

attitudes toward mathematics. They may also assign homework and conduct informal as well as formal assessments to evaluate achievement outcomes.

How Do the Characteristics of Mathematics Classrooms Impact Instruction?

Because it can affect pedagogical strategies, class size data are shown in Exhibit 7.1. Teachers' reports about the sizes of their eighth-grade mathematics classes reveal that across countries the average class size was 30 students, but there was considerable variation – from more than 54 students in the Philippines to 20 students in Belgium (Flemish). At the fourth grade, classes typically were smaller. The average class size for the TIMSS participants was 26 students, ranging from 40 in the Philippines to 20 in Belgium (Flemish), Italy and Slovenia.

The relationship between class size and achievement is difficult to disentangle, given the variety of policies and practices that countries have in determining class size. For example, countries and schools cannot always control class size. Because of this, the ability to cap class sizes can indicate the availability of more resources in general. As

Students were placed in the high category, if, on average, teachers reported their classrooms were impacted only a little (or less) and in the low category, if, on average, these factors impacted instruction at least somewhat. The remaining students fell in the medium category. The results show that average mathematics achievement is related to the impact of student characteristics on classroom instruction, with lower achievement related to having more instructionally challenging and diverse students in the class. On average, internationally, 20 percent of the students were in such classrooms.

Exhibit 7.1:

MATHEMATICS
Grade 4

[Empty rectangular box]

Grade



How Much School Time Is Devoted to Mathematics Instruction?

Exhibit 7.3 presents information about the amount of mathematics instruction given to students at the eighth and fourth grades. Since different systems have school years of different lengths and different arrangements of weekly and daily instruction, the comparisons are given in terms of the average number of hours of mathematics instruction over the school year



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

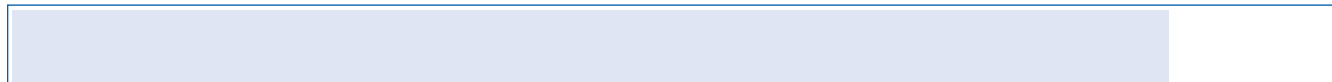


Exhibit 7.4: Percentage of Time in Mathematics Class Devoted to TIMSS Content Areas During the School Year



Armenia	r					
Australia						
Belgium (Flemish)						
Chinese Taipei						
Cyprus						
England						
Hong Kong, SAR						
Hungary						
Iran, Islamic Rep. of						
Italy						
Japan						
Latvia	s					
Lithuania						
Moldova, Rep. of	r					
Morocco						
Netherlands						
New Zealand						
Norway						
Philippines						
Russian Federation						
Scotland						
Singapore						
Slovenia						
Tunisia	r					
United States						
International Avg.						
Indiana State, US						
Ontario Province, Can.						
Quebec Province, Can.						

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

Background data provided by teachers

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

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

An "r" indicates data are available for at least 70 but less than 85% of the students. An "s" indicates data are available for at least 50 but less than 70% of the students. An "x" indicates data are available for less than 50% of the students.

What Activities Do Students Do in Their 1 r he1 r i s eutenq

lessons, and one-fourth were measuring things. In contrast, teachers reported an overwhelming emphasis on having students practice numerical operations. The teachers said they asked 82 percent of the students, on average, internationally, to practice adding, subtracting, multiplying, or dividing in half of the lessons or more. They reported asking 29 percent, on average, internationally, to work on fractions and decimals this frequently. According to teachers, measuring things, making graphs, and learning about shapes were relatively infrequent activities for more than 80 percent of the fourth-grade students.

Exhibit 7.5:

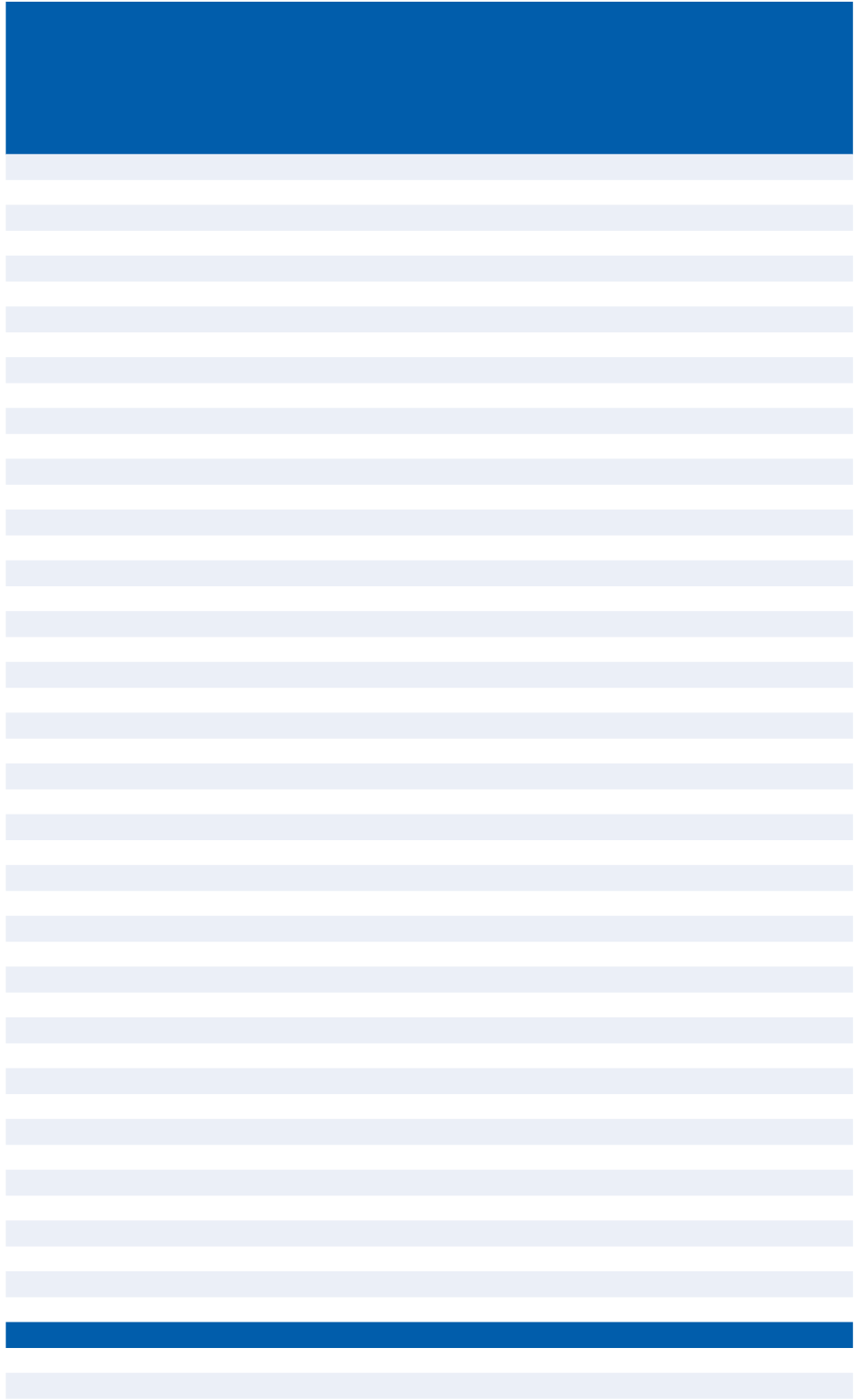
MATHEMATICS
Grade 8



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

Educators, parents, employers, and most of the public support the goal of improving students' capacity for mathematics problem-solving. To examine the emphasis placed on that goal, TIMSS asked eighth-grade students and teachers about how often students were asked to do the following three activities – relate what was being learned in mathematics to their daily lives, explain their answers, and decide procedures for solving complex problems.

Exhibits 7.7 and 7.8 present students' and teachers' reports, respectively. In most of the countries, students reported a moderate emphasis on doing these types of problems in mathematics class. About two-thirds (67 percent), on average, internationally, said they were asked to explain answers in at least half their lessons, and more than half (53%) reported deciding problem-solving procedures this frequently. Students reported the least attention to relating mathematics to their daily lives (44%). On average, internationally, teachers reported more emphasis on explanations than did the students. They reported asking about three-fourths of the students (78%) to explain answers in at least half the lessons. Perhaps as a matter for some concern, the teachers reported somewhat less emphasis on relating mathematics to daily lives than did the students.



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

What Instructional Strategies Are Used in Mathematics Classes?

As shown in Exhibit 7.9, the textbook is often the foundation of mathematics instruction at both the eighth and fourth grades. On average, internationally, nearly two-thirds of the eighth- and fourth-grade students (65-66%) had teachers who reported using a textbook as the primary basis of their lessons. For another 32 percent of the eighth-grade students and 29 percent of the fourth-grade students, teachers reported using textbooks as a supplementary resource.

Exhibit 7.10 presents a profile of the activities most commonly encountered in mathematics classes around the world, as reported by mathematics teachers. At the eighth grade, the three most predominant activities, accounting for 59 percent of class time, on average, internationally, were teacher lecture (19 % of class time), teacher-guided student practice (22 %), and students working on problems on their own (18%). At the fourth grade, these activities accounted for approximately about the same percentage of time as at the eighth grade (61%). The distribution was slightly different, though, since problem-solving activities with teacher guidance (22%) and on students' own (23%) accounted for nearly half the time. Teachers reported that 16 percent of the time, on average, was devoted to teacher lecture.

Exhibit 7.10:

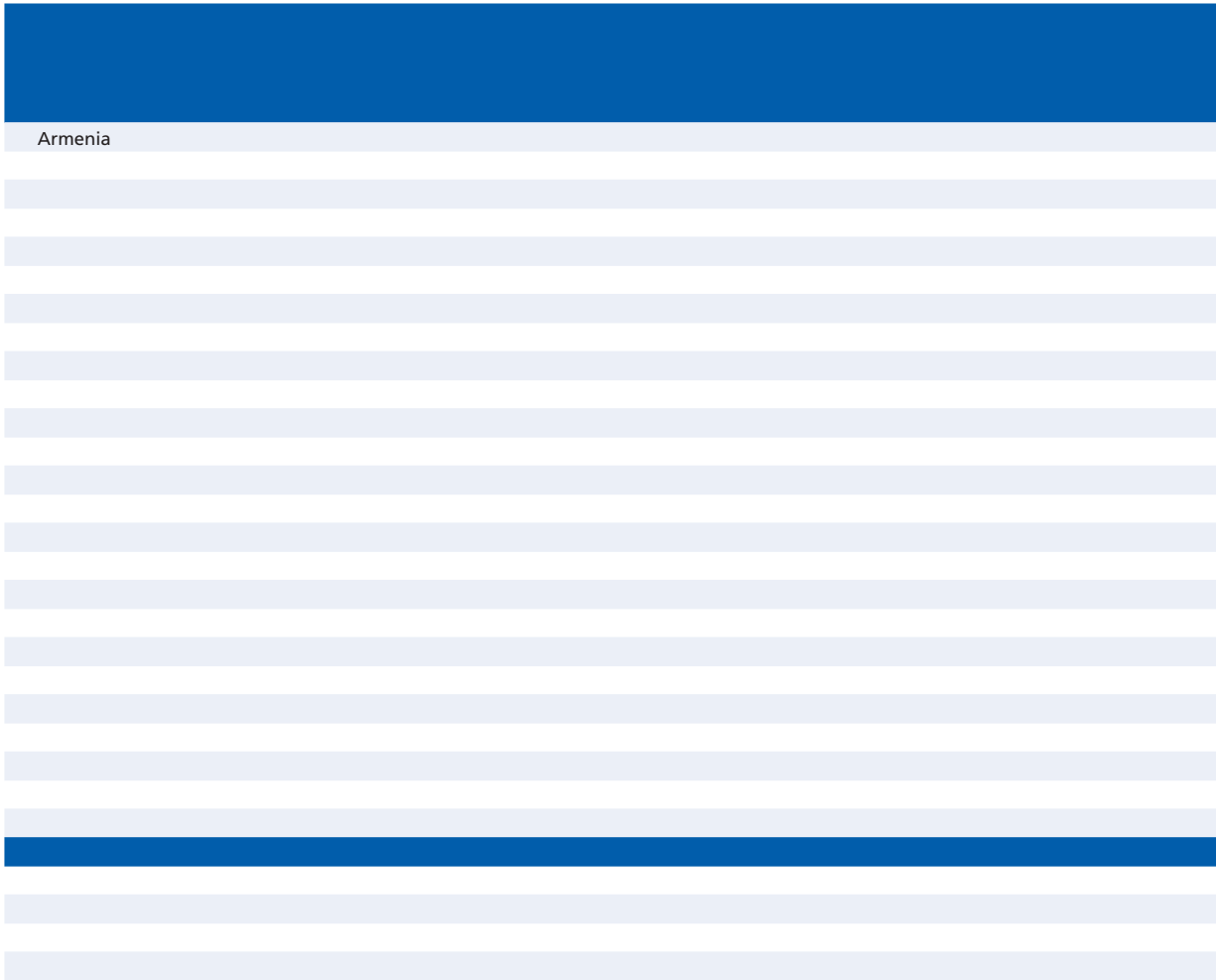
MATHEMATICS
Grade

Country	Classroom Size	Teacher's Gender	Teacher's Age	Teacher's Experience	Teacher's Education	Teacher's Salary	Teacher's Status	Teacher's Training
Armenia	c	" \$! Ž /	c	" " ! Ž /	c	% ! Ž /	c	% ! Ž /
Australia		* ! Ž /		(! Ž /		(! Ž /		\$! Ž /
Bahrain		" # ! Ž /		" \$! Ž /		' ! Ž /		' ! Ž /
Belgium (Flemish)		" " ! Ž /		" " ! Ž /		% ! Ž /		# ! Ž /
Botswana	c	" " ! Ž /	c	" ! ! Ž /	c	' ! Ž /	c	& ! Ž /
Bulgaria		" (! Ž /) ! Ž /		\$! Ž /		# ! Ž /
Chile		" % ! Ž /		" " ! Ž /		' ! Ž /		\$! Ž /
Chinese Taipei		* ! Ž /		" ! ! Ž /		% ! Ž /		\$! Ž /
Cyprus	c ^a	" # ! Ž /	c	" ! & Ž / •	c	& ! Ž /	c	# ! Ž /
Egypt		" & ! Ž /		" " ! Ž /		' ! Ž /		(! Ž /
H (5)	(0.4)							

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

Exhibit 7.10:

MATHEMATICS
Grade



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

How Are Calculators and Computers Used?

Exhibit 7.11 shows the number of countries with national policies on calculator use, the percentages of students not permitted to use calculators in mathematics class, and the percentages of students using calculators for various activities in about half of the lessons or more. At the eighth grade, 29 countries and all four benchmarking participants reported that their official curriculum contained statements about using calculators. According to their teachers, the percentages of students not permitted to use calculators varied dramatically from country to country. More than half the eighth-grade students were not permitted to use calculators in Bahrain, Cyprus, Ghana, Iran, Jordan, Romania, and Saudi Arabia. The countries permitting calculator use for essentially all eighth-grade students (98% or more) included Egypt, Hong Kong SAR, Lithuania, Morocco, the Netherlands, Norway, the Palestinian National Authority, Scotland, Sweden, and England. The percentages of eighth-grade students asked to use calculators in at least half of their lessons for each of four different activities reveal that, on average, internationally, teachers asked the most students to use calculators for checking answers (27%), performing routine computations (29%), and solving complex problems (31%). Only 14 percent, on average, were asked to explore number concepts.

At the fourth grade, 14 participants reported that their national or regional mathematics curriculum contained statements about using calculators. Compared to eighth grade, teachers in the TIMSS countries reported that greater percentages of fourth-grade students were not permitted to use calculators – 57 percent, on average. The countries permitting widespread calculator usage (90% of the students or more) at the fourth grade included Australia, Cyprus, England, New Zealand, and Scotland. However, even in those countries, teachers reported asking relatively small percentages of students to do any calculator activities in half the lessons or more.

Exhibit 7.11:



Country	Teacher's role in the classroom	Teacher's role in the classroom	Teacher's role in the classroom	Teacher's role in the classroom	Teacher's role in the classroom	Teacher's role in the classroom
Armenia	<input type="radio"/>	1	2	3	4	5
Australia	<input checked="" type="radio"/>	1	2	3	4	5
Bahrain	<input type="radio"/>	1	2	3	4	5
Belgium (Flemish)	<input checked="" type="radio"/>	1	2	3	4	5
Botswana	<input checked="" type="radio"/>	1	2	3	4	5
Bulgaria	<input type="radio"/>	1	2	3	4	5

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

Exhibit 7.11:

MATHEMATICS
Grade 4



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

Exhibit 7.12:

		○	r	88 (26)	r	0 (00)	r	0 (00)	r	1 (06)
Armenia		○	r	88 (26)	r	0 (00)	r	0 (00)	r	1 (06)
Australia		●		24 (36)		5 (23)		8 (24)		3 (1.7)
B,H)	A(B),C)									

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

What Are the Roles of Homework and Assessment?

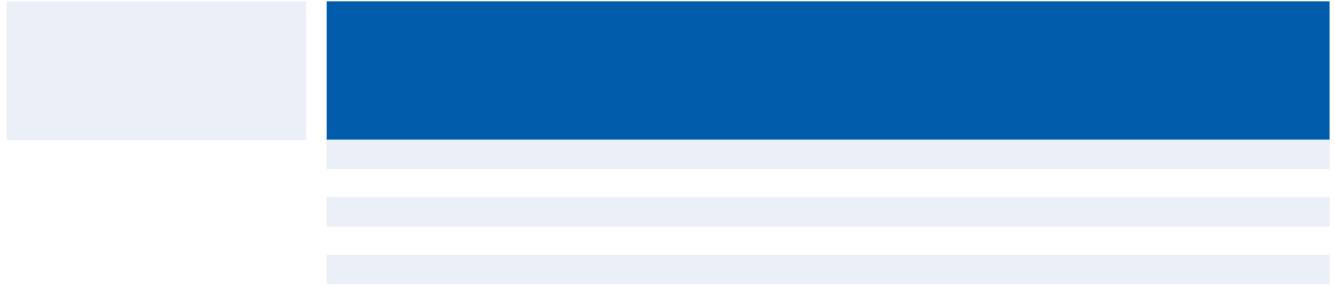
The amount of time students spend on homework assignments is an important consideration in examining their opportunity to learn mathematics. Exhibit 7.13 presents the index of teachers' emphasis on mathematics homework. Students in the high category had teachers who reported giving relatively long homework assignments (more than 30 minutes) on a relatively frequent basis (in about half the lessons or more). Those in the low category had teachers who gave short assign-

almost always monitoring whether homework was completed (for 78 percent of the students, on average). For more than half the eighth-grade students, on average, teachers reported always or almost always correcting assignments and giving feedback to students, but for about one-third, on average, the students corrected their own homework in class. About one-fourth of the students, on average, had teachers that reported using homework as basis for class discussion (27%) and to contribute toward grades or marks (25%).

As shown in Exhibit 7.15, eighth-grade teachers reported substantial variation across countries in the frequency of testing in mathematics class. On average, internationally, nearly half the students (47%) reported having a mathematics test or examination every two weeks or more and another 40 percent reported such testing about once a month. Testing every two weeks or more for most students (80% or more) was reported by eighth-grade teachers in Bahrain, Belgium (Flemish), Chinese Taipei, Lebanon, Lithuania, the Philippines, the Russian Federation, the Slovak Republic, and the Canadian province of Quebec. Even though the international average was low (14%) for infrequent testing, there were countries where teachers reported testing only a few times a year.

Exhibit 7.13:

MATHEMATICS
Grade 8



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

Exhibit 7.14:



Armenia	r	86 (2.6)	r	68 (3.8)	r	18 (2.9)	r	16 (2.7)	r	9 (2.1)
Australia		75 (3.4)		56 (3.6)		25 (3.7)		16 (3.2)		22 (3.3)
Bahrain		92 (2.4)		91 (2.3)		70 (1.8)		50 (3.9)		66 (2.4)
Belgium (Flemish)		88 (2.9)		83 (2.8)		24 (3.3)		7 (1.8)		22 (3.2)
Botswana		97 (1.8)		93 (2.4)		31 (4.3)		30 (3.8)		8 (1.6)
Bulgaria		79 (3.9)		53 (4.7)		7 (2.2)		22 (3.6)		3 (1.2)
Chile		79 (3.4)		72 (3.4)		59 (4.0)		37 (3.9)		20 (3.0)
Chinese Taipei		75 (3.6)		48 (4.5)		46 (3.9)		48 (4.5)		57 (4.1)
Cyprus		85 (1.9)		84 (1.8)		28 (2.1)		44 (2.6)		46 (2.4)
Egypt		80 (3.1)		72 (3.8)		31 (3.5)		37 (3.7)		42 (4.3)
Estonia		72 (3.6)		20 (3.3)		19 (3.2)		21 (3.5)		13 (2.2)
Ghana		87 (3.3)		83 (3.8)		45 (4.7)		43 (4.6)		52 (4.5)
Hong Kong, SAR		86 (3.2)		78 (3.8)		20 (3.5)		23 (3.7)		20 (3.5)
Hungary		97 (1.6)		38 (3.6)		73 (3.5)		13 (2.7)		7 (2.2)
Indonesia		92 (2.5)		85 (3.0)		22 (3.6)		14 (3.0)		37 (4.2)
Iran, Islamic Rep. of		76 (3.5)		43 (3.6)		56 (3.7)		41 (3.6)		38 (3.9)
Israel		71 (3.3)		39 (3.7)		29 (3.5)		38 (3.6)		47 (3.5)
Italy		82 (2.5)		41 (3.8)		59 (3.7)		48 (3.3)		9 (2.2)
Japan		51 (3.7)		15 (2.7)		41 (3.8)		9 (2.3)		24 (3.2)
Jordan		83 (3.0)		73 (3.6)		66 (3.9)		54 (3.8)		35 (4.2)
Korea, Rep. of	s	76 (3.0)	s	13 (2.9)	s	28 (3.4)	s	3 (1.3)	s	28 (3.2)
Latvia		80 (3.1)		57 (4.1)		11 (3.0)		9 (2.0)		26 (3.0)
Lebanon		77 (3.7)		66 (4.3)		62 (4.6)		44 (4.8)		15 (3.0)
Lithuania		67 (3.5)		26 (3.5)		8 (2.3)		6 (1.6)		6 (1.8)
Macedonia, Rep. of		69 (4.0)		54 (3.8)		24 (3.8)		27 (3.9)		42 (4.5)
Malaysia		89 (2.8)		86 (3.3)		14 (3.0)		31 (3.9)		5 (1.8)
Moldova, Rep. of	r	70 (5.0)	r	34 (4.7)	r	33 (4.0)	r	21 (4.1)	r	25 (4.5)
Morocco	s	60 (7.0)	s	79 (6.1)	s	59 (5.5)	s	41 (6.4)	s	8 (3.6)
Netherlands		44 (4.5)		39 (5.0)		69 (4.4)		13 (3.0)		4 (1.9)
New Zealand		68 (4.9)		34 (4.2)		41 (5.4)		13 (3.4)		12 (3.5)
Norway		21 (3.4)		4 (1.6)		12 (2.6)		10 (2.4)		20 (3.6)
Palestinian Nat'l Auth.		92 (2.5)		66 (3.8)		66 (3.5)		50 (4.1)		38 (4.2)
Philippines		85 (3.6)		83 (3.6)		43 (4.7)		41 (4.5)		55 (4.9)
Romania		86 (3.0)		49 (4.1)		15 (3.1)		35 (3.7)		9 (2.3)
Russian Federation		86 (3.3)		48 (3.1)		16 (2.3)		8 (1.7)		6 (1.7)
Saudi Arabia		95 (1.2)		84 (5.1)		65 (5.5)		42 (5.4)		68 (5.7)
Scotland		88 (3.0)		62 (4.6)		13 (3.0)		19 (3.7)		11 (3.0)
Serbia		77 (3.4)		38 (3.7)		21 (2.8)		22 (3.4)		11 (2.7)
Singapore		89 (1.8)		87 (1.8)		5 (1.2)		24 (2.1)		18 (1.6)
Slovak Republic		74 (4.0)		46 (4.2)		19 (3.1)		12 (2.6)		6 (2.1)
Slovenia		79 (3.7)		23 (3.2)		60 (3.8)	(3.3)	18 (3.6)	853(2.8)	3 (1.5)
South Africa		85 (2.5)		80 (2.3)	r	38 (3.6)	r			

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

Exhibit 7.15:

MATHEMATICS
Grade



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

