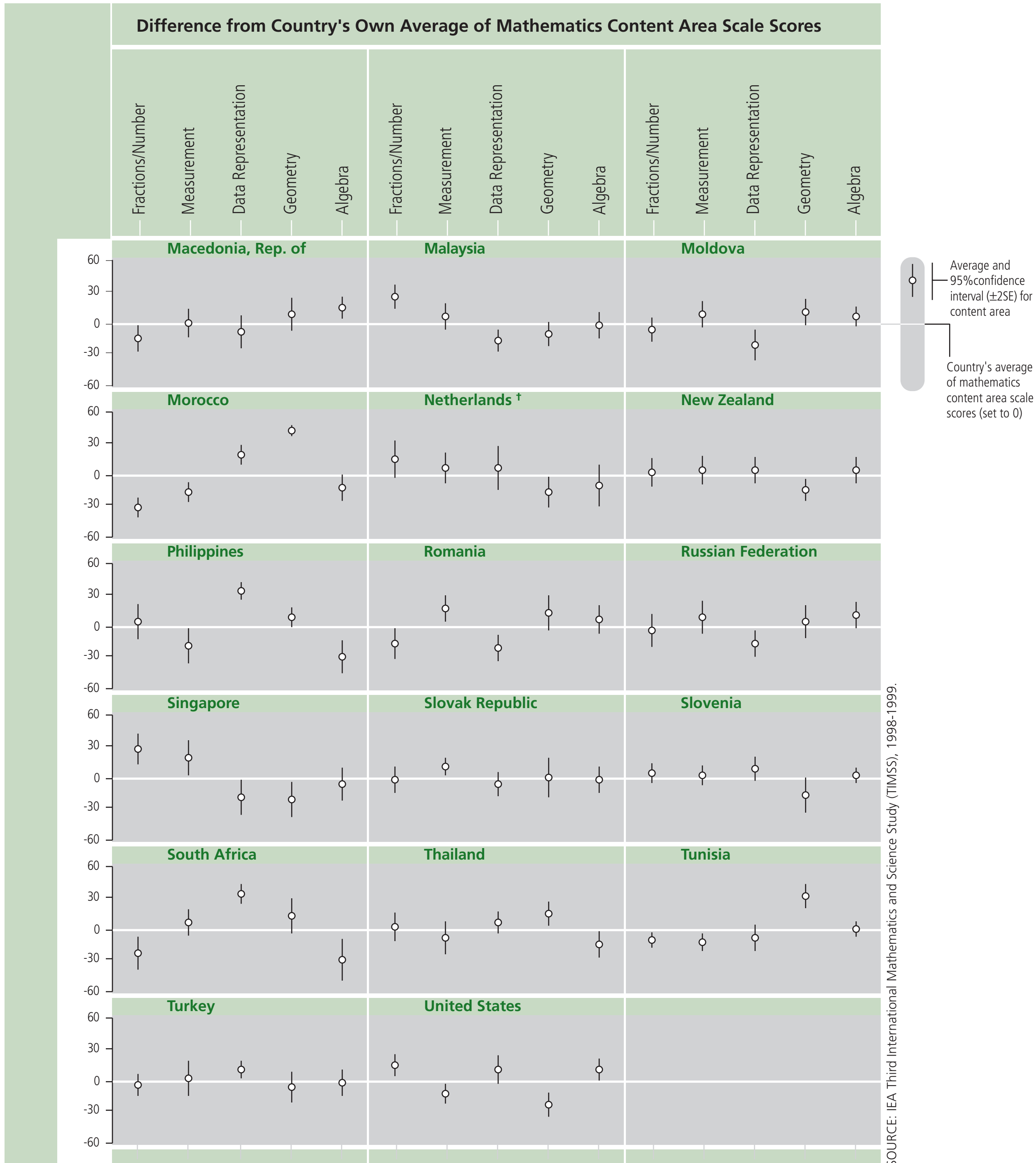


† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

1 National Desired Population does not cover all of International Desired Population (see Exhibit A.5). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

2 National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.5).

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



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

What Are the Gender Differences in Achievement for the Content Areas?

3.3 Exhibit 3.3 displays average achievement in mathematics content areas by gender. The most striking feature of the exhibit is the very small number of statistically significant differences. In geometry and algebra, there were no significant gender differences in average achievement in any country. Across all content areas, there were only five significant differences – three in Tunisia, and one apiece in Israel and the United States. Two of the cases occurred in fractions and number sense (Israel and Tunisia), two in measurement (Tunisia and the United States), and one in data representation, analysis, and probability (Tunisia). Only in fractions and number sense and in measurement were there significant differences in the international averages for girls and boys. It is noted, however, that the few significant differences in content area achievement showed boys having significantly higher achievement than girls.

An important stage of item selection for the TIMSS 1995 and TIMSS 1999 tests was the examination of item statistics to detect items that differentiated between groups, including girls and boys, at the country level. Such items were scrutinized and retained when there was no apparent source of gender bias. It is therefore likely that the absence of significant gender differences in the averages for girls and boys in a country is due partly to a balance between items on which one or the other gender tends to perform better. It is also reasonable to assume that where significant differences do occur, they result from gender differences in one or more of those factors in student backgrounds and schooling that have consistently been found to affect achievement in mathematics.

In spite of there being very few statistically significant differences between average achievement of girls and boys in the content areas, it is interesting to look at the patterns in differences. As highlighted by the differences in international averages, there is a strong tendency across countries for boys to have higher average achievement than girls in fractions and number sense, measurement, and geometry, and to a lesser extent in data representation, analysis, and probability. In algebra, the pattern shows girls with higher averages than boys (in 24 of the 38 countries).

The patterns in the performance of girls and boys found in TIMSS 1999 are consistent with previous IEA mathematics assessments. Girls tended to perform better than boys in algebra in both TIMSS 1995 and the Second International Mathematics Study (SIMS),[4] while boys were markedly stronger in measurement in previous studies.

4 Robitaille D.F. (1989), "Student's Achievements: Population A" in D.F. Robitaille and R.A. Garden (eds.), *The IEA Study of Mathematics II: Contexts and Outcomes of School Mathematics*, New York: Pergamon Press, p.121; Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996a), *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS)*, Chestnut Hill, MA: Boston College.

Exhibit 3.3 Overleaf

Exhibit 3.3 Average Achievement in Mathematics Content Areas by Gender

	Average Scale Scores for Mathematics Content Areas					
	Fractions and Number Sense		Measurement		Data Representation, Analysis, and Probability	
	Girls	Boys	Girls	Boys	Girls	Boys
Australia	515 (4.7)	523 (5.7)	525 (6.4)	534 (6.5)	527 (10.6)	517 (6.2)
Belgium (Flemish) †	555 (6.0)	558 (7.7)	550 (6.5)	547 (8.2)	549 (6.7)	539 (8.8)
Bulgaria	502 (7.1)	505 (7.5)	494 (7.5)	500 (8.3)	493 (6.4)	492 (7.1)
Canada	530 (2.4)	536 (3.4)	519 (4.6)	523 (4.4)	520 (5.2)	522 (6.6)
Chile	400 (6.3)	406 (6.1)	403 (5.6)	420 (9.6)	426 (4.5)	431 (5.3)
Chinese Taipei	574 (4.9)	579 (5.2)	563 (3.3)	569 (5.2)	557 (5.5)	561 (7.9)
Cyprus	478 (3.8)	483 (3.9)	470 (3.8)	471 (5.5)	475 (6.1)	470 (7.5)
Czech Republic	498 (5.7)	517 (6.1)	525 (6.1)	545 (6.6)	502 (7.0)	524 (6.9)
England †	487 (6.0)	507 (5.4)	500 (6.4)	515 (5.4)	498 (6.8)	513 (10.9)
Finland	527 (4.1)	535 (4.9)	520 (5.5)	521 (4.8)	524 (5.5)	526 (6.4)
Hong Kong, SAR †	579 (4.5)	578 (6.1)	567 (5.7)	567 (7.3)	546 (5.3)	548 (7.4)
Hungary	520 (4.8)	531 (4.6)	533 (3.7)	543 (4.3)	514 (7.5)	527 (6.2)
Indonesia	407 (4.6)	406 (6.1)	394 (6.8)	396 (4.7)	419 (4.1)	428 (6.3)
Iran, Islamic Rep.	425 (6.8)	445 (4.9)	385 (6.9)	411 (7.9)	421 (6.4)	435 (8.3)
Israel 2	463 (4.9)	482 (5.2) ▲	449 (6.5)	465 (4.8)	464 (5.9)	473 (5.1)
Italy	463 (6.7)	479 (4.8)	494 (5.7)	508 (5.6)	483 (7.3)	484 (6.2)
Japan	563 (3.4)	576 (4.0)	556 (3.5)	559 (3.0)	552 (5.5)	559 (3.8)
Jordan	433 (5.3)	430 (5.5)	437 (7.9)	439 (7.1)	438 (9.9)	434 (7.2)
Korea, Rep. of	566 (4.3)	573 (3.3)	567 (3.8)	575 (3.2)	574 (6.2)	579 (5.4)
Latvia (LSS) 1	490 (4.9)	503 (5.2)	500 (4.5)	509 (5.5)	498 (5.0)	492 (7.4)
Lithuania 1‡	477 (5.1)	481 (4.9)	463 (4.1)	472 (5.4)	492 (5.4)	494 (5.7)
Macedonia, Rep. of	436 (6.1)	437 (5.4)	449 (8.9)	453 (6.6)	441 (9.7)	443 (6.3)
Malaysia	535 (5.3)	528 (6.6)	516 (5.6)	513 (7.4)	493 (6.1)	488 (10.7)
Moldova	461 (4.2)	470 (6.5)	479 (4.5)	478 (7.4)	449 (4.6)	452 (8.1)
Morocco	326 (5.7)	341 (4.5)	341 (6.4)	353 (4.6)	376 (5.5)	388 (3.3)
Netherlands †	540 (7.9)	551 (7.5)	535 (7.5)	540 (6.2)	534 (10.3)	541 (8.3)
New Zealand	496 (5.6)	490 (6.9)	494 (5.3)	498 (7.4)	502 (7.0)	492 (6.6)
Philippines	382 (7.4)	373 (6.3)	355 (6.4)	355 (8.6)	410 (5.2)	403 (4.3)
Romania	459 (5.4)	458 (7.1)	492 (5.9)	491 (6.8)	453 (6.0)	452 (5.8)
Russian Federation	510 (6.2)	516 (7.1)	524 (7.0)	529 (6.1)	502 (7.0)	501 (9.4)
Singapore	607 (6.2)	609 (6.8)	597 (7.3)	601 (9.0)	563 (6.8)	561 (8.8)
Slovak Republic	522 (5.4)	528 (5.3)	531 (3.9)	543 (4.7)	515 (5.1)	528 (5.9)
Slovenia	523 (4.8)	531 (4.5)	521 (4.9)	526 (5.5)	529 (6.6)	531 (6.9)
South Africa	292 (7.7)	308 (6.7)	322 (5.4)	336 (5.6)	352 (5.5)	361 (5.3)
Thailand	473 (6.4)	469 (5.6)	463 (8.9)	462 (6.4)	480 (6.5)	471 (5.1)
Tunisia	429 (3.1)	458 (3.4) ▲	429 (3.5)	455 (3.7) ▲	435 (6.6)	457 (4.5) ▲
Turkey	428 (5.2)	432 (5.0)	428 (6.7)	443 (7.7)	446 (5.0)	445 (4.8)
United States	505 (4.5)	514 (5.0)	475 (4.0)	489 (4.9) ▲	503 (7.0)	508 (6.3)
International Avg.	484 (0.9)	491 (0.9) ▲	483 (1.0)	491 (1.0) ▲	486 (1.1)	489 (1.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

1 National Desired Population does not cover all of International Desired Population (see Exhibit A.5). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

2 National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.5).

‡ Lithuania tested the same cohort of students as other countries, but later in 1999, 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.

	Average Scale Scores for Mathematics Content Areas			
	Geometry		Algebra	
	Girls	Boys	Girls	Boys
Australia	496 (7.5)	498 (5.4)	523 (6.6)	517 (5.4)
Belgium (Flemish) †	538 (6.9)	531 (9.1)	545 (6.8)	535 (8.8)
Bulgaria	523 (5.8)	525 (7.8)	516 (5.6)	509 (5.7)
Canada	511 (6.5)	503 (4.9)	526 (3.7)	524 (5.2)
Chile	408 (6.2)	415 (6.0)	399 (4.5)	398 (6.3)
Chinese Taipei	555 (7.1)	560 (6.8)	585 (4.5)	588 (6.1)
Cyprus	487 (3.9)	482 (8.2)	487 (2.2)	472 (2.4)
Czech Republic	506 (7.6)	520 (4.9)	513 (3.9)	516 (6.7)
England †	467 (4.8)	474 (6.7)	493 (6.0)	502 (5.1)
Finland	495 (9.8)	494 (8.8)	498 (4.9)	498 (3.8)
Hong Kong, SAR †	558 (6.1)	554 (6.4)	570 (4.8)	568 (5.6)
Hungary	487 (8.1)	492 (7.3)	540 (4.9)	533 (4.9)
Indonesia	439 (7.3)	443 (5.8)	422 (6.8)	426 (5.9)
Iran, Islamic Rep.	433 (5.4)	457 (4.1)	431 (5.8)	435 (6.9)
Israel [2]	456 (7.1)	468 (6.8)	476 (5.6)	483 (5.4)
Italy	476 (8.6)	489 (5.1)	481 (5.4)	481 (4.0)
Japan	572 (5.8)	578 (5.8)	568 (4.2)	571 (3.6)
Jordan	451 (8.4)	447 (7.9)	446 (5.1)	433 (8.9)
Korea, Rep. of	569 (7.3)	578 (4.8)	585 (3.7)	585 (3.9)
Latvia (LSS) [1]	517 (4.2)	528 (9.0)	499 (4.5)	498 (5.0)
Lithuania [1]‡	494 (7.0)	498 (6.1)	490 (5.1)	483 (5.8)
Macedonia, Rep. of	459 (6.8)	460 (8.3)	469 (4.7)	461 (4.2)
Malaysia	496 (5.5)	497 (6.0)	508 (6.0)	502 (5.5)
Moldova	480 (7.0)	481 (7.6)	480 (4.6)	475 (5.5)
Morocco	405 (5.3)	408 (5.4)	350 (7.4)	354 (4.2)
Netherlands †	516 (7.0)	515 (5.2)	522 (9.3)	522 (7.4)
New Zealand	481 (8.3)	474 (6.7)	506 (5.6)	487 (6.4)
Philippines	383 (5.5)	383 (4.2)	355 (7.6)	333 (8.8)
Romania	490 (12.2)	484 (7.3)	489 (5.5)	473 (6.0)
Russian Federation	518 (7.2)	526 (7.4)	533 (5.7)	524 (6.3)
Singapore	556 (9.2)	565 (6.5)	578 (6.7)	574 (7.9)
Slovak Republic	524 (8.8)	529 (6.9)	530 (5.3)	521 (4.7)
Slovenia	507 (8.2)	505 (6.3)	530 (3.1)	520 (3.8)
South Africa	333 (8.5)	338 (6.1)	290 (8.4)	296 (9.7)
Thailand	483 (4.7)	486 (7.9)	460 (6.0)	452 (5.4)
Tunisia	476 (7.5)	492 (5.2)	450 (3.6)	460 (2.7)
Turkey	429 (5.5)	428 (8.1)	442 (5.1)	426 (4.7)
United States	469 (5.5)	477 (5.1)	507 (4.3)	504 (4.6)
International Avg.	485 (1.2)	489 (1.1)	489 (0.9)	485 (0.9)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

What Changes Have Occurred in Content Area Achievement?

3.4 To examine changes in achievement in the mathematics content areas, Exhibit 3.4 shows the average percent correct for eighth-grade students in 1995 and 1999 for items given in both the 1995 and 1999 TIMSS assessments, and the difference in performance between assessments. This content area trend analysis uses average percent correct rather than average scale score because there were insufficient items to reliably link the results for both assessments to the TIMSS scale.

Changes in average achievement at a national level are not easy to bring about and inevitably take place over several years. Amending official curricula, producing relevant supporting resources, and changing teacher practice all take time, even under the most favorable conditions. TIMSS 1999 is only the second in what is expected to become a series of international surveys designed to reveal trends in achievement in mathematics and science. It is not surprising, therefore, that the trend data contained in Exhibit 3.4 reveal only a few significant changes in average achievement in the content areas. It is likely that the next TIMSS administration scheduled for 2003 will show more significant changes in achievement.

Still, even during the four years between 1995 and 1999, statistically significant improvements occurred for Canada and Latvia (LSS) in all content areas except measurement, and for Cyprus in three content areas. Each of these countries also showed slight improvement in the remaining content areas. Average achievement in the Czech Republic showed statistically significant decreases in three content areas, and a slight decline in the remaining two areas. A small but significant increase in the international average for data representation, analysis, and probability, the only content area with a significant change internationally between 1995 and 1999, may be a result of increasing efforts to include elementary statistical concepts at the primary grades.

Although the changes were not statistically significant, Australia, Belgium (Flemish), Hong Kong, the Netherlands, and the United States showed small increases in achievement in all five content area means. Conversely, Bulgaria and Italy had small decreases in average achievement in all content areas (with a significant change in Bulgaria in data representation, analysis, and probability).

Exhibit 3.4 Overleaf

Exhibit 3.4 Trends in Average Percent Correct in Mathematics Content Areas

	Average Percent Correct in Mathematics Content Areas*								
	Total Mathematics Trend Items (48 items)			Fractions and Number Sense Trend Items (17 items)			Measurement Trend Items (6 items)		
	1995	1999		1995	1999		1995	1999	
Australia	68 (0.9)	69 (1.1)	●	68 (0.8)	70 (1.0)	●	71 (0.9)	73 (1.1)	●
Belgium (Flemish)	73 (1.3)	76 (0.7)	●	75 (1.2)	77 (0.6)	●	77 (1.5)	79 (1.1)	●
Bulgaria	70 (1.3)	65 (1.3)	●	67 (1.6)	61 (1.4)	●	69 (1.5)	63 (1.1)	●
Canada	67 (0.5)	70 (0.4)	▲	69 (0.5)	72 (0.5)	▲	64 (0.6)	67 (0.7)	●
Cyprus	54 (0.5)	56 (0.4)	▲	55 (0.5)	58 (0.5)	▲	45 (0.8)	46 (0.6)	●
Czech Republic	72 (1.0)	67 (0.9)	▼	67 (1.2)	61 (1.1)	▼	80 (0.8)	77 (1.0)	●
England	64 (0.6)	63 (0.9)	●	65 (0.7)	65 (0.9)	●	67 (0.8)	66 (1.2)	●
Hong Kong, SAR	77 (1.3)	79 (0.9)	●	78 (1.3)	81 (0.9)	●	76 (1.4)	77 (1.0)	●
Hungary	67 (0.8)	68 (0.8)	●	63 (0.8)	65 (0.9)	●	73 (0.8)	74 (0.7)	●
Iran, Islamic Rep.	44 (0.6)	44 (0.6)	●	46 (0.7)	45 (0.7)	●	31 (1.0)	34 (0.7)	●
Italy	60 (0.9)	58 (1.1)	●	57 (1.0)	55 (1.1)	●	64 (1.2)	63 (1.2)	●
Japan	78 (0.3)	78 (0.3)	●	76 (0.4)	76 (0.4)	●	75 (0.4)	74 (0.5)	●
Korea, Rep. of	80 (0.4)	81 (0.4)	●	76 (0.5)	77 (0.4)	●	81 (0.6)	83 (0.4)	●
Latvia (LSS)	59 (0.8)	64 (0.8)	▲	54 (0.9)	59 (0.9)	▲	66 (1.0)	70 (1.0)	●
Lithuania	56 (1.0)	57 (1.0)	●	52 (1.0)	54 (1.1)	●	57 (0.9)	56 (0.9)	●
Netherlands	70 (1.6)	74 (1.6)	●	70 (1.3)	75 (1.7)	●	76 (1.6)	77 (1.6)	●
New Zealand	64 (1.1)	62 (1.2)	●	65 (1.0)	63 (1.2)	●	66 (1.2)	65 (1.3)	●
Romania	55 (1.0)	54 (1.1)	●	51 (0.9)	50 (1.1)	●	57 (1.2)	57 (1.3)	●
Russian Federation	68 (1.4)	68 (1.3)	●	64 (1.7)	64 (1.4)	●	69 (1.1)	73 (1.3)	●
Singapore	84 (0.7)	83 (1.1)	●	87 (0.6)	85 (1.0)	●	86 (0.7)	83 (1.1)	●
Slovak Republic	69 (0.7)	69 (0.9)	●	66 (0.8)	67 (1.1)	●	75 (0.7)	75 (0.9)	●
Slovenia	69 (0.7)	70 (0.6)	●	68 (0.8)	69 (0.7)	●	72 (0.8)	72 (0.7)	●
United States	61 (1.1)	63 (0.9)	●	63 (1.1)	66 (0.9)	●	53 (1.1)	55 (1.1)	●
International Avg. §	66 (0.2)	67 (0.2)	●	65 (0.2)	66 (0.2)	●	67 (0.2)	68 (0.2)	●
Countries with Unapproved Sampling Procedures at the Classroom Level in 1995									
Israel	66 (1.3)	59 (1.1)	▼	67 (1.2)	61 (1.0)	▼	63 (1.5)	55 (1.1)	▼
South Africa	29 (1.2)	27 (0.8)	●	31 (1.2)	29 (0.8)	●	30 (1.4)	28 (0.7)	●
Thailand	65 (1.3)	54 (1.0)	▼	66 (1.3)	55 (1.1)	▼	63 (1.5)	51 (1.2)	▼

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

* Applies only to items that appeared on both the 1995 and 1999 assessments.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

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

	Average Percent Correct in Mathematics Content Areas*					
	Data Representation, Analysis, and Probability Trend Items		Geometry Trend Items		Algebra Trend Items	
	(8 items)		(6 items)		(11 items)	
	1995	1999	1995	1999	1995	1999
Australia	71 (0.8)	74 (1.0) ●	58 (1.1)	59 (1.4) ●	67 (1.0)	69 (1.2) ●
Belgium (Flemish)	74 (1.3)	77 (0.9) ●	66 (1.4)	70 (1.1) ●	72 (1.6)	73 (0.8) ●
Bulgaria	74 (1.3)	66 (1.1) ▼	76 (1.2)	73 (1.5) ●	71 (1.5)	66 (1.4) ●
Canada	70 (0.7)	73 (0.5) ▲	61 (0.7)	64 (0.7) ▲	64 (0.7)	70 (0.6) ▲
Cyprus	56 (0.7)	59 (0.6) ▲	56 (0.8)	59 (0.7) ●	53 (0.6)	54 (0.6) ●
Czech Republic	75 (0.8)	73 (0.8) ●	73 (1.2)	67 (1.2) ▼	72 (1.3)	65 (1.1) ▼
England	71 (0.7)	73 (0.9) ●	51 (1.0)	49 (1.2) ●	61 (0.8)	60 (1.2) ●
Hong Kong, SAR	74 (1.1)	78 (0.8) ●	78 (1.6)	80 (1.1) ●	78 (1.4)	79 (1.0) ●
Hungary	74 (0.6)	75 (0.9) ●	56 (1.1)	55 (1.1) ●	70 (0.9)	72 (0.8) ●
Iran, Islamic Rep.	45 (0.7)	47 (0.6) ●	44 (0.9)	44 (0.8) ●	48 (0.9)	47 (0.8) ●
Italy	67 (0.9)	65 (1.3) ●	59 (1.2)	58 (1.3) ●	58 (1.0)	55 (1.3) ●
Japan	79 (0.3)	80 (0.4) ●	84 (0.4)	82 (0.5) ●	79 (0.4)	79 (0.5) ●
Korea, Rep. of	85 (0.5)	85 (0.3) ●	83 (0.6)	84 (0.5) ●	81 (0.4)	83 (0.5) ●
Latvia (LSS)	63 (0.9)	69 (0.8) ▲	67 (1.0)	73 (0.9) ▲	56 (1.0)	60 (0.9) ▲
Lithuania	60 (1.0)	66 (0.9) ▲	64 (1.3)	63 (1.4) ●	55 (1.2)	54 (1.2) ●
Netherlands	77 (1.6)	80 (1.5) ●	62 (1.8)	66 (1.7) ●	65 (2.1)	70 (2.0) ●
New Zealand	70 (1.0)	69 (1.3) ●	55 (1.3)	51 (1.4) ●	60 (1.2)	60 (1.5) ●
Romania	57 (1.1)	56 (1.1) ●	62 (1.3)	59 (1.3) ●	56 (1.2)	55 (1.3) ●
Russian Federation	69 (1.4)	69 (1.2) ●	71 (1.0)	70 (1.6) ●	69 (1.5)	71 (1.4) ●
Singapore	79 (0.8)	79 (1.1) ●	82 (0.9)	81 (1.3) ●	83 (0.9)	82 (1.3) ●
Slovak Republic	71 (0.8)	73 (0.9) ●	71 (0.9)	71 (1.2) ●	67 (1.0)	66 (1.1) ●
Slovenia	75 (0.7)	76 (0.7) ●	64 (0.9)	63 (0.9) ●	69 (0.8)	69 (0.7) ●
United States	67 (1.0)	69 (0.9) ●	50 (1.1)	52 (1.0) ●	63 (1.3)	66 (1.0) ●
International Avg. §	70 (0.2)	71 (0.2) ▲	65 (0.2)	65 (0.2) ●	66 (0.2)	66 (0.2) ●
Countries with Unapproved Sampling Procedures at the Classroom Level in 1995						
Israel	66 (1.5)	62 (1.1) ●	65 (1.6)	56 (1.3) ▼	65 (1.6)	59 (1.2) ●
South Africa	31 (1.1)	29 (0.8) ●	23 (1.2)	22 (0.7) ●	27 (1.4)	26 (1.0) ●
Thailand	66 (1.0)	58 (1.0) ▼	68 (1.4)	57 (1.3) ▼	64 (1.5)	50 (1.1) ▼

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons