Chapter 1

International Student Achievement in Science

Chapter 1 summarizes achievement for eighth- and fourth-grade students on the TIMSS 2003 science assessment for each of the participating countries. It also shows trends in student performance at the eighth grade for those countries that also participated in TIMSS 1995 and 1999. At the fourth grade, trends are presented for those countries that participated in the 1995 assessment (no assessment was conducted at the fourth grade in 1999). Achievement differences by gender at both grades also are provided.

How Do Countries Differ in Science Achievement?

The first page of Exhibit 1.1 presents the distribution of student achievement[1] for the 46 countries and four benchmarking entities that participated at the eighth grade in TIMSS 2003 and the second page presents the distribution of student achievement for the 25 countries and three benchmarking entities that participated at the fourth grade.[2] Countries are shown in decreasing order of average (mean) scale score, together with an indication of whether the country average is

1 ▼ ( ) 500
100.

Countries	Years of Schooling*	Average Age

students begin formal schooling and different policies about promotion and retention from grade to grade.

At the eighth grade, the aim was that the students assessed would have had eight years of formal schooling. Most notably, 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. Even though the students assessed at the eighth grade typically averaged between 14 and 15 years old, the variety of countries assessed and their situations also resulted in a considerable range in the average age of the students assessed. To illustrate how education policies can affect the interaction between age and number of years of schooling, it is interesting to note that Scotland, one of the few countries with an additional year of schooling, starts formal schooling at an early age and had the youngest students assessed – 13.7 years old on average. Other countries assessing students younger than 14 years old included Slovenia, Norway, and Cyprus with 13.8 and Australia, Jordan, and Italy with 13.9. Students in the Balkans and some Eastern European countries start school later and tended to be older, particularly in Estonia with an average of 15.2. Students also were older in several African countries including Botswana and South Africa both averaging 15.1, Morocco averaging 15.2, and Ghana averaging 15.5. In these countries, it is not unusual for students to start school at an older age and also, perhaps, to find it necessary to interrupt their schooling.

At the fourth grade, the aim was to assess students having had four years of formal schooling and this was the case for the most part. However, 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. In terms of chronological age, students in most countries averaged between 10 and 11 years old. Consistent with the patterns at the eighth grade, students were somewhat younger in Scotland, averaging

9.7 years old; Italy, Slovenia, and Norway, averaging 9.8; and Austra-

Countries

Benchmarking Participants

number of countries was one of having lower mean achievement than some countries, about the same mean achievement as other countries, and higher mean achievement than a third group of countries.

At the eighth grade, Singapore and Chinese Taipei were the top-performing countries having significantly higher mean achievement than the rest of the participating countries. The Republic of Korea also performed very well, with mean science achievement higher than all of the other participating countries except Singapore, Chinese Taipei, and Hong Kong SAR. Hong Kong SAR, Estonia and Japan had significantly higher achievement than most other participating countries, as did England, Hungary, and the Netherlands. Singapore was the top-performing country at the fourth grade, with higher average science achievement than all other participants. With the exception of Singapore, Chinese Taipei had higher average achievement than the rest of the participating countries. Japan, Hong Kong SAR, and England had significantly higher average achievement than the other participating countries. The United States, Latvia, Hungary, and the Russian Federation also performed better, on average, than most of the other countries.

How Has Science Achievement Changed Since 1995 and 1999?

Exhibit 1.3 shows the countries that have comparable data from previous TIMSS assessments at the eighth and fourth grades. At the eighth grade, 35 countries and three of the benchmarking participants have data from one or both of the previous TIMSS assessments conducted in 1995 and 1999. Well over half of the countries and two of the bench-

Countries	Science Achievement Distribution

	00	377 (5.8)			14.8
	1999	345 (7.5)	32 (.7) ▲		14.1
	00	244 (6.7)			15.1
	1999	243 (7.8)	1 (10.2)		15.5
‡	00	544 (4.1)			14.3
	1999	538 (4.8)	5 (6.4)		14.2
	199	533 (3.6)		11 (5.5)	14.0
Benchmarking Participants					
	00	531 (4.8)			14.5
	1999	534 (7.0)	-4 (8.5)		14.4
	00	533 (2.7)			13.8
	1999	518 (3.1)	15 (4.1) ▲		13.
	199	4 6 (3.7)		37 (4.6) ▲	14.0
	00	531 (3.0)			14.2
	1999	540 (4.8)	- (5.7)		14.3
	199	510 (6.)		21 (7.5) ▲	14.5

Countries	Science Achievement Distribution
00 565 (5.5)	

collection in Australia and Slovenia so their 1999 data are not shown. Also, the 1995 data are not shown for Israel, Italy, and South Africa since the characteristics of their samples were not completely known in that fi

Ontario. Several participants showed significant declines, including Japan, Scotland, Norway, and Quebec.

A number of countries showed remarkable changes in science achievement over the eight-year period covered by the TIMSS assessments, some of which may be the result of societal or educational changes during this time. For example, the political changes in Eastern Europe more than a decade ago spawned far-reaching educational reform initiatives that have changed the face of education in many countries in the region. The achievement growth in Latvia and Lithuania as well as the strong performance of Estonia in its first TIMSS appearance may reflect the efforts at improvement in those countries. In contrast, countries in the region where reform efforts seem to have been less successful include Bulgaria, the Russian Federation, the Slovak Republic, each of which show decreases over the period.

What Are the Gender Differences in Science Achievement?

Exhibit 1.4 shows gender differences in eighth- and fourth-grade mathematics achievement in 2003. It presents average achievement separately for girls and boys for each of the TIMSS 2003 countries, as well as the difference between the means. Countries are shown in increasing order of this gender difference. The gender difference for each country is shown by a bar indicating the amount of the difference, whether the direction of the difference favored girls or boys, and whether the difference is statistically significant (indicated by a darkened bar).

On average, across all countries, boys outperformed girls at the

Japan, Egypem Ir7 TDChc0 0 TTDCyprus Tw(SPhilippc0 TwstatNew Zea024 Twee6ich show dec.333.

However, in the majority of participants (33), boys outperformed girls, often by a substantial margin. For example, countries where the gender difference was 20 points or more included Israel, Australia, Belgium (Flemish), Tunisia, Hungary, Chile, and Ghana. At the fourth grade, the average difference internationally was negligible. However, girls had significantly higher average achievement in Armenia, Moldova, the Philippines, and Iran. Boys had higher average achievement in the United States, Chinese Taipei, Cyprus, the Netherlands, and Scotland.

Achievement differences between TIMSS 2003 and 1995 and 1999 are presented separately for girls and for boys in Exhibit 1.5. At the eighth grade, girls showed a seven-point improvement, on average, since 1999, however, boys showed no improvement. Fifteen participants showed significant improvement for girls, and just eight for boys. Both boys and girls had significantly higher achievement in 2003 than in previous assessments in Hong Kong SAR, Israel, Jordan, Latvia (LSS), Lithuania, Malaysia, the Philippines, the United States, and Ontario. Girls but not boys showed improved performance compared to 1999 in Iran, Korea, Moldova, Singapore, and England. Only in Australia and Quebec did boys show improvement and girls not. Both boys and girls had significantly lower average achievement in TIMSS 2003 in Belgium (Flemish), Bulgaria, Cyprus, Norway, the Slovak Republic, Sweden, and Tunisia. In Indonesia, Macedonia, and the Russian Federation, the boys, but not the girls, had a significant decrease.

At the fourth grade, both boys and girls improved performance significantly on average since 1995 (17 points for girls and 9 points for boys). Both genders improved in Cyprus, Hong Kong SAR, Hungary, Iran, Latvia (LSS), New Zealand, Singapore, Slovenia, and Ontario. In England, only girls improved. Both boys and girls showed declines in Japan, Norway, and Quebec. Boys but not girls showed declines in the Netherlands and the United States.

						Girls	Boys
	46 (2.7)	422 (4.8)	54 (2.7)	421 (5.5)	1 (6.8)		
	40 (4.1)	454 (3.)	60 (4.1)	453 (3.7)	1 (6.1)		
	48 (1.0)	571 (3.8)	52 (1.0)	572 (3.8)	1 (3.1)		
	51 (0.7)	364 (3.2)	4 (0.7)	366 (3.4)	2 (3.3)		
	51 (0.)	242 (7.2)	4 (0.)	244 (7.7)	2 (6.1)		
	57 (1.8)	3 2 (4.8)	43 (1.8)	3 5 (6.0)	3 (6.4)		
	4 (0.8)	576 (4.0)	51 (0.8)	57 (5.0)	3 (3.1)		
	50 (1.0)	554 (2.8)	50 (1.0)	551 (2.)	3 (2.8)		
	4 (0.6)	443 (2.3)	51 (0.6)	440 (2.8)	4 (3.0)		
1	50 (0.)	516 (2.7)	50 (0.)	522 (2.4)	6 (2.5)		
	4 (0.8)	465 (2.)	51 (0.8)	471 (2.6)	6 (2.5)		
	50 (0.2)	471 (0.7)	50 (0.2)	477 (0.7)	6 (0.6)		
	50 (0.)	517 (2.4)	50 (0.)	524 (2.3)	7 (3.0)		
	58 (0.)	380 (5.)	42 (0.)	374 (6.4)	7 (4.1)		
	4 (0.8)	50 (2.6)	51 (0.8)	516 (3.0)	7 (2.4)		
	51 (0.)	521 (3.2)	4 (0.)	528 (2.7)	8 (2.5)		
	50 (0.8)	4 0 (2.2)	50 (0.8)	4 8 (3.0)	8 (2.)		
	4 (0.)	454 (3.7)	51 (0.)	445 (4.2)	8 (3.3)		
	51 (0.8)	477 (3.5)	4 (0.8)	468 (3.7)	8 (2.6)		
	52 (0.)	465 (5.5)	48 (0.)	474 (4.)	(3.5)		
	50 (2.4)	552 (3.4)	50 (2.4)	561 (3.8)	(3.)		
	4 (1.2)	548 (3.0)	51 (1.2)	557 (2.7)	(4.5)		
	52 (1.7)	515 (4.8)	48 (1.7)	525 (6.7)	(5.7)		
	11 1 . 0. 31 2.06 0 . 0 . _ 5 1 . 13.4828 0 .				(50)-350.4((1.8))-2450.	(505)-33 .5((3.4))-3105.	(50)-350.4((0.8))-2450. (505)-3( )(1.8). 1

						Girls	Boys
1	4 (0.)	513 (3.0)	51 (0.)	513 (2.)	0 (2.5)		
	4 (1.4)	565 (5.4)	51 (1.4)	565 (6.4)	1 (4.2)		
	48 (1.1)	4 1 (3.0)	52 (1.1)	4 0 (3.2)	1 (3.7)		
	50 (0.8)	467 (3.2)	50 (0.8)	466 (2.)	1 (3.1)		
	50 (0.7)	527 (5.)	50 (0.7)	526 (4.)	1 (3.3)		
( )	50 (1.0)	518 (1.)	50 (1.0)	51 (2.3)	1 (2.3)		
	4 (0.2)	48 (1.1)	51 (0.2)	488 (0.)	1 (0.8 0.8)	467 (.127	73.80467348 (1.1)

	517 (4.6)			10 (6.0)		537 (4.6)			18 (7.1)	▲
( )	505 (3.0)	-21 (5.4)	▼	-19 (9.2)	▼	528 (3.4)	-16 (7.9)	▼	-14 (9.7)	
	470 (6.3)	-41 (8.6)	▼	-78 (8.8)	▼	487 (5.2)	-38 (8.3)	▼	-56 (7.6)	▼
	398 (3.2)	-11 (5.6)				427 (3.6)	-5 (6.2)			
	571 (3.8)	10 (5.5)				572 (3.8)	-6 (6.6)			
	443 (2.3)	-11 (4.2)	▼	-11 (3.6)	▼	440 (2.8)	-26 (4.2)	▼	-11 (3.8)	▼
	552 (3.4)	29 (5.7)	▲	60 (7.4)	▲	561 (3.8)	24 (6.2)	▲	36 (7.4)	▲
	530 (3.4)	-10 (5.5)		5 (4.8)		556 (3.0)	-10 (5.4)		7 (4.7)	
	415 (3.9)	-12 (7.7)				426 (4.6)	-18 (6.7)	▼		
	454 (3.9)	24 (6.9)	▲	6 (7.0)		453 (3.7)	-7 (5.7)		-22 (5.8)	▼
	479 (3.2)	18 (6.8)	▲			498 (4.1)	23 (7.0)	▲		
	486 (2.7)	1 (4.9)				496 (3.8)	-7 (7.2)			
	548 (3.0)	5 (4.0)		3 (3.5)		557 (2.7)	0 (4.1)		-7 (3.6)	▼
	489 (4.5)	29 (6.8)	▲			462 (5.6)	20 (8.3)	▲		
	552 (2.1)	14 (4.4)	▲	22 (3.2)	▲	564 (1.9)	5 (4.0)		6 (3.4)	
( )	511 (3.2)	16 (5.9)	▲	48 (5.0)	▲	515 (3.3)	5 (6.0)		25 (5.4)	▲
	516 (2.7)	38 (5.2)	▲	64 (5.2)	▲	522 (2.4)	23 (5.6)	▲	45 (5.1)	▲
	454 (3.7)	-4 (7.1)				445 (4.2)	-13 (6.6)	▼		
	505 (4.3)	17 (7.1)	▲			515 (4.0)	18 (7.1)	▲		
	477 (3.5)	22 (5.7)	▲			468 (3.7)	3 (6.2)			
	528 (3.3)	-8 (8.0)		0 (6.5)		543 (3.8)	-11 (8.2)		-11 (8.3)	
	515 (4.8)	9 (7.0)		18 (7.5)	▲	525 (6.7)	11 (9.7)		18 (7.1)	▲