Chapter 2

International Student Achievement in Advanced Mathematics

Chapter 2 focuses on the TIMSS Advanced achievement results for students enrolled in advanced mathematics courses in the nal year of secondary school in each of the participating countries. e chapter also addresses trends in mathematics achievement over time for participants in the previous TIMSS assessment at this level in 1995. Achievement di erences by gender are also discussed.

Mathematics Achievement

Exhibit 2.1 shows the distribution of student achievement in mathematics for the participants in TIMSS Advanced , including the average (mean) scale score with its 95 percent con dence interval and the ranges in performance for the middle half of the students (25th to 75th percentiles), as well as the extremes (5th and 95th percentiles).

(0.968), and Sweden (0.956). With an index value of 0.813, just over the 0.8 borderline for the UNDP's high category, the Russian Federation also falls into the high category. However, four countries had index values in the 0.7 range and fall into the UNDP's medium category. Of the four countries, Armenia, Lebanon, and the Philippines had nearly

200

2007

When the IEA began studying education internationally in the 1950s and 1960s, the populations compared often were to some degree comprised of elite students, especially at the secondary school level.

at is, substantial proportions of students had dropped out of school and only the better students were continuing their schooling. Beyond that, most systems employed some type of tracking or streaming so that the better students received the more advanced education. However, as the years have gone by, more and more students in more and more countries are enrolled in basic education and also completing secondary education. us, recent international assessments

2007		
Russian Federation	544 (4.9)	h
Netherlands	535 (2.1)	h
Italy	507 (3.1)	h
Sweden	503 (2.5)	
Slovenia	502 (1.8)	
TIMSS Scale Avg.	500	
Armenia	500 (4.3)	
Norway	473 (2.5)	i
Iran, Islamic Rep. of	402 (4.1)	i

2007		
** Netherlands	536 (3.8)	h
Russian Federation	512 (4.1)	h
Slovenia	501 (2.1)	
TIMSS Scale Avg.	500	
Armenia	499 (3.5)	
Sweden	491 (2.3)	i
Italy	480 (3.0)	i
Norway	469 (2.0)	i
Lebanon	449 (4.0)	i

200		
Russian Federation	561 (7.2)	h
Netherlands	552 (2.6)	h
Lebanon	545 (2.3)	h
TIMSS Scale Avg.	500	
Iran, Islamic Rep. of	497 (6.4)	
Slovenia	457 (4.2)	i
Italy	449 (7.2)	i
Norway	439 (4.9)	i
Armenia		

e Russian Federation performed above the scale average in all three assessments—fourth grade, eighth grade, and the nal year of secondary school. It appears to be doing a good job of educating all of its students through lower secondary school as well as making it possible for a small percentage of elite students (1.4) to reach a high level of excellence in mathematics by their nal year of secondary school. Although the Russian Federation had the smallest coverage index, its students had 10 or 11 years of school (compared to 12 or 13) and were among the youngest (17 years old). It is especially noteworthy that all Russian students study mathematics and physics every year in lower secondary and upper secondary education, and the students assessed by TIMSS Advanced were having 6 hours or more of mathematics instruction per week. Similarly, the Netherlands demonstrated high achievement in TIMSS at the fourth grade, in TIMSS at the eighth grade, and for their mathematics specialists (3.5 of the age cohort) in TIMSS Advanced . Its mathematics specialists were in

average results for the three populations of students, but its HDI value is among the lowest. Also, the Philippine students participating in TIMSS Advanced were among those with the fewest years of schooling, were the youngest, and according to their teachers had not been taught a considerable amount of the curriculum assessed.

Several countries had relatively lower achievement on TIMSS Advanced than on TIMSS . Slovenia and Armenia performed at about the TIMSS scale average at the fourth and eighth grades, but below the scale average for TIMSS Advanced. Slovenia is a high HDI country and its students were in the 12

to its TIMSS performance, which was below the TIMSS scale average at the eighth grade. Similarly, Iran performed at about the TIMSS Advanced scale average, in contrast to its performance in TIMSS of approximately 100 scale points below the TIMSS scale average at both the fourth and eighth grades. ese two countries are facing a number of challenges that have likely impacted their TIMSS results, including socioeconomic di culties (medium category HDIs). Nevertheless, as evidenced by their TIMSS Advanced results, these countries have educated select groups of students (about 6) to relatively high levels of achievement in mathematics internationally.

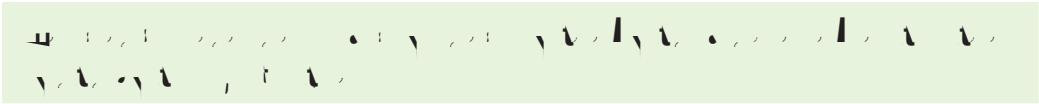

Exhibit 2.4 shows the percentages of girls and boys enrolled in advanced mathematics in each of the participating countries and their di erences in mathematics achievement on TIMSS Advanced . It presents average achievement separately for females and males for the TIMSS Advanced countries, as well as the absolute di erence between the two averages. The difference between the average achievement of females and males is shown in the graph by a bar indicating the amount of the di erence, whether the direction of the di erence was positive for females or males, and whether the di erence is statistically significant (indicated by a darkened bar). Countries are shown in increasing order of the absolute di erence in average achievement between females and males.

Armenia was the only country with equivalent percentages of female students (52) and male students (48) taking advanced courses in mathematics, although the Russian Federation and Iran had nearly equivalent percentages (about 45 female and 55 male). e greatest imbalance was in the Netherlands, where 77 of the students

were male. Also, in Italy, Norway, Lebanon, and Sweden, from 60 to 66 percent of the students were male. In Slovenia and the Philippines, there was approximately a 60/40 split with the larger percentage of students being female.

In four countries, there was essentially no di erence in average

Exhibit 2.5 d A A Ad d

TIMSSAdvanced 2008 A

			200	1 5	1 5 200	1 5	200
	200	1 5					
Russian Federation	1.4%	2.0%	561 (7.2)	549 (7.7)	12 (10.6)		
‡ Slovenia	40.5%	75.4%	457 (4.2)	478 (9.3)	–20 (10.2)		
Italy	19.7%	20.2%	449 (7.2)	483 (10.8)	–34 (12.9)		
Sweden	12.8%	16.2%	412 (5.5)	502 (5.6)	–89 (7.9)		

from about 75 to 41 percent, and coverage for Sweden also was reduced to some extent, from approximately 16 to 13 percent.

The participants are shown in the exhibit according to the di erence between their average achievement in 1995 and 2008. In

uses average percent correct rather than average scale scores because there were insu cient items in all of the di erent domains to develop reliable scales. e countries are listed in alphabetical order.

In Armenia, students did relatively better in the algebra content domain than they did overall and relatively less well in calculus. The result in calculus is consistent with the reports that Armenia covered fewer of the TIMSS Advanced calculus topics than the other participating countries. In the cognitive domains, Armenian students did relatively better in the knowing domain than they did overall and less well in the applying domain. Iranian students and Italian students had similar achievement patterns across domains, demonstrating consistency with their overall average achievement in the content domains, but relatively higher average achievement on the knowing items and lower average achievement on the applying items. Dutch students also had consistent performance across the content domains, but had relatively higher average achievement in the reasoning domains and relatively lower average achievement in knowing and applying. Students in Lebanon performed relatively better in geometry and less well in algebra, and better in knowing and less well in applying and reasoning. Compared to their overall average achievement, students in Norway, the Philippines, and Slovenia demonstrated relative weakness in the calculus domain and relative strength in the geometry domain. For the Philippines and to a lesser extent Slovenia, this is consistent with teacher reports that they did not feel well prepared to teach some calculus topics and some calculus topics were not taught to sizeable percentages of students. Norway had consistent performance across the cognitive domains, whereas the Philippines had relative strength in knowing and relative weakness in applying. Slovenia's relative strength was in knowing and relative weakness in applying. Students in the Russian Federation did comparatively better in the content domain

Exhibit 2.7 A C D

TIMSSAdvanced 2008 Advanced Mathematics

	(71)	(25)		(25)		(21)		(27)		(27)		(17)	
Armenia	32 (0.7)	37 (0.8)	h	27 (0.6)	i	33 (0.8)		39 (0.7)	h	27 (0.8)	i	31 (0.8)	
Iran, Islamic Rep. of	43 (1.4)	45 (1.5)		41 (1.4)		44 (1.4)		52 (1.3)	h	36 (1.4)	i	42 (1.7)	
Italy	35 (1.1)	33 (1.2)		36 (1.3)		36 (1.1)		40 (1.1)	h	31 (1.2)	i	33 (1.3)	
Lebanon	53 (0.5)	51 (0.6)	i	53 (0.6)		55 (0.5)	h	65 (0.5)	h	43 (0.6)	i	51 (0.6)	i
† Netherlands	54 (0.5)	55 (0.5)		53 (0.6)		53 (0.6)		51 (0.5)	i	51 (0.6)	i	63 (0.6)	h
Norway	33 (0.7)	33 (0.8)		30 (0.7)	i	37 (0.7)	h	34 (0.7)		33 (0.7)		32 (0.8)	
Philippines	24 (0.6)	24 (0.9)		19 (0.5)	i	31 (0.6)	h	28 (0.7)	h	21 (0.7)	i	24 (0.6)	
Russian Federation	57 (1.6)	62 (1.6)	h	53 (1.6)		56 (1.6)		59 (1.4)		56 (1.7)		56 (1.7)	
Slovenia	36 (0.7)	38 (0.7)		32 (0.8)	i	38 (0.9)	h	41 (0.8)	h	34 (0.8)		33 (0.7)	i
Sweden	31 (0.7)	32 (0.9)		28 (0.8)	i	32 (0.6)		32 (0.8)		28 (0.7)	i	34 (0.8)	h

h

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

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

SOURCE: IEA TIMSS Advanced 2008 ©