CHAPTER 5

5

The Mathematics Curriculum

The first part of Chapter 5 presents information about the curricular goals in the TIMSS 1999 countries, referred to as the intended curriculum. Data are provided about how the curriculum is supported and monitored within each country and the relationship between national testing and the curriculum. The second part of the chapter contains teachers' reports about the mathematics topics actually studied in their classrooms, also known as the implemented curriculum.

In comparing achievement across countries, it is important to consider differences in students' curricular experiences and how they may affect the mathematics they have studied. At the most fundamental level, students' opportunity to learn the content, skills, and processes tested in the TIMSS 1999 assessment depends to a great extent on the curricular goals and intentions inherent in each country's policies for mathematics education. Just as important as what students are expected to learn, however, is what their teachers choose to teach them. The lessons provided by the teacher ultimately determine what mathematics students are taught.

Chapter 5 presents information about the curricular goals in the TIMSS 1999 countries and teachers' reports about the mathematics content studied. Teacher's instructional programs for their classes are usually guided by an "official curriculum" that describes the mathematics education that should be provided. The official curriculum can be communicated by means of documents or statements of various sorts (often called guides, guidelines, or frameworks) prepared by the education ministry or by national or regional education departments. These documents or statements, together with supporting material such as instructional guides or mandated textbooks, are referred to as the *intended curriculum*.

To collect information about the intended mathematics curriculum at the eighth grade in each of the TIMSS 1999 countries, the National Research Coordinators responsible for implementing the study completed questionnaires and participated in interviews. As part of the process, information was gathered about factors related to supporting and monitoring the implementation of the official curriculum, including the availability of teacher training, instructional materials, assessments, and audits aligned with the curriculum.

In many cases, teachers need to interpret and modify the intended curriculum according to their perceptions of the needs and abilities of their classes, and this evolves into the *implemented curriculum*. Research has shown that the implemented curriculum, even in highly regulated educational systems, is not identical to the intended curriculum. To collect data about the implemented curriculum, the mathematics teachers of the students tested in TIMSS 1999 completed questionnaires about whether students had been taught the various mathematics topics covered in the test.

Does Decision Making About the Intended Curriculum Take Place at the National or Local Level?

Depending on the educational system, students' learning goals are commonly set at three levels: the national or regional level, the school level, and the classroom level. Some countries are highly centralized, with the ministry of education (or highest authority in the system) being exclusively responsible for the major decisions governing the direction of education. In others, such decisions are made regionally or locally. Each approach has its strengths and weaknesses. Centralized decision making can add coherence and uniformity in curriculum coverage, but may constrain a school or teacher's flexibility in tailoring instruction to the needs of students.

5.1

Exhibit 5.1 presents information for each TIMSS 1999 country about the highest level of authority responsible for making decisions about the curriculum and gives the curriculum's current status. The data reveal that 35 of the 38 countries reported that the specifications for students' curricular goals were developed as national curricula. Australia determined curricula at the state level, with local input; the United States did so at both the state and local levels, with variability across states; and Canada determined what students are expected to learn at the provincial level.

In recent decades, it has become common for intended curricula to be updated regularly. At the time of the TIMSS 1999 testing, the official mathematics curriculum in 29 countries had been in place for less than a decade, and more than half of them were in revision. Of the eight countries with a mathematics curriculum of more than 10 years' standing, five were being revised. In Australia, Canada, and the United States, curriculum change is made at the state or provincial level, and some mathematics curricula were in revision at the time of testing. The mathematics curricula in these three countries were relatively recent, having been developed within ten years prior to the study.

Exhibit 5.1 Mathematics Curriculum

TIMSS 1999 8th grade Mathematics

	National or Regional Curriculum	Year Curriculum Introduced	Status of Curriculum
Australia	Regional & Local	1995-1998	In revision (2 states); not being revised (3 states); no curriculum statement (3 states)
Belgium (Flemish)	National	1997	As introduced
Bulgaria	National	1997	As introduced
Canada	Regional	1997-1998 (most provinces)	As introduced
Chile	National	1980	In revision
Chinese Taipei	National	1997	In revision
Cyprus	National	1987	In revision
Czech Republic	National	1996	In revision
England	National	1995	In revision, same structure with minor revisions (to be implemented 2000/01)
Finland	National	1994	As introduced
Hong Kong, SAR	National	1987	In revision
Hungary	National	1986	In revision
Indonesia	National	1994	In revision
Iran, Islamic Rep.	National	1985	As introduced
Israel	National	1990	As introduced
Italy	National	1979	As introduced
Japan	National	1993	As introduced
Jordan	National	1993-1994	In revision
Korea, Rep. of	National	1995	As introduced
Latvia (LSS)	National	1992	In revision
Lithuania	National	1997	In revision
Macedonia, Rep. of	National	1979 (adaptations in 1995)	As introduced
Malaysia	National	1990	In revision
Moldova	National	1991	In revision
Morocco	National	1991	In revision
Netherlands	National	1993	As introduced
New Zealand	National	1993	As introduced
Philippines	National	1998	In revision
Romania	National	1993	In revision
Russian Federation	National	1997	In revision
Singapore	National	1993	In revision
Slovak Republic	National	–	–
Slovenia	National	1983	In revision
South Africa	National	1996	In revision
Thailand	National	1990	In revision
Tunisia	National	1997	As introduced
Turkey	National	1991	In revision
United States [1]	Regional & Local	1994-1999	As of 1999, 49 of 50 states completed standards

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

Background data provided by National Research Coordinators.

A dash (–) indicates data are not available.

1 United States: The NCTM standards were developed in 1989 and are in revision. As of 1999, most states had developed content standards. Currently, many states are in the process of updating and revising their standards.

How Do Countries Support and Monitor Curriculum Implementation?

Education systems use different ways to achieve the best match between the intended and the implemented curriculum. For example, teachers can be trained in the content and pedagogical approaches specified in the curriculum guides. Another way to help ensure alignment is to develop instructional materials, including textbooks, instructional guides, and ministry notes, that are tailored to the curriculum. Systems can also monitor implementation by means of school inspection or audit. The different methods used by the TIMSS 1999 countries are shown in Exhibit 5.2. It is assumed that monitoring implementation encourages teachers to use the official curriculum in planning their teaching programs. Testing and assessment of the intended curriculum are also widely used to support and monitor curriculum implementation; these are addressed in Exhibits 5.3 and 5.4.

5.2

Of the methods for supporting and monitoring curriculum implementation shown in Exhibit 5.2, 10 countries reported using all six, and a further 14 countries used five. Nearly all countries (34) used in-service teacher education, and most countries (31) used mandated or recommended textbooks. Ministry notes and directives, or a system of school inspection or audit, were used in 30 countries. Beyond the methods included in the questionnaire, a majority of representatives from the TIMSS national centers reported in interviews that mathematics specialists were employed to advise mathematics teachers.

Exhibit 5.2 Methods Used to Support or Monitor Curriculum Implementation*

TIMSS 1999 8th grade Mathematics

	Pre-Service Teacher Education	In-Service Teacher Education	Mandated or Recommended Textbook(s)	Instructional or Pedagogical Guide	Ministry Notes and Directives	System of School Inspection or Audit
Australia [1]	●	●		●	●	
Belgium (Flemish)	●	●		●	●	●
Bulgaria	●	●	●		●	●
Canada [2]	●	●	●	●	●	
Chile			●		●	
Chinese Taipei	●	●	●	●		●
Cyprus		●	●		●	●
Czech Republic	●		●		●	●
England	●	●				●
Finland	●	●	●	●		
Hong Kong, SAR	●	●	●	●	●	●
Hungary	●	●	●	●	●	
Indonesia		●	●	●	●	●
Iran, Islamic Rep.	●	●	●	●	●	●
Israel	●	●	●		●	
Italy		●		●	●	●
Japan		●	●	●	●	●
Jordan		●	●	●	●	●
Korea, Rep. of	●	●	●	●	●	●
Latvia (LSS)	●	●	●	●	●	●
Lithuania		●	●		●	
Macedonia, Rep. Of	●	●	●	●		●
Malaysia	●	●	●	●	●	●
Moldova		●	●		●	●
Morocco	●	●	●	●	●	●
Netherlands	●	●		●	●	●
New Zealand	●	●				●
Philippines		●	●	●	●	●
Romania	●	●	●	●	●	●
Russian Federation	●	●	●	●	●	●
Singapore	●	●	●	●	●	●
Slovak Republic	●		●		●	●
Slovenia	●	●	●	●		●
South Africa	●	●	●	●		●
Thailand	●	●	●	●	●	●
Tunisia		●	●	●	●	●
Turkey		●	●		●	●
United States [3]	+	+	+	+	+	+

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

● Country reported that method is used to support or monitor the implementation of the national/regional curriculum at grade 8

\+ Not applicable nationally

Background data provided by National Research Coordinators.

* Other than public examinations and system-wide assessments described in Exhibits 5.3 and 5.4, respectively.

1 Australia: Results shown are for the majority of states/territories.

2 Canada: Results shown are for the majority of provinces.

3 United States: Methods are implemented by individual states and vary from state to state. As of 1998, 13 of 50 have policies on textbook/materials selection; 8 of 50 states have policies recommending textbook/materials.

What Countries Have Public Examinations in Mathematics?

5.3

Using public examinations as a way to select students for university or academic tracks in secondary school can be an important motivating factor for student achievement. Exhibit 5.3 shows information on public examinations and their purpose. Thirty-seven countries reported having public examinations or awards, at one or more grades, that included testing achievement in mathematics. Most countries held their examinations in the final year of schooling for certification and selection to higher education (often, university education). Certification also provides students not going on to full-time post-secondary education with evidence of educational attainment for prospective employers. In about one-third of the countries, public examinations were also reported to be used to select students for entry to different types of secondary school, or to assign them to different tracks or courses within secondary schools. Providing feedback to policy makers in the educational system, schools, or both was also an important use of assessments in some countries.

Belgium (Flemish) was the one country that reported having no public examinations in mathematics. This was the only country where decisions about promotion from one grade to the next, certification, and qualification for entrance to university were made at the school level without reliance on system-wide public examinations.

Exhibit 5.3 Public Examinations in Mathematics

	Public Exams/ Awards	Grade(s)	Purpose/Consequences
Australia	Yes	12	Certification and selection for tertiary education
Belgium (Flemish)	No		
Bulgaria	Yes	7/8, 12	Candidates for profile schools (grade 7 or 8); certification and entrance to university -- not taken by all students (grade 12)
Canada [1]	Yes	3,6,8 (1 province); 10, 11(1 province); 12 (4 provinces)	Feedback to system and schools; certification (grade 12)
Chile	Yes	12	Entry to university
Chinese Taipei	Yes	9, 12	Entry to secondary school (grade 9); entry to university (grade 12)
Cyprus	Yes	12	Certification and entry to university (grade 12); a certification exam occurs on a local level for grade 9
Czech Republic	Yes	13	Certification (mathematics can be chosen as one of four subjects for leaving examination)
England	Yes	10, 12	Certification (grade 10), certification and entry to university (grade 12); feedback to system and schools
Finland	Yes	12	Certification and selection for tertiary education
Hong Kong, SAR	Yes	6, 11, 13	School placement (grade 6); certification and placement for 12th grade (grade 11); placement in tertiary institutions (grade 13)
Hungary	Yes	12	Certification and entry to university
Indonesia	Yes	6, 9, 12	Leaving exam and selection for junior secondary school (grade 6); selection for senior secondary school (grade 9); leaving exam (grade 12); system-level feedback, in some cases school- and classroom-level feedback
Iran, Islamic Rep.	Yes	11, 12	Certification (grade 11); entry to tertiary education (grade 12); in addition, provincial exams are administered at grade 8
Israel	Yes	11 or 12	Entry to higher education
Italy	Yes	13	Certification and entry to university
Japan	Yes	9, 12	Entry to prefectural and municipal upper secondary schools (grade 9); entry to national, prefectural and municipal universities (grade 12)
Jordan	Yes	12	Certification and entry to tertiary education
Korea, Rep. of	Yes	12	College entrance exam for selection of students
Latvia (LSS)	Yes	9, 12	Certification
Lithuania	Yes	9, 12	Graduation from Basic and Upper Secondary schools
Macedonia, Rep. Of	Yes	12	Certification and entry to university; the exam constitutes 40% of the required points for entry to university with the remaining points based on university entry exams
Malaysia	Yes	6, 9, 11, 13	Feedback to system and schools; achievement test (grade 6); entry to course tracks (grade 9); certification and end of secondary (grade 11); certification and entry to university (grade 13)
Moldova	Yes	9, 11/12	Certification and selection for high school (grade 9); graduation (grade 11 or 12 depending on school)
Morocco	Yes	6, 9, 10, 11, 12	Remedial test for retention purposes (grade 6); certification, selection to secondary, and selection to courses (grade 9); certification and entry to tertiary (grade 12); feedback to system and schools
Netherlands	Yes	10, 11, 12	End-of-track examinations; exams recommended at grades 6 and 8
New Zealand	Yes	10, 12	Certification and course selection (grade 10); entry to tertiary education (grade 12); feedback to system and schools; informal between-school comparisons
Philippines	Yes	6, 10	Feedback to system and schools
Romania	Yes	8, 12	Certification (grade 8); certification (grade 12; mathematics can be chosen as one of 7 subjects)
Russian Federation	Yes	9, 11	Certification
Singapore	Yes	6, 10, 12	Selection into courses; certification and entry to university; feedback to system and schools
Slovak Republic	Yes	12	Certification (mathematics can be chosen as one of four subjects for leaving exam)
Slovenia	Yes	8, 12	Entry to secondary school (grade 8); certification and entry to tertiary education (grade 12)
South Africa	Yes	12	Certification and selection for tertiary education
Thailand	Yes	12	Entry to university
Tunisia	Yes	6, 9, 13	Regional exam for promotion (grade 6); feedback to system and schools, selection for schools and courses, and promotion (grade 9); certification and entry to university (grade 13)
Turkey	Yes	8, 11	Placement in specialized schools for some students (grade 8); entry to university (grade 11)
United States [2]	Yes	varies	Primarily feedback to system and schools; in 8 states grade promotion is dependent on results; in 18 states graduation is dependent on results of grade 12 exams

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

Background data provided by National Research Coordinators.

1 Canada: Public examinations are administered in 5 of 10 provinces.

2 United States: As of 1997-1998, public examinations are administered in 47 of 50 states at grades 7-8 or 9-12.

What Countries Have System-Wide Assessment in Mathematics?

Although national public examinations can provide information of interest to national and regional policy makers, their main purpose is to make decisions about individual students. In comparison, system-wide assessments are designed primarily to inform policy makers about matters such as national standards of achievement of the intended curriculum objectives, strengths and weaknesses in the curriculum or how it is being implemented, and whether educational achievement is improving or deteriorating.

5.4 Exhibit 5.4 summarizes information about national assessments in mathematics. Such assessments were conducted in about two-thirds of the participating countries. Half of these countries assessed all students in the grade, and the other half a sample of students from the grade. Most countries tested two or three grades, with Hong Kong (nine grades) and Korea (seven grades) testing the most grades.

Generally, the purpose of the system-wide assessments was to provide feedback to government policy makers and the public. Feedback to individual schools was a feature reported by some countries whose methodology, namely assessment of the entire grade level, allowed for this type of reporting. In Singapore, the 20 schools found to provide the greatest value-added measures received monetary rewards, as did teachers of the top 25 percent of classes in Chile.

In addition to collecting information about examinations and assessments, questionnaires and interviews were used to determine whether, and to what extent, explicit achievement standards were a feature of intended curricula (see Exhibit R2.1 in the reference section). Twenty-two countries reported that such standards were incorporated in their curricula or related documents. However, the term "achievement standards" means different things in different countries and was unfamiliar to some. Some countries regard them as learning objectives, and others include in this category performance indicators that describe levels of required or desired performance. Exhibit R2.1 includes countries that reported learning objectives or performance objectives as a component of their curriculum documents.

R2.1

Exhibit 5.4 System-Wide Assessments in Mathematics

TIMSS 1999 8th grade Mathematics

	System-Wide Assessments[1]	Grades		Purpose/Consequences
		Entire Grade Level	Sample from Grade Level	
Australia [2]	Yes	3, 5 (all states) 7 (four states)		System-level, school-level, and individual student-level feedback
Belgium (Flemish)	No			
Bulgaria	Yes		4, 8	System-level feedback, administered only in 1998
Canada [3]	Yes	3, 6, 9 (5 provinces); 5, 8, 11 (1 province); 4, 7, 10 (1 province); 12 (1 province)	Ages 13 and 16 nationally (most provinces)	System- and school-level feedback
Chile	Yes	4, 8, 10		System-level, school-level, class-level feedback; top 25% of teachers are given monetary rewards; usually one grade level assessed each year
Chinese Taipei	No			
Cyprus	No			
Czech Republic	No			
England	Yes	1, 5, 8		School-level feedback; course selection and placement for grade 9
Finland	Yes		4, 6, 9	System-level feedback
Hong Kong, SAR	Yes		1 - 9	System-level feedback
Hungary	Yes		4, 6, 8, 10, 12	System-level, school-level, and individual-level feedback
Indonesia	Yes		various grades	System-level feedback, assessments given irregularly at different primary grades
Iran, Islamic Rep.	No			
Israel	Yes		4, 8	System-level feedback
Italy	Yes		6, 8, 10, 13	System-level feedback; first administered in 1999 with a grade 4 assessment instituted in 2000
Japan	Yes		5, 6, 7, 8, 9	System-level feedback
Jordan	Yes		4, 5, 8, 10	System-level feedback; monitoring reform impact; curricular revisions
Korea, Rep. of	Yes	4, 5, 6, 7, 8, 10, 11		System-level feedback
Latvia (LSS)	No			
Lithuania	No			
Macedonia, Rep. Of	Yes		4, 5, 6, 7, 8	System-level feedback and research purposes (projects and curriculum development)
Malaysia	Yes	6, 9, 11, 13		System- and school-level feedback; "good schools" publicized
Moldova	No			
Morocco	Yes	6, 9, 10, 11, 12		System- and school-level feedback
Netherlands	Yes	10, 11, 12	6	System-level feedback
New Zealand	Yes		3, 7	System-level feedback
Philippines	Yes	6, 10		System- and school-level feedback (the assessment was sample-based up until 1999)
Romania	No			
Russian Federation	Yes		various grades	Irregularly for research purposes
Singapore	Yes	6,10,12		System- and school-level feedback; selection into courses, certification and entry to university
Slovak Republic	No			
Slovenia	No			Assessments administered in grades 1-8 from 1991-1996
South Africa	No			
Thailand	Yes	6, 9, 12		System-level feedback
Tunisia	Yes	4, 6, 9, 13		System- and school-level feedback; may lead to redistribution of teachers in the regions; assessments at grades 4 and 6 developed regionally
Turkey	Yes		5, 8, 11	System- and school-level feedback
United States	Yes		4, 8, 12	National and state-level feedback

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

Background data provided by National Research Coordinators.

1 Public examinations are also used for system-wide assessment purposes in these countries: Malaysia, Morocco, Netherlands, Philippines, Singapore, Tunisia and Turkey.

2 Australia: System-wide assessments are administered in 3 of 8 states/territories.

3 Canada: System-wide assessments are administered in 5 of 10 provinces.

How Much Instructional Time Is Recommended for Mathematics?

The different percentages of time devoted to mathematics instruction at different grades highlight one of the difficulties in investigating the relationship between achievement and instructional time across countries. If instructional time is measured only for the eighth grade, the total time for which students in a country have been exposed to instruction in mathematics during their schooling may be under- or over-estimated. These data for grades 4, 6, and 8 provide a better estimate of students' intended instructional time for mathematics across the school years.

5.5

Percentages of instructional time designated for mathematics specified in the intended curricula for grades 4, 6, and 8 are shown in Exhibit 5.5. The pattern across countries shows that the percentage of time remains the same or decreases from grade 4 to grade 6 and again from grade 6 to grade 8, with 18 countries reporting a decrease in instructional time in mathematics from grade 6 to grade 8. Interestingly, the reverse pattern holds for science.[1] Average percentages of time for mathematics instruction across all countries were 17 percent, 16 percent, and 13 percent for grades 4, 6, and 8, respectively. An opposite trend was found for Morocco and Tunisia, where instructional time for mathematics increased in the eighth grade. Cyprus data show a sharp drop from 17 percent in each of grades 4 and 6 to nine percent in grade 8. Percentages of total instructional time specified for mathematics ranged from eight percent at each of grades 4, 6, and 8 for Thailand to 20 percent or more for six countries at grade 4, two at grade 6, and one (Morocco) at grade 8. Schools' and teachers' reports of the percentage of instructional time actually devoted to the sciences at grade 8, shown in Exhibit 6.4 in the next chapter, generally correspond with the intended percentages reported in Exhibit 5.5.

[1] Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Gregory, K.D., Smith, T.A., Chrostowski, S.J., Garden, R.A., and O'Connor, K.M. (2000), *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade*, Chestnut Hill, MA: Boston College.

Exhibit 5.5 Overleaf

Exhibit 5.5 Instructional Time for Mathematics

	Instructional Time Specified for Mathematics			Comments
	Grade 4	Grade 6	Grade 8	
Australia	N/S	N/S	N/S	At primary level, English and mathematics are given about the same amount of instructional time. The proportion of time decreases in secondary school. Some students do not study mathematics in their final year of secondary school.
Belgium (Flemish)	18%	18%	15%	Instructional time varies from 10% to 16% in grades 9-10, and from 6% to 25% in grades 11-12.
Bulgaria	16%	13%	13%	At grade 1, 18% of instructional time is devoted to mathematics. This decreases slightly to 15% at 5th grade and is 13% from grades 6-9. Instructional time ranges from 11-14% in grades 10-12.
Canada	15%	15%	15%	For three provinces, there is no change in emphasis as students progress through school. For two provinces, the proportion of time dedicated to mathematics decreases and in one province it increases after grade 6.
Chile	17%	17%	17%	The primary school curriculum states that 5 of 30 classes per week must be devoted to mathematics.
Chinese Taipei	12%	18%	11%	
Cyprus	17%	17%	9%	
Czech Republic	20%	15%	13%	
England	N/S	N/S	N/S	The national curriculum does not specify instructional time fo mathematics. The proposed curriculum assumes 126 hours per year for grade 4 (year 5), and 90 hours per year for grades 6 and 8 (years 7 and 9).
Finland	16%	16%	10%	The curriculum framework indicates the minimum amount of instructional time on average for grade spans 1-6 and 7-9. Schools decide on instructional time for specific grades.
Hong Kong, SAR	15%	15%	15%	Total instructional time on mathematics increases to 17.5% at grade 9 and 11-20% at grades 12 and 13.
Hungary	–	–	–	
Indonesia	14%	14%	14%	
Iran, Islamic Rep.	14%	14%	11%	
Israel	15%	14%	13%	
Italy	N/S	10-15%	10-15%	The curriculum indicates 20% instructional time be devoted to mathematics and science as one subject. The exact distribution of time for each of these subjects is decided by the teacher.
Japan	17%	17%	13%	Time devoted to mathematics is less in lower secondary school, especially at grade 7 where it is only 10%. However, mathematics instructional time at grade 8 is the same as Japanese language and social sciences.
Jordan	18%	15%	13%	At grade 1 about 20% of instructional time is devoted to mathematics. This decreases slightly in other grades and is about 13% from grades 8 -10.
Korea, Rep. of	14%	13%	12%	
Latvia (LSS)	20%	16%	16%	
Lithuania	17-22%	14-17%	13%	Mathematics is usually treated as an important subject since it is one of the two basic school exit exams at grade 10.
Macedonia, Rep. of	20%	17%	13%	
Malaysia	20%	20%	13%	From grade 8 through secondary school, the instructional time specified for mathematics remains about the same. The mathematics curriculum emphasizes understanding concepts and mastering processes (calculating, measuring, computing, communicating mathematically, and problem solving). Emphasis for the higher-level processes increases as students progress through school.
Moldova	17%	17%	16%	
Morocco	15%	15%	20%	
Netherlands	N/S	N/S	10%	Students can choose to stop taking mathematics after grade 9, depending on their course of study.
New Zealand	N/S	N/S	N/S	All schools are required to teach mathematics as part of a "balanced curriculum." Schools decide on instructional time. In general, in primary school, mathematics is allocated the second highest proportion of instructional time, after language (which includes reading). Time for mathematics, science, and English are about the same in secondary school.
Philippines	12%	11%	10%	To supplement the regular mathematics program, enrichment topics and activities are included in mathematics for grade 7, especially in the special science classes/schools.
Romania	17%	17%	15%	
Russian Federation	18%	17%	15%	Mathematics is given less emphasis than philology in grades 1-7. Emphasis on mathematics in grades 8-9 is still less than philology and is equal or slightly less than science and social science.

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

Background data provided by National Research Coordinators.

All data rounded to the nearest whole number.

N/S indicates instructional time not specified in the national/regional curriculum.

A dash (–) indicates data not available.

	Instructional Time Specified for Mathematics			Comments
	Grade 4	Grade 6	Grade 8	
Singapore	22%	20%	15%	Students are required to study mathematics, English and the mother-tongue language throughout primary and secondary school. Pupils who are planning to pursue further study in mathematics or a related discipline are offered an additional mathematics subject in grade 9.
Slovak Republic	–	–	–	
Slovenia	23%	16%	16%	Instructional time for mathematics is relatively equal to instructional time for other subjects.
South Africa	N/S	N/S	N/S	
Thailand	8%	8%	8%	There is no change in content, but there is change in depth.
Tunisia	15%	15%	16%	Mathematics is given the most instructional time after the mother tongue, Arabic. Time devoted to mathematics remains constant, but the amount of instructional time for mathematics compared to other subjects increases in grades 4 and up.
Turkey	13%	13%	13%	There is a tendency to enhance student-centered teaching and learning activities.
United States	N/S	N/S	N/S	States do not generally specify; it is largely a local decision.

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

How Do Countries Deal with Individual Differences?

The challenge of maximizing opportunity to learn for students with widely differing abilities and interests is met differently in different countries. Exhibit 5.6 summarizes questionnaire and interview data on how countries dealt with this issue in organizing the intended curricula.

5.6

Some countries indicated using more than one method of dealing with individual differences among students, and in these cases the category describing the main method was reported. The most common approach, found in 24 countries, was to have the same intended curriculum for all students, but to recommend that teachers adapt the level and scope of their teaching to the abilities and needs of their students. Adaptations for individuals and classes were also recommended in the intended curricula of some countries with different levels of curricula or different curricula for different groups.

In the Czech Republic, England, and Israel, mathematics topics were taught at different levels with different groups. The Czech Republic had four levels, Israel three, and England nine. In England's curriculum, the levels were defined in terms of progressively more complex performance to be demonstrated. Among the countries with different curricula for different groups of students, Belgium (Flemish) and the Russian Federation each provided two different levels, Singapore three, and the Netherlands four.

National Research Coordinators from seven countries reported that their official mathematics curricula did not address the issue of differentiating instruction for grade 8 students with different abilities or interests, but this does not necessarily mean that schools and teachers in those countries did not make allowance for individual differences. Schools' reports on how they organize to accommodate students with different abilities or interests are shown in Exhibit R2.2 in the reference section. Substantial percentages of students in many countries were in schools that offered remedial mathematics, including several of the countries without specific curricular statements about differentiation.

R2.2

Exhibit 5.6 Differentiation of Instruction for Students with Different Abilities or Interests

TIMSS 1999 8th grade Mathematics

	Curriculum Addresses Differentiation	Approaches to Addressing Students with Different Abilities or Interests at Grade 8			
		Same Curriculum for All Students, and Teachers Adapt to Students' Needs	Same Curriculum with Different Levels for Different Groups	Different Curricula for Different Groups	Number of Curriculum Levels
Australia	Yes	Yes	No	No	1
Belgium (Flemish)	Yes	No	No	Yes	2
Bulgaria	Yes	Yes	No	No	1
Canada	Yes	Yes	No	No	1
Chile	No				
Chinese Taipei	Yes	Yes	No	No	1
Cyprus	Yes	Yes	No	No	1
Czech Republic	Yes	No	Yes	No	4
England [1]	Yes	No	Yes	No	9
Finland	Yes	Yes	No	No	1
Hong Kong, SAR	Yes	Yes	No	No	1
Hungary	Yes	Yes	No	No	1
Indonesia	No				
Iran, Islamic Rep.	Yes	Yes	No	No	1
Israel	Yes	No	Yes	No	3
Italy	No				
Japan	No				
Jordan	Yes	Yes	No	No	1
Korea, Rep. of	Yes	Yes	No	No	1
Latvia (LSS)	No				
Lithuania	No				
Macedonia, Rep. Of	Yes	Yes	No	No	1
Malaysia	Yes	Yes	No	No	1
Moldova	No				
Morocco	Yes	Yes	No	No	1
Netherlands	Yes	No	No	Yes	4
New Zealand	Yes	Yes	No	No	1
Philippines	Yes	Yes	No	No	1
Romania	Yes	Yes	No	No	1
Russian Federation	Yes	No	No	Yes	2
Singapore	Yes	No	No	Yes	3
Slovak Republic	Yes	Yes	No	No	1
Slovenia	Yes	Yes	No	No	1
South Africa	Yes	Yes	No	No	1
Thailand	Yes	Yes	No	No	1
Tunisia	Yes	Yes	No	No	1
Turkey	Yes	Yes	No	No	1
United States [2]	Yes	Yes	No	No	1

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

Background data provided by National Research Coordinators.

1 England: While there is one "programme of study" for grades 6-8, the document identifies nine performance-levels describing the types and range of performance that pupils working at a particular level should demonstrate.

2 United States: Most state standards are designed for all students.

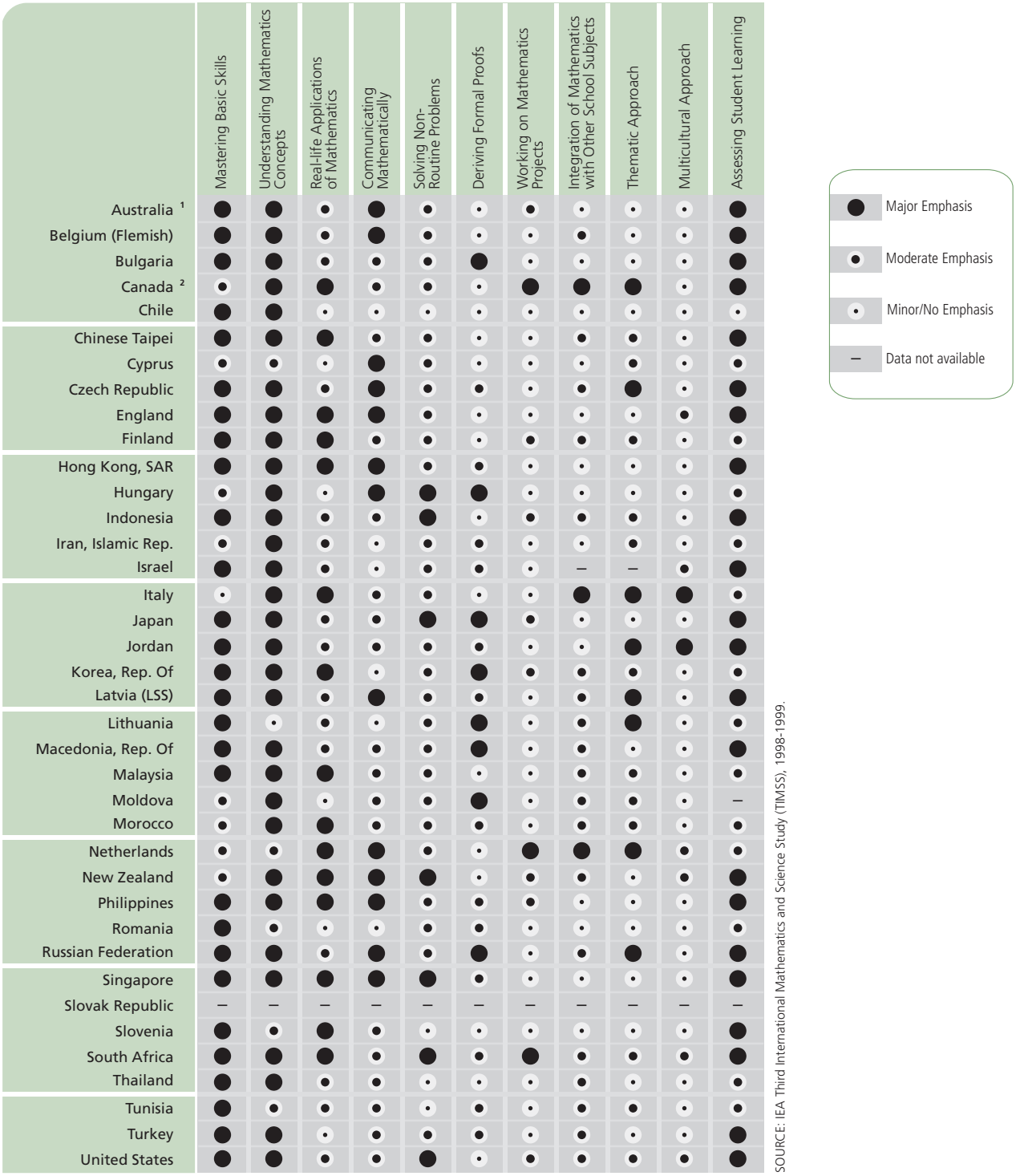
What Are the Major Characteristics of the Intended Curriculum?

5.7

Exhibit 5.7 indicates the relative emphasis given to various aspects of mathematics instruction in the intended curriculum. As might be anticipated for students at this point in their schooling, major emphasis was most commonly placed on mastering basic skills and understanding mathematical concepts. Most countries moderately or strongly emphasized assessing student learning. Similarly, "real-life" applications of mathematics were encouraged in the curriculum of most countries, with 15 countries giving this approach major emphasis and 16 moderate emphasis. The Netherlands' intended curriculum was reported to emphasize this approach more than either mastering basic skills or understanding mathematics concepts. Communicating mathematically, an aspect of teaching and learning that has received increasing attention in recent years, was included in the curriculum of most countries and was accorded major emphasis in 13 countries. Similarly, recent efforts to improve students' abilities to apply their mathematical understandings have led to recommendations for more experience with novel problem-solving situations. Thirty-three countries reported at least moderate emphasis on solving non-routine problems.

The mathematical area with the greatest variation across countries' intended curricula was deriving formal proofs. It was given major emphasis in eight countries, moderate emphasis in 13, and minor or no emphasis in 16. Integration of mathematics with other subjects to some degree was a common aim across countries, and about half the countries placed some emphasis on a thematic approach. Working on mathematics projects was given minor or no emphasis in the intended curriculum of most countries, as was a multicultural approach.

Exhibit 5.7 Emphasis on Approaches and Processes



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

Background data provided by National Research Coordinators.

1 Australia: Results shown are for the majority of states/territories.

2 Canada: Results shown are for the majority of provinces.

What Mathematics Content Do Teachers Emphasize at the Eighth Grade?

5.8

Teachers of the mathematics classes tested were asked what subject matter they emphasized most in their classes (e.g., geometry, algebra, various combinations of content, etc.). Their responses are presented in Exhibit 5.8.

More than a quarter of the students received instruction emphasizing mainly number in eight countries: Canada, Chile, Finland, Lithuania, Malaysia, the Philippines, Thailand, and the United States. Internationally on average, more than half the students were taught a combination of mathematics topics (i.e., combined algebra, geometry, number, etc.). However, there was considerable variation among countries, ranging from all students in England being given the combined emphasis to none in the Russian Federation. In the latter, 100 percent of the students were taught combined algebra and geometry. Internationally on average, about one-fifth of the students received the combined algebra and geometry emphasis.

Twenty percent or more of students were in mathematics classes that emphasized algebra in Korea, Morocco, Singapore, and the United States. Very few students were given an emphasis in geometry (three percent on average internationally), with Tunisia the only country where 20 percent or more of the students were in classes that emphasized geometry.

Exhibit 5.8 Subject Matter Emphasized Most in Mathematics Class

TIMSS 1999 8th grade Mathematics

	Percentage of Students Whose Teachers Report the Subject Matter Emphasized Most in Their Grade 8 Mathematics Class					
	Mainly Number	Combined Algebra, Geometry, Number, etc.	Combined Algebra and Geometry	Algebra	Geometry	Other
Australia	– –	– –	– –	– –	– –	– –
Belgium (Flemish)	10 (3.3)	65 (3.6)	17 (2.3)	3 (1.2)	2 (1.3)	3 (2.3)
Bulgaria	0 (0.0)	27 (4.2)	64 (4.7)	8 (3.2)	1 (0.8)	0 (0.0)
Canada r	26 (3.0)	53 (2.8)	6 (1.6)	6 (1.4)	1 (0.0)	9 (1.9)
Chile	72 (3.6)	15 (2.8)	4 (1.7)	0 (0.0)	3 (1.3)	6 (1.9)
Chinese Taipei	2 (1.1)	57 (4.2)	24 (3.6)	4 (1.7)	9 (2.6)	4 (1.6)
Cyprus r	1 (0.0)	71 (4.4)	21 (3.7)	7 (2.3)	0 (0.0)	0 (0.0)
Czech Republic	0 (0.2)	76 (3.9)	19 (3.9)	4 (1.2)	0 (0.0)	0 (0.0)
England s	0 (0.0)	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Finland	32 (4.3)	46 (4.6)	12 (3.2)	3 (1.3)	4 (1.4)	3 (1.5)
Hong Kong, SAR	7 (2.4)	60 (4.8)	11 (2.8)	13 (3.3)	4 (1.8)	5 (2.1)
Hungary	11 (2.6)	75 (3.1)	8 (1.9)	5 (1.6)	0 (0.0)	0 (0.0)
Indonesia	10 (3.0)	71 (4.9)	10 (2.5)	5 (2.2)	4 (2.7)	0 (0.4)
Iran, Islamic Rep.	17 (4.1)	57 (4.3)	14 (3.1)	6 (2.1)	6 (2.1)	0 (0.0)
Israel r	1 (0.4)	35 (4.0)	42 (4.1)	19 (3.4)	1 (0.6)	2 (1.3)
Italy	2 (1.0)	67 (3.8)	22 (3.3)	5 (1.8)	4 (1.4)	1 (0.0)
Japan	7 (2.0)	30 (4.1)	35 (4.0)	16 (3.1)	9 (2.5)	4 (1.6)
Jordan	20 (3.6)	71 (3.9)	3 (1.5)	3 (1.4)	2 (1.2)	1 (1.0)
Korea, Rep. of	6 (1.9)	51 (4.0)	20 (3.1)	20 (3.4)	2 (1.1)	2 (0.9)
Latvia (LSS)	1 (0.6)	71 (3.7)	20 (3.1)	7 (2.5)	0 (0.0)	0 (0.0)
Lithuania ‡	42 (3.9)	0 (0.0)	28 (3.7)	17 (3.2)	1 (1.0)	11 (2.6)
Macedonia, Rep. of r	8 (2.5)	51 (4.5)	37 (4.1)	4 (2.4)	1 (0.5)	0 (0.0)
Malaysia	34 (4.3)	61 (4.4)	1 (0.0)	3 (1.4)	1 (0.0)	1 (0.6)
Moldova	x x	x x	x x	x x	x x	x x
Morocco	10 (2.1)	34 (2.7)	20 (2.9)	20 (2.4)	13 (1.9)	3 (1.0)
Netherlands	4 (3.2)	77 (4.6)	13 (2.9)	2 (1.1)	1 (0.8)	3 (1.6)
New Zealand	1 (0.0)	98 (1.3)	0 (0.0)	0 (0.0)	1 (0.9)	1 (0.0)
Philippines	42 (4.4)	47 (4.6)	2 (1.3)	3 (1.7)	1 (0.9)	4 (1.9)
Romania	4 (1.9)	72 (4.1)	21 (3.3)	2 (1.4)	1 (0.0)	0 (0.0)
Russian Federation	0 (0.0)	0 (0.0)	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Singapore	8 (2.3)	46 (4.5)	12 (2.9)	29 (3.7)	0 (0.0)	5 (1.7)
Slovak Republic	12 (3.0)	74 (4.0)	7 (2.0)	4 (1.9)	0 (0.0)	4 (1.8)
Slovenia	5 (1.9)	77 (3.8)	14 (3.0)	2 (1.1)	0 (0.0)	1 (1.1)
South Africa	3 (1.2)	59 (4.4)	25 (3.8)	10 (2.6)	3 (1.4)	1 (0.8)
Thailand	44 (3.5)	47 (3.7)	4 (1.6)	2 (1.0)	0 (0.0)	2 (1.4)
Tunisia	8 (2.5)	41 (4.4)	21 (3.3)	8 (2.4)	22 (3.4)	1 (0.7)
Turkey	– –	– –	– –	– –	– –	– –
United States	28 (3.0)	32 (3.4)	6 (1.6)	27 (2.7)	1 (0.8)	6 (1.4)
International Avg.	14 (0.4)	55 (0.6)	19 (0.5)	8 (0.4)	3 (0.2)	2 (0.2)

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

Background data provided by teachers.

‡ 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.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Are There National or Regional Policies on Using Calculators?

5.9

For the TIMSS 1999 countries, official policies on calculator use are summarized in Exhibit 5.9. The data indicate wide variation across countries, ranging from encouraging unrestricted use, through use with restrictions, to banning calculator use entirely. Official documents of 23 countries included an explicit policy on the use of calculators. Seven of these reported that their curriculum policy allowed unrestricted use of calculators, and 14 restricted use. In Canada and the United States, policy varied across provinces and states, respectively.

Several countries commented that calculators were not permitted in lower grades of their primary school systems, and others that the use of calculators in these grades was limited so that students could master basic computational skills, both mentally and using pencil and paper. During preparation of the original TIMSS tests, the question whether students should be permitted to use calculators in the test was considered, but for equity reasons TIMSS decided not to permit the use of calculators at the middle school grades.

Exhibit 5.9 Policy On Calculator Usage*

TIMSS 1999 8th grade Mathematics

	Curriculum Contains Recommendations About Use of Calculators	Type of Policy	Comments
Australia	Yes	Unrestricted Use	Calculators are unrestricted as a teaching/learning tool. Computational skills like mental arithmetic are also promoted.
Belgium (Flemish)	Yes	Restricted Use	Calculators are permitted on a limited basis so that students can master the basic skills of computation and mental calculation. Calculator usage increases and is compulsory after grade 9.
Bulgaria	No		
Canada	Yes	Unrestricted, 2 provinces, Restricted, 8 provinces	In general, calculator use is encouraged, except in lower grades in some provinces.
Chile	No		
Chinese Taipei	Yes	Restricted Use	Calculators are not allowed on entrance exams so teachers limit their use in the classroom.
Cyprus	Yes	Restricted Use	Calculators are not permitted in final exams until grade 10.
Czech Republic	Yes	Restricted Use	Computational skills are practiced without calculators.
England	Yes	Restricted Use	Calculator use increases as students progress through school. The emphasis is on pupils having a range of skills: calculator, pencil and paper, and mental computation. Graphic calculators are required at higher levels.
Finland	Yes	Unrestricted Use	Although permitted at the lower levels, policy indicates that the use of calculators is more appropriate at the upper levels (grades 7 - 9).
Hong Kong, SAR	Yes	Unrestricted Use	Calculators may be used for exploration only from grades 1 to 6. No restrictions are set on the use of calculators for students from grade 7 onwards.
Hungary	Yes	Restricted Use	Calculator use considered appropriate in higher grades.
Indonesia	Yes	Restricted Use	Calculators are not permitted in lower grades.
Iran, Islamic Rep.	No		
Israel	Yes	Unrestricted Use	Calculators are permitted through all school levels (grades 1-12).
Italy	No		
Japan	Yes	Unrestricted Use	Calculators are not permitted until grade 5.
Jordan	Yes	Restricted Use	The curriculum does not contain an explicit policy on classroom use of calculators, but policy does indicate that calculator usage is prohibited during tests.
Korea, Rep. of	Yes	Restricted Use	Currently, calculators are not used in class. However, the new curriculum, to be implemented in 2000/1, recommends the wide use of calculators.
Latvia (LSS)	No		
Lithuania	No		
Macedonia, Rep. Of	No		
Malaysia	No		Calculators are used as learning aids. At the secondary level, calculators may be used in public exams when calculation and computational skills are not being assessed.
Moldova	Yes	Restricted Use	For specific problems, a calculator is acceptable.
Morocco	No		
Netherlands	Yes	Unrestricted Use	Calculators are compulsory at national exam level. In grades 11-12 the graphic calculator is compulsory for mathematics students.
New Zealand	Yes	Unrestricted Use	The policy assumes that calculators will be available and used "appropriately" at all levels.
Philippines	No		In the high school, calculators are used mainly for statistics and trigonometry.
Romania	No		
Russian Federation	Yes	Restricted Use	There is some use of calculators in elementary school. Recommended use of calculators on a level with oral and written calculations in secondary school. Students are not allowed to use calculators on public exams in grades 9 and 11.
Singapore	Yes	Restricted Use	In primary school, students are not allowed to use calculators in mathematics. In secondary school, the use of calculators is allowed from grade 7, though the use is restricted.
Slovak Republic	–	–	
Slovenia	No		
South Africa	Yes	Restricted Use	As students progress through school, the policy becomes less restricted. For grades 8-12, the policy restriction indicates that students may not use a programmable calculator.
Thailand	No		
Tunisia	Yes	Restricted Use	Calculators are not permitted until grade 8.
Turkey	No		
United States	Yes	Varies from state to state	

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

Background data provided by National Research Coordinators.

A dash (–) indicates data are not available.

* The use of calculators on TIMSS was not allowed in 1995 or in 1999.

What Mathematics Topics Are Included in the Intended Curriculum?

In the course of their meetings on planning and implementation of TIMSS 1999, the National Research Coordinators developed a list of mathematics topics that they agreed covered most of the content in the intended mathematics curriculum in their respective countries. This list of topics, presented in Exhibit 5.10, built on the topics covered in the TIMSS 1995 mathematics test and included in the teacher questionnaire. It represents a comprehensive list of the topics likely to have been included in the curricula of the participating countries up to and including eighth grade. From the following choices, the National Research Coordinators indicated the percentage of students in their own countries expected to have been taught each topic:

5.10

- All or almost all students (at least 90 percent)
- About half of the students
- Only the more able students (top track – about 25 percent)
- Only the most advanced students (10 percent or less).

Exhibit 5.11 summarizes the data according to the percentage of topics intended to be taught to all or almost all students (at least 90 percent) in each country, across the entire list of topics and for each content area. On average across countries, curricular guidelines called for nearly all students to have been taught three-fourths of the topics overall. Internationally on average, the greatest percentage of topics intended to be taught to 90 percent or more of the students was in fractions and number sense (86 percent) and in measurement (83 percent).

5.11

About two-thirds of the topics in geometry (67 percent) and algebra (68 percent), internationally on average, were expected to have been taught to nearly all students. In eight countries, including high-performing Japan, Korea, and Singapore, countries reported that 10 or more of the 11 algebra topics were intended to be taught to at least 90 percent of the students. Information on specific topics in the intended curricula for each content area is presented in Exhibits R2.3 through R2.7 in the reference section of this report.

R2.3–R2.7

The least agreement between the intended curricula and the topic areas was in data representation, analysis, and probability, with an international average of 60 percent of the topics intended to be taught. Only seven countries intended for all five topics listed for this content area to be taught to nearly all students: Australia, Canada, Moldova, New Zealand, the Russian Federation, Turkey, and the United States.

It should be noted that some countries reported having different curricula or different levels of curriculum for different groups of students, as detailed in Exhibit 5.6. Not surprisingly, then, these countries often reported that about half, only the more able (25 percent), or the top 10 percent of students were expected to have been taught substantial percentages of the topics, in particular those in geometry and algebra. The three countries with the lowest percentages of topics overall intended to be taught to nearly all students have differentiated curricula – England, Israel, and the Netherlands.

In addition, if content within a topic area required different responses, National Research Coordinators chose the response that best represented the entire topic area and noted the discrepancy (see Exhibit A.11 in the appendix for details).

Exhibit 5.10 Mathematics Topics Included in the TIMSS Questionnaires

Fractions and Number Sense

- ■ Whole numbers - including place values, factorization and operations (+, -, x, ÷)
- ■ Understanding and representing common fractions
- ■ Computations with common fractions
- ■ Understanding and representing decimal fractions
- ■ Computations with decimal fractions
- ■ Relationships between common and decimal fractions, ordering of fractions
- ■ Rounding whole numbers and decimal fractions
- ■ Estimating the results of computations
- ■ Number lines
- ◆ Whole number powers of integers
- ■ Computations with percentages and problems involving percentages
- ■ Simple computations with negative numbers
- ■ Square roots (of perfect squares less than 144), small integer exponents
- ◆ Prime factors, highest common factor, lowest common multiple, rules for divisibility
- ◆ Sets, subsets, union, intersection, Venn diagrams
- ◆ Rate problems
- ■ Concepts of ratio and proportion; ratio and proportion problems

Measurement

- ■ Units of measurement; standard metric units
- ■ Reading measurement instruments
- ■ Estimates of measurement; accuracy of measurement
- ◆ Conversions of units between measurement systems
- ■ Perimeter and area of simple shapes – triangles, rectangles and circles
- ■ Perimeter and area of combined shapes
- ■ Volume of rectangular solids – i.e., Volume = length x width x height
- ◆ Volume of other solids (e.g., pyramids, cylinders, cones, spheres)
- ◆ Computing with measurements (+, -, x, ÷)
- ■ Scales applied to maps and models

Data Representation, Analysis, and Probability

- ◆ Collecting and graphing data from a survey
- ■ Representation and interpretation of data in graphs, charts, and tables
- ■ Arithmetic mean
- ◆ Median and mode
- ■ Simple probabilities – understanding and calculations

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

■ Topics included in the curriculum and teacher questionnaires (intended and implemented curriculum).

◆ Topics also included in the curriculum questionnaire (intended curriculum).

Geometry

- ■ Cartesian coordinates of points in a plane
- ■ Coordinates of points on a given straight line
- ■ Simple two dimensional geometry – angles on a straight line, parallel lines, triangles and quadrilaterals
- ■ Congruence and similarity
- ◆ Angles – (acute, right, supplementary, etc.)
- ◆ Pythagorean theorem (without proof)
- ■ Symmetry and transformations (reflection and rotation)
- ■ Visualization of three-dimensional shapes
- ◆ Geometric constructions with straight-edge and compass
- ◆ Regular polygons and their properties – names (e.g., hexagon and octagon), sum of angles, etc.
- ◆ Proofs (formal deductive demonstrations of geometric relationships)
- ◆ Sine, cosine, and tangent in right-angle triangles
- ◆ Nets of solids

Algebra

- ■ Number patterns and simple relations
- ◆ Writing expressions for general terms in number pattern sequence
- ◆ Translating from verbal descriptions to symbolic expressions
- ■ Simple algebraic expressions
- ◆ Evaluating simple algebraic expressions by substitution of given value of variables
- ■ Representing situations algebraically; formulas
- ■ Solving simple equations
- ■ Solving simple inequalities
- ◆ Solving simultaneous equations in two variables
- ◆ Interpreting linear relations
- ◆ Using the graph of a relationship to interpolate/extrapolate

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

■ Topics included in the curriculum and teacher questionnaires (intended and implemented curriculum).

◆ Topics also included in the curriculum questionnaire (intended curriculum).

Exhibit 5.11 Mathematics Topics in the Intended Curriculum for At Least 90% of Students, Up to and Including Eighth Grade

TIMSS 1999 8th grade Mathematics

	Percentage of Topics Intended to Be Taught to All or Almost All (at least 90%) Students					
	Overall	Fractions and Number Sense	Measurement	Data Representation, Analysis, and Probability	Geometry	Algebra
Australia	89	94	100	100	85	73
Belgium (Flemish)	80	100	90	80	62	64
Bulgaria	82	88	100	40	77	82
Canada	82	94	90	100	77	55
Chile	61	76	80	80	54	18
Chinese Taipei	59	82	50	40	46	55
Cyprus	63	82	70	0	54	64
Czech Republic	77	94	90	80	69	45
England	25	29	30	40	23	9
Finland	57	65	80	60	31	55
Hong Kong, SAR	79	94	80	40	77	73
Hungary	77	94	60	60	69	82
Indonesia	86	94	100	60	85	73
Iran, Islamic Rep.	80	88	100	40	77	73
Israel	41	47	40	60	23	45
Italy	91	100	80	80	92	91
Japan	89	82	100	80	85	100
Jordan	89	100	100	80	85	73
Korea, Rep. of	80	82	100	80	54	91
Latvia (LSS)	70	82	80	20	54	82
Lithuania	80	94	100	40	69	73
Macedonia, Rep. of	59	59	60	0	69	73
Malaysia	80	94	90	40	85	64
Moldova	95	94	90	100	92	100
Morocco	59	82	90	40	54	9
Netherlands	46	53	40	60	54	27
New Zealand	80	100	70	100	69	64
Philippines	71	94	90	80	23	73
Romania	93	100	100	20	100	100
Russian Federation	75	88	60	100	62	73
Singapore	89	94	100	80	77	91
Slovak Republic	–	–	–	–	–	–
Slovenia	91	100	100	40	92	91
South Africa	73	88	100	0	69	64
Thailand	73	88	90	40	54	73
Tunisia	79	100	90	60	62	64
Turkey	91	88	90	100	85	100
United States	93	100	100	100	85	82
International Avg.	75	86	83	60	67	68

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

Background data provided by National Research Coordinators according to the national curriculum. NRCs indicated the percentage of students who should have been taught each of the topics listed in Exhibit 5.10. The response categories were: all or almost all of the students (at least 90%); about half of the students; only the more able students (top track - about 25%); only the most advanced students (10% or less); not included in curriculum through grade 8. (See reference exhibits R2.3-R2.7 for detail by topic.)

A dash (–) indicates data are not available.

Have Students Been Taught the Topics Tested by TIMSS?

In interpreting the achievement results, it is important to consider how extensively the topics tested are taught in the participating countries. As shown in Exhibits 5.12 through 5.16, the five major mathematics content areas assessed in TIMSS 1999 were represented by 34 topic areas. For each area, teachers indicated whether their students had been taught the topics before this year, one to five periods this year, more than five periods this year; whether the topics had not yet been taught; or whether the teacher did not know. Exhibits 5.12 through 5.16 show the percentages of students in each country reported to have been taught each topic before or during the year of the testing.

According to their teachers, nearly all of the students in all of the countries had been taught the topics in fractions and number sense, as shown in Exhibit 5.12. The international average for each topic exceeded 90 percent of students, with the exception of "square roots (of perfect squares less than 144), small integer exponents" and "concepts of ratio and proportions; ratio and proportion problems," with averages of 83 and 87 percent, respectively. Exhibit R2.8 in the reference section indicates that many students had instruction in these topics before the eighth grade.

5.12

R2.8

Similarly, instructional coverage was high for the measurement topics presented in Exhibit 5.13. At least 87 percent of students, on average internationally, were taught five of the six topics. The topic with the lowest international average was "scales applied to maps and models." Two topics, "units of measurement; standards metric units" and "perimeter and area of simple shapes – triangles, rectangles, and circles," were taught to 96 percent of the students on average, internationally. As indicated by Exhibit R2.9 in the reference section, measurement topics received less emphasis in the eighth grade than fractions and number sense topics (see Exhibit R2.8). As with fractions and number sense, substantial percentages of students had studied the measurement topics before the eighth grade.

5.13

R2.9

Corresponding to the reports for the intended curricula, teachers reported lower average percentages internationally across the data representation, analysis, and probability topic areas, shown in Exhibit 5.14. Teachers were asked about three topics in this content area, including "representation and interpretation of data in graphs, charts, and tables." Most of the test items in this content area dealt with interpretation of graphs and tables, and the international average for students who were taught this topic was 75 percent. The average percentages of

5.14

students taught the other two topics in this content area were 70 percent for "arithmetic mean" and 43 percent for "simple probabilities." In 22 countries, teachers indicated that less than half the students were taught the latter topic. For most students, the topics in this content area were receiving moderate attention at the eighth grade, and few students had been taught them at earlier grades (see Exhibit R2.10).

R2.10

Teachers reported a range of instructional coverage across topics in geometry, presented in Exhibit 5.15. "Simple two dimensional geometry – angles on a straight line, parallel lines, triangles and quadrilaterals" was reported to have been taught internationally on average to 95 percent of the students, and "visualization of three-dimensional shapes" was taught to only 57 percent. The two topics showing the greatest variation across countries were "symmetry and transformations" and "visualization of three-dimensional shapes." In more than nine countries, these topics were reported to be taught to less than 50 percent of the students, and in at least 15 countries to 70 percent or more of the students. As shown in Exhibit R2.11 in the reference section, only small percentages of students had completed instruction in the geometry topics before the eighth grade. According to their teachers, most were receiving moderate emphasis on the geometry topics in the eighth grade. On average internationally, 22 percent of students had not yet been taught 50 percent or more of the geometry topics.

5.15

R2.11

Teachers across countries reported that most students had studied the algebra topics. The international average percentage of students taught each of these topics exceeded 85 percent, with the exception of "solving simple inequalities," with an average of 66 percent. Four of the five topics were taught to 70 percent or fewer of the students in three countries, Chile, Finland, and the Philippines. In contrast, substantial percentages of students (90 percent or more) had been introduced to all algebra topics before or during the eighth grade in ten countries, including high-performing Japan, Korea, and Singapore. For many countries, however, teachers reported presenting algebra topics during the eighth grade for substantial percentages of students (see Exhibit R2.12).

5.16

R2.12

Exhibits 5.12–5.16 Overleaf

Exhibit 5.12 Percentages of Students Taught Fractions and Number Sense Topics*

	Whole numbers - including place values, factorization and operations (+, –, x, ÷)	Understanding and representing common fractions	Computations with common fractions	Understanding and representing decimal fractions	Computations with decimal fractions	Relationships between common and decimal fractions, ordering of fractions	Rounding whole numbers and decimal fractions
Australia	100 (0.0)	100 (0.3)	100 (0.3)	100 (0.0)	100 (0.3)	100 (0.0)	99 (0.6)
Belgium (Flemish)	95 (3.1)	99 (1.2)	97 (2.4)	88 (2.9)	83 (2.2)	89 (4.1)	90 (3.5)
Bulgaria	s 99 (0.9)	s 99 (0.6)	s 99 (0.9)	s 99 (0.6)	s 99 (0.9)	s 99 (0.9)	s 99 (0.6)
Canada	r 99 (0.6)	r 100 (0.3)	r 100 (0.3)	r 99 (0.5)	r 98 (0.8)	r 99 (0.4)	r 100 (0.3)
Chile	100 (0.0)	100 (0.4)	100 (0.0)	99 (0.5)	99 (0.5)	98 (1.0)	92 (2.2)
Chinese Taipei	100 (0.0)	100 (0.3)	100 (0.3)	100 (0.3)	99 (0.7)	100 (0.3)	98 (1.1)
Cyprus	s 96 (2.7)	r 100 (0.0)	r 100 (0.0)	r 100 (0.0)	r 99 (0.8)	r 99 (0.8)	r 94 (2.6)
Czech Republic	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
England	s 100 (0.1)	s 99 (0.5)	s 93 (2.0)	s 97 (0.9)	s 95 (1.1)	s 94 (1.1)	s 97 (0.9)
Finland	98 (1.3)	94 (2.6)	88 (3.3)	100 (0.5)	99 (0.8)	90 (3.0)	89 (2.9)
Hong Kong, SAR	98 (1.1)	99 (0.8)	99 (0.8)	99 (0.8)	100 (0.0)	99 (0.8)	100 (0.4)
Hungary	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
Indonesia	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
Iran, Islamic Rep.	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.4)	99 (0.9)	99 (0.9)	98 (1.4)
Israel	97 (1.3)	99 (0.6)	99 (0.5)	98 (1.0)	98 (0.9)	98 (1.0)	r 96 (1.6)
Italy	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.5)	100 (0.0)	100 (0.0)	100 (0.4)
Japan	99 (1.0)	98 (1.4)	100 (0.0)	98 (1.4)	100 (0.0)	99 (1.0)	92 (2.7)
Jordan	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
Korea, Rep. of	92 (2.1)	96 (1.5)	96 (1.6)	97 (1.4)	96 (1.6)	96 (1.7)	94 (2.0)
Latvia (LSS)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	99 (0.7)
Lithuania ‡	– –	– –	– –	– –	– –	– –	– –
Macedonia, Rep. of	90 (2.4)	87 (2.8)	87 (2.8)	87 (2.8)	88 (2.5)	88 (2.6)	87 (2.6)
Malaysia	98 (1.0)	99 (0.9)	99 (0.9)	97 (1.3)	97 (1.5)	95 (1.5)	96 (1.7)
Moldova	– –	– –	– –	– –	– –	– –	– –
Morocco	– –	– –	– –	– –	– –	– –	– –
Netherlands	r 74 (5.8)	100 (0.3)	100 (0.3)	r 96 (3.2)	r 96 (3.3)	r 96 (3.3)	100 (0.0)
New Zealand	100 (0.0)	96 (1.5)	94 (1.7)	98 (0.8)	98 (0.8)	96 (1.3)	96 (1.2)
Philippines	100 (0.0)	100 (0.0)	100 (0.0)	98 (1.2)	99 (0.7)	99 (0.8)	97 (1.5)
Romania	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	99 (1.0)
Russian Federation	– –	– –	– –	– –	– –	– –	– –
Singapore	100 (0.0)	100 (0.0)	100 (0.0)	99 (0.9)	100 (0.0)	100 (0.0)	100 (0.0)
Slovak Republic	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
Slovenia	100 (0.0)	100 (0.0)	99 (0.9)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
South Africa	– –	– –	– –	– –	– –	– –	– –
Thailand	94 (1.8)	97 (1.3)	99 (0.6)	98 (1.1)	99 (0.9)	99 (0.6)	94 (2.0)
Tunisia	99 (0.8)	r 93 (2.4)	r 97 (1.6)	94 (2.2)	99 (0.8)	r 91 (2.7)	r 46 (5.3)
Turkey	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.2)
United States	100 (0.2)	100 (0.0)	100 (0.0)	98 (0.8)	98 (0.8)	98 (0.8)	99 (0.7)
International Avg.	98 (0.3)	99 (0.2)	98 (0.2)	98 (0.2)	98 (0.2)	98 (0.2)	95 (0.3)

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

Background data provided by teachers.

* Taught before or during this school year.

‡ 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.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

	Estimating the results of computations	Number lines	Computations with percentages and problems involving percentages	Simple computations with negative numbers	Square roots (of perfect squares less than 144), small integer exponents	Concepts of ratio and proportions; ratio and proportion problems
Australia	96 (1.4)	99 (0.9)	97 (1.5)	99 (1.0)	94 (2.2)	86 (3.6)
Belgium (Flemish)	r 94 (2.0)	96 (2.5)	93 (2.1)	89 (2.6)	80 (2.2)	70 (2.8)
Bulgaria	s 98 (1.2)	r 47 (5.3)	s 97 (1.7)	s 99 (1.3)	r 38 (4.3)	r 98 (1.0)
Canada	r 100 (0.3)	r 100 (0.1)	r 98 (0.8)	r 97 (1.6)	r 96 (1.2)	r 95 (1.3)
Chile	88 (2.7)	99 (0.9)	80 (3.1)	77 (3.2)	57 (3.7)	88 (2.3)
Chinese Taipei	95 (2.0)	99 (0.8)	94 (1.9)	100 (0.3)	96 (1.6)	90 (2.6)
Cyprus	r 96 (2.1)	s 100 (0.0)	r 100 (0.0)	r 100 (0.0)	s 100 (0.0)	r 100 (0.0)
Czech Republic	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.2)
England	s 96 (1.7)	s 97 (1.3)	s 96 (1.3)	s 96 (1.3)	s 87 (2.0)	s 79 (2.7)
Finland	86 (3.6)	96 (1.9)	48 (4.3)	98 (1.6)	20 (3.1)	14 (3.1)
Hong Kong, SAR	r 94 (2.2)	92 (2.6)	95 (1.9)	99 (0.8)	98 (1.2)	91 (2.5)
Hungary	100 (0.0)	95 (1.6)	100 (0.0)	100 (0.0)	99 (0.8)	98 (1.0)
Indonesia	97 (2.0)	100 (0.0)	100 (0.0)	99 (0.4)	98 (1.3)	92 (2.9)
Iran, Islamic Rep.	r 86 (3.2)	100 (0.0)	99 (1.1)	100 (0.0)	100 (0.0)	100 (0.0)
Israel	r 94 (1.5)	99 (0.5)	92 (2.1)	99 (0.4)	r 83 (2.9)	r 35 (4.5)
Italy	94 (2.0)	99 (0.8)	96 (1.6)	98 (1.1)	100 (0.0)	99 (0.8)
Japan	r 89 (3.3)	100 (0.0)	100 (0.0)	100 (0.0)	14 (3.0)	97 (1.6)
Jordan	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	99 (0.5)
Korea, Rep. of	89 (2.5)	98 (1.2)	92 (2.0)	95 (1.8)	64 (4.1)	90 (2.3)
Latvia (LSS)	r 91 (2.5)	30 (4.3)	100 (0.0)	100 (0.0)	98 (0.7)	98 (1.1)
Lithuania ‡	– –	– –	– –	– –	– –	– –
Macedonia, Rep. of	82 (3.2)	r 83 (3.1)	92 (2.3)	88 (2.7)	91 (2.5)	r 97 (1.9)
Malaysia	98 (1.1)	100 (0.0)	96 (1.5)	99 (0.6)	98 (1.0)	97 (1.3)
Moldova	– –	– –	– –	– –	– –	– –
Morocco	– –	– –	– –	– –	– –	– –
Netherlands	r 99 (1.0)	99 (0.9)	98 (1.2)	98 (1.4)	92 (3.1)	r 80 (5.8)
New Zealand	97 (0.9)	97 (1.5)	93 (2.1)	96 (1.5)	86 (2.8)	67 (3.8)
Philippines	91 (2.3)	94 (2.1)	97 (1.5)	87 (3.2)	65 (4.1)	92 (2.4)
Romania	99 (0.9)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
Russian Federation	– –	– –	– –	– –	– –	– –
Singapore	100 (0.4)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
Slovak Republic	99 (0.6)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
Slovenia	98 (1.3)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
South Africa	– –	– –	– –	– –	– –	– –
Thailand	94 (2.1)	98 (1.0)	100 (0.0)	98 (1.1)	94 (2.3)	99 (0.8)
Tunisia	s 35 (4.5)	r 54 (4.4)	81 (3.6)	92 (2.5)	20 (3.7)	r 35 (4.3)
Turkey	x x	80 (2.8)	97 (1.6)	99 (0.7)	96 (1.2)	99 (0.4)
United States	100 (0.2)	99 (0.5)	96 (1.4)	97 (1.1)	82 (3.7)	93 (1.8)
International Avg.	93 (0.4)	92 (0.3)	95 (0.3)	97 (0.2)	83 (0.4)	87 (0.4)

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

Exhibit 5.13 Percentages of Students Taught Measurement Topics*

	Units of measurement, standard metric units	Reading measurement instuments	Estimates of measurement, accuracy of measurement	Perimeter and area of simple shapes - triangles, rectangles, and circles	Perimeter and area of combined shapes	Volume of rectangular solids - i.e., volume=length × width × height	Scales applied to maps and models
Australia	99 (1.0)	r 96 (2.0)	94 (2.2)	98 (1.2)	97 (1.4)	85 (3.2)	73 (4.4)
Belgium (Flemish)	95 (1.8)	r 83 (3.8)	r 85 (4.1)	98 (1.2)	r 85 (3.9)	89 (3.5)	88 (2.2)
Bulgaria	s 98 (1.2)	s 87 (3.1)	s 92 (2.7)	s 98 (1.3)	s 84 (4.2)	s 94 (2.6)	s 87 (3.0)
Canada	r 99 (0.5)	r 97 (1.2)	r 97 (1.0)	r 97 (0.9)	r 96 (1.3)	r 68 (2.7)	r 92 (2.1)
Chile	87 (2.7)	74 (3.6)	67 (3.9)	88 (2.7)	74 (3.8)	45 (4.4)	49 (4.0)
Chinese Taipei	96 (1.7)	95 (2.0)	90 (2.7)	100 (0.3)	92 (2.3)	99 (0.7)	74 (3.8)
Cyprus	s 100 (0.0)	x x	x x	s 100 (0.0)	s 100 (0.0)	r 67 (3.7)	r 43 (5.0)
Czech Republic	100 (0.2)	r 99 (0.6)	97 (1.2)	100 (0.0)	90 (3.2)	100 (0.0)	98 (1.2)
England	s 98 (0.9)	s 96 (1.3)	s 86 (2.8)	s 98 (1.0)	s 96 (1.1)	s 93 (1.4)	s 76 (2.6)
Finland	98 (0.9)	r 88 (3.0)	r 77 (4.0)	65 (4.2)	51 (4.5)	58 (4.3)	20 (3.7)
Hong Kong, SAR	98 (1.2)	96 (1.9)	92 (2.5)	100 (0.0)	99 (0.8)	98 (1.5)	91 (2.7)
Hungary	100 (0.0)	100 (0.2)	100 (0.2)	99 (0.6)	97 (1.2)	98 (1.1)	90 (2.5)
Indonesia	96 (1.6)	94 (2.1)	87 (3.5)	100 (0.0)	98 (1.1)	87 (3.6)	94 (2.1)
Iran, Islamic Rep.	91 (2.7)	86 (2.6)	86 (3.0)	100 (0.0)	97 (1.6)	97 (1.7)	81 (4.1)
Israel	r 90 (2.5)	s 77 (4.3)	s 81 (3.9)	r 84 (3.1)	r 62 (4.0)	r 47 (4.7)	s 43 (5.0)
Italy	100 (0.0)	96 (1.6)	90 (2.3)	99 (0.8)	96 (1.3)	95 (1.4)	91 (2.2)
Japan	90 (2.5)	r 84 (3.3)	r 66 (4.2)	99 (0.7)	78 (3.3)	98 (1.4)	84 (3.1)
Jordan	100 (0.0)	100 (0.0)	97 (1.6)	100 (0.0)	99 (0.9)	99 (0.5)	88 (3.1)
Korea, Rep. of	85 (2.7)	84 (2.7)	93 (2.1)	98 (1.2)	95 (1.8)	98 (1.0)	73 (3.4)
Latvia (LSS)	99 (0.7)	92 (2.7)	71 (4.5)	96 (1.8)	72 (4.6)	81 (3.9)	94 (2.4)
Lithuania ‡	– –	– –	– –	– –	– –	– –	– –
Macedonia, Rep. of	88 (2.7)	r 81 (3.7)	r 82 (3.4)	92 (2.8)	r 91 (3.0)	r 95 (1.5)	s 70 (4.4)
Malaysia	96 (1.7)	93 (2.0)	93 (2.0)	97 (2.0)	95 (2.3)	91 (2.4)	86 (3.0)
Moldova	– –	– –	– –	– –	– –	– –	– –
Morocco	– –	– –	– –	– –	– –	– –	– –
Netherlands	r 93 (4.7)	s 54 (8.4)	r 78 (6.3)	98 (1.2)	84 (4.9)	89 (4.9)	88 (5.3)
New Zealand	99 (0.8)	95 (1.6)	85 (2.9)	95 (1.8)	92 (2.1)	92 (1.8)	66 (4.1)
Philippines	88 (2.8)	83 (3.4)	82 (3.3)	92 (2.3)	83 (3.1)	76 (3.7)	40 (4.4)
Romania	100 (0.0)	100 (0.0)	96 (1.7)	100 (0.0)	99 (0.9)	99 (0.9)	98 (1.3)
Russian Federation	– –	– –	– –	– –	– –	– –	– –
Singapore	100 (0.0)	r 98 (1.2)	98 (1.3)	100 (0.0)	100 (0.0)	100 (0.0)	96 (1.6)
Slovak Republic	99 (1.2)	r 77 (4.2)	r 93 (2.7)	100 (0.0)	99 (0.8)	97 (1.5)	99 (1.2)
Slovenia	100 (0.0)	91 (2.7)	93 (2.2)	100 (0.0)	100 (0.0)	97 (1.3)	97 (1.7)
South Africa	– –	– –	– –	– –	– –	– –	– –
Thailand	91 (2.5)	86 (3.0)	88 (2.7)	95 (1.8)	78 (3.7)	99 (0.7)	85 (3.0)
Tunisia	94 (2.2)	r 74 (3.9)	r 53 (4.6)	98 (1.3)	89 (2.6)	89 (2.5)	r 47 (5.2)
Turkey	89 (2.6)	88 (2.4)	90 (2.2)	92 (2.2)	79 (3.1)	56 (3.8)	r 60 (3.6)
United States	96 (1.0)	r 92 (1.7)	r 91 (1.2)	95 (1.4)	90 (1.6)	83 (2.0)	r 84 (2.5)
International Avg.	96 (0.3)	89 (0.5)	87 (0.5)	96 (0.3)	89 (0.5)	87 (0.5)	77 (0.6)

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

Background data provided by teachers.

* Taught before or during this school year.

‡ 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.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit 5.14 Percentages of Students Taught Data Representation, Analysis, and Probability Topics*

TIMSS 1999 8th grade Mathematics

	Representation and interpretation of data in graphs, charts, and tables	Arithmetic mean	Simple probabilities – understanding and calculations
Australia	92 (2.4)	74 (3.5)	52 (4.3)
Belgium (Flemish)	86 (4.1)	93 (2.1)	r 24 (3.0)
Bulgaria	r 71 (6.6)	r 39 (5.5)	r 10 (2.6)
Canada	r 91 (2.4)	r 81 (2.7)	r 72 (3.3)
Chile	49 (3.8)	49 (3.5)	35 (3.6)
Chinese Taipei	11 (2.3)	12 (2.7)	4 (1.6)
Cyprus	r 1 (0.1)	r 6 (2.2)	r 0 (0.0)
Czech Republic	49 (5.6)	88 (3.4)	7 (2.8)
England	s 99 (0.4)	s 93 (2.3)	s 90 (2.4)
Finland	65 (3.5)	62 (4.3)	14 (3.3)
Hong Kong, SAR	65 (4.5)	30 (4.1)	10 (2.8)
Hungary	99 (0.8)	92 (2.4)	56 (3.5)
Indonesia	93 (2.1)	93 (2.4)	95 (1.9)
Iran, Islamic Rep.	94 (3.8)	92 (3.8)	r 45 (5.0)
Israel	r 62 (4.4)	r 71 (3.8)	s 28 (3.8)
Italy	84 (3.0)	62 (3.6)	49 (3.8)
Japan	43 (4.7)	38 (4.5)	3 (1.4)
Jordan	93 (2.6)	93 (2.6)	95 (1.8)
Korea, Rep. of	95 (1.7)	78 (3.2)	99 (0.6)
Latvia (LSS)	98 (1.3)	99 (0.6)	40 (4.3)
Lithuania ‡	– –	– –	– –
Macedonia, Rep. of	r 76 (4.5)	82 (3.4)	r 45 (5.0)
Malaysia	56 (3.8)	38 (3.5)	33 (3.7)
Moldova	– –	– –	– –
Morocco	– –	– –	– –
Netherlands	87 (4.7)	77 (5.7)	r 46 (6.5)
New Zealand	87 (3.0)	77 (3.4)	61 (3.9)
Philippines	60 (4.2)	34 (4.3)	29 (4.2)
Romania	95 (2.2)	100 (0.0)	95 (1.7)
Russian Federation	– –	– –	– –
Singapore	97 (1.7)	88 (3.2)	s 17 (4.2)
Slovak Republic	72 (4.7)	98 (1.2)	30 (4.7)
Slovenia	97 (1.4)	94 (2.2)	r 40 (4.4)
South Africa	– –	– –	– –
Thailand	90 (2.9)	57 (4.3)	44 (4.2)
Tunisia	38 (4.4)	28 (4.0)	6 (2.3)
Turkey	79 (2.6)	93 (2.2)	78 (4.0)
United States	96 (1.2)	93 (1.6)	79 (2.3)
International Avg.	75 (0.6)	70 (0.6)	43 (0.6)

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

Background data provided by teachers.

* Taught before or during this school year.

‡ 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.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Exhibit 5.15 Percentages of Students Taught Geometry Topics*

	Cartesian coordinates of points in a plane	Coordinates of points on a given straight line	Simple two dimensional geometry - angles on a straight line, parallel lines, triangles and quadrilaterals	Congruence and similarity	Symmetry and transformations (reflection and rotation)	Visualization of three-dimensional shapes
Australia	92 (2.4)	80 (3.7)	96 (1.7)	61 (4.2)	64 (3.8)	r 75 (4.2)
Belgium (Flemish)	78 (3.0)	r 54 (3.9)	91 (4.1)	79 (2.5)	87 (2.9)	57 (4.0)
Bulgaria	92 (2.5)	r 91 (3.9)	100 (0.5)	81 (3.6)	82 (3.4)	r 24 (4.7)
Canada	r 81 (2.5)	r 84 (2.6)	r 94 (1.8)	r 84 (2.7)	r 78 (2.4)	r 63 (3.2)
Chile	59 (3.7)	65 (3.9)	96 (1.5)	69 (3.8)	26 (3.0)	47 (4.3)
Chinese Taipei	100 (0.0)	99 (0.9)	78 (3.5)	60 (4.3)	29 (3.7)	42 (4.1)
Cyprus	r 6 (2.5)	r 20 (4.3)	r 100 (0.0)	r 16 (4.0)	r 23 (4.7)	r 40 (5.1)
Czech Republic	94 (2.6)	88 (4.9)	100 (0.0)	86 (3.7)	98 (1.1)	73 (5.2)
England	s 94 (1.3)	s 79 (3.1)	s 95 (1.6)	s 54 (4.1)	s 88 (2.6)	s 75 (3.0)
Finland	93 (1.9)	64 (4.0)	88 (2.8)	36 (3.8)	37 (4.0)	30 (4.0)
Hong Kong, SAR	98 (1.3)	95 (1.9)	97 (1.6)	89 (2.8)	r 31 (4.6)	r 29 (4.7)
Hungary	100 (0.3)	92 (2.3)	99 (0.7)	82 (3.1)	97 (1.2)	70 (3.6)
Indonesia	100 (0.0)	100 (0.0)	94 (2.5)	66 (3.9)	56 (4.2)	28 (4.1)
Iran, Islamic Rep.	97 (1.4)	100 (0.0)	98 (1.0)	97 (1.5)	95 (1.7)	77 (4.0)
Israel	87 (3.1)	r 83 (3.4)	91 (2.5)	53 (4.0)	r 21 (3.3)	r 11 (2.6)
Italy	93 (1.9)	79 (3.0)	98 (1.2)	91 (2.0)	65 (3.8)	89 (2.4)
Japan	100 (0.0)	99 (1.0)	97 (1.4)	98 (1.2)	98 (1.3)	82 (2.9)
Jordan	95 (1.9)	93 (2.5)	98 (1.1)	99 (0.5)	27 (4.0)	99 (1.1)
Korea, Rep. of	98 (1.1)	99 (0.7)	99 (0.7)	99 (0.7)	71 (3.7)	52 (4.2)
Latvia (LSS)	99 (1.1)	99 (0.9)	99 (0.8)	72 (4.0)	11 (2.4)	7 (1.9)
Lithuania ‡	– –	– –	– –	– –	– –	– –
Macedonia, Rep. of	95 (1.5)	91 (2.7)	90 (2.6)	r 95 (1.5)	90 (2.6)	r 74 (4.3)
Malaysia	x x	x x	96 (1.4)	71 (3.1)	68 (3.7)	70 (3.5)
Moldova	– –	– –	– –	– –	– –	– –
Morocco	– –	– –	– –	– –	– –	– –
Netherlands	r 97 (1.5)	r 97 (1.5)	98 (1.1)	49 (5.8)	78 (5.3)	r 60 (6.2)
New Zealand	83 (2.9)	69 (3.6)	97 (1.6)	49 (4.2)	76 (3.1)	70 (3.7)
Philippines	49 (4.4)	57 (4.3)	77 (3.8)	50 (4.1)	26 (3.8)	31 (3.7)
Romania	99 (0.6)	99 (0.6)	100 (0.0)	100 (0.0)	86 (2.7)	97 (1.7)
Russian Federation	– –	– –	– –	– –	– –	– –
Singapore	91 (2.6)	93 (2.4)	96 (1.8)	96 (1.9)	84 (3.4)	r 72 (4.4)
Slovak Republic	74 (4.1)	73 (4.4)	95 (2.3)	28 (3.7)	41 (5.0)	r 43 (5.0)
Slovenia	99 (0.9)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	86 (2.9)
South Africa	– –	– –	– –	– –	– –	– –
Thailand	91 (2.7)	88 (3.1)	90 (2.9)	92 (2.6)	53 (4.5)	74 (4.1)
Tunisia	14 (3.2)	78 (3.3)	86 (2.9)	r 8 (2.6)	30 (4.0)	50 (4.4)
Turkey	90 (2.6)	99 (0.6)	97 (1.3)	97 (1.3)	86 (3.0)	37 (3.5)
United States	r 83 (2.4)	82 (2.5)	89 (2.0)	r 80 (2.6)	r 62 (2.9)	r 61 (2.7)
International Avg.	85 (0.4)	84 (0.5)	95 (0.3)	72 (0.6)	63 (0.6)	57 (0.7)

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

Background data provided by teachers.

* Taught before or during this school year.

‡ 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.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit 5.16 Percentages of Students Taught Algebra Topics*

TIMSS 1999 8th grade Mathematics

	Number patterns and simple relations	Simple algebraic expressions	Representing situations algebraically; formulas	Solving simple equations	Solving simple inequalities
Australia	100 (0.0)	100 (0.0)	96 (1.6)	94 (1.8)	45 (3.9)
Belgium (Flemish)	r 86 (2.9)	84 (1.9)	84 (3.1)	85 (2.8)	r 9 (2.1)
Bulgaria	r 98 (1.1)	r 99 (0.7)	98 (1.3)	100 (0.5)	99 (0.7)
Canada	r 98 (1.0)	r 98 (0.8)	r 92 (2.1)	r 94 (2.3)	r 50 (3.2)
Chile	66 (3.7)	68 (3.5)	56 (3.9)	84 (2.6)	69 (3.9)
Chinese Taipei	92 (2.5)	99 (0.8)	99 (0.8)	98 (1.2)	43 (4.2)
Cyprus	r 84 (3.3)	r 89 (3.9)	r 100 (0.0)	s 100 (0.0)	r 100 (0.0)
Czech Republic	r 99 (1.2)	100 (0.0)	97 (1.9)	96 (2.0)	32 (5.2)
England	s 98 (0.6)	s 96 (1.1)	s 89 (1.8)	s 93 (1.5)	s 39 (3.7)
Finland	49 (4.8)	73 (3.9)	47 (4.3)	52 (4.3)	4 (1.6)
Hong Kong, SAR	r 87 (3.0)	100 (0.0)	100 (0.0)	100 (0.0)	27 (4.0)
Hungary	94 (2.1)	100 (0.3)	98 (1.3)	100 (0.0)	99 (0.8)
Indonesia	61 (4.2)	92 (2.6)	91 (2.5)	97 (1.8)	96 (2.0)
Iran, Islamic Rep.	99 (0.7)	100 (0.0)	96 (1.7)	100 (0.0)	r 24 (3.8)
Israel	100 (0.2)	97 (1.2)	88 (3.0)	99 (0.9)	92 (1.8)
Italy	98 (1.2)	100 (0.4)	95 (1.7)	95 (1.7)	27 (2.9)
Japan	r 94 (2.4)	100 (0.0)	98 (1.2)	100 (0.0)	99 (0.7)
Jordan	35 (4.1)	99 (0.9)	96 (1.7)	100 (0.0)	60 (4.2)
Korea, Rep. of	95 (1.3)	99 (0.7)	96 (1.6)	99 (0.7)	99 (1.0)
Latvia (LSS)	92 (2.6)	100 (0.0)	100 (0.0)	100 (0.0)	96 (1.8)
Lithuania ‡	– –	– –	– –	– –	– –
Macedonia, Rep. of	81 (3.7)	94 (2.5)	r 97 (1.5)	r 99 (0.7)	97 (1.5)
Malaysia	98 (1.2)	99 (0.9)	98 (1.1)	99 (1.0)	72 (3.4)
Moldova	– –	– –	– –	– –	– –
Morocco	– –	– –	– –	– –	– –
Netherlands	87 (4.9)	r 86 (4.9)	81 (6.0)	76 (5.3)	r 39 (6.4)
New Zealand	99 (0.8)	97 (1.2)	91 (2.5)	90 (2.5)	38 (4.3)
Philippines	70 (3.6)	78 (3.3)	66 (4.0)	69 (4.2)	45 (4.3)
Romania	100 (0.0)	100 (0.0)	99 (1.0)	100 (0.0)	99 (0.9)
Russian Federation	– –	– –	– –	– –	– –
Singapore	98 (1.4)	100 (0.0)	100 (0.0)	100 (0.0)	93 (2.3)
Slovak Republic	99 (0.9)	100 (0.1)	97 (1.5)	100 (0.0)	93 (2.5)
Slovenia	98 (1.1)	100 (0.0)	99 (0.6)	100 (0.0)	92 (2.5)
South Africa	– –	– –	– –	– –	– –
Thailand	75 (4.1)	75 (4.3)	74 (4.2)	99 (0.5)	97 (1.3)
Tunisia	r 71 (4.0)	85 (3.3)	r 61 (4.7)	72 (4.0)	21 (3.7)
Turkey	91 (2.0)	93 (2.2)	94 (2.0)	99 (1.0)	99 (0.7)
United States	97 (1.1)	98 (0.9)	96 (1.1)	98 (0.6)	83 (2.3)
International Avg.	88 (0.5)	94 (0.4)	90 (0.4)	94 (0.3)	66 (0.5)

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

Background data provided by teachers.

* Taught before or during this school year.

‡ 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.

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An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Can Meaningful Comparisons Be Made Between the Intended and Implemented Curriculum?

The TIMSS 1999 results indicate some discrepancies in a number of countries between the intended curriculum in mathematics and the implemented curriculum as reported by teachers. There are many cases of topics intended to be taught to all, or almost all, students in a country for which teachers reported lower coverage. For example, curricular goals and aims in 25 countries included "visualization of three-dimensional shapes" for all or almost all students, but teachers in only eight countries reported that at least 75 percent of the students had been taught this topic. Interestingly, there are also cases for which teachers reported greater topic coverage than would be expected from the intended curriculum. Substantial percentages of students in several countries had been taught "simple probabilities" even when this topic was not included in the official curriculum. Such discrepancies are consistent with previous IEA studies.[2] However, considering the broad nature of the topics, care should be taken in interpreting the results. Further analysis will need to be done within each country to strengthen the match between the intended and implemented curricula.

2 Livingstone, I.D., (1986), *Second International Mathematics Study: Perceptions of the Intended and Implemented Mathematics Curriculum*, Washington, D.C., Center for Statistics, U.S. Department of Education.