

Chapter 5

TEACHERS AND INSTRUCTION

Teachers and the instructional approaches they use are fundamental in building students' understanding of science. Primary among their many duties and responsibilities, teachers structure and guide the pace of individual, small-group, and whole-class work to present new material, engage students in scientific tasks, and help deepen students' grasp of the science being studied. Teachers may help students use technology and laboratory equipment to investigate scientific ideas, develop their understanding of scientific approaches to problem solving, and promote positive attitudes towards science. They also may assign homework and conduct informal as well as formal assessments to monitor progress in student learning, make instructional decisions, and evaluate achievement outcomes.

Effective science teaching is a complex endeavor requiring knowledge of the subject matter of science, understanding of student learning, and appreciation of the pedagogy of science. It can be fostered through institutional support and adequate resources. Teachers also can support each other in planning instructional strategies, devising real-world applications of scientific concepts, and developing sequences that move students from concrete tasks to the ability to think for themselves and explore scientific theories.

TIMSS administered a background questionnaire to teachers to gather information about their backgrounds and training. The questionnaire also asked about how they spend their school-related time and how science classes are organized.

This chapter presents the results of teachers' responses to some of these questions. Because the sampling for the teacher questionnaires was based on participating students, the responses to the teacher questionnaire do not necessarily represent all of the fourth-grade teachers in each of the TIMSS countries. Rather, they represent teachers of the representative samples of students assessed. It is important to note that in this report, the student is always the unit of analysis, even when information from the teachers' questionnaires is being reported. Using the student as the unit of analysis makes it possible to describe the instruction received by representative samples of students. Although this approach may provide a different perspective from that obtained by simply collecting information from teachers, it is consistent with the TIMSS goals of providing information about the educational contexts and performance of students.

In the primary grades, students generally are taught mathematics and science by a single classroom teacher who provides instruction in all subjects. Accordingly, the international version of the teacher questionnaire for the primary grades was prepared as a single document asking about demographic information and instruction in both mathematics and science. However, in some countries, a portion or even all of the

students are taught mathematics and science by different teachers, and it was difficult to make provisions for both teachers to complete the questionnaire. Also, because countries were required to sample two classes (from adjacent grades), it was possible for an individual to be the mathematics and/or science teacher of both the upper- and lower-grade classes. In order to keep the response burden for teachers to a minimum, no teacher was asked to respond to more than one questionnaire, even where that teacher taught mathematics and/or science to more than one of the sampled classes. These situations, together with the fact that teachers sometimes did not complete the questionnaire assigned to them, meant that each country had some percentage of students for whom no teacher questionnaire information was available. The tables in this chapter contain special notation regarding response rates. For a country where teacher responses were available for 70% to 84% of the students, an “r” is included next to the data for that country. When teacher responses were available for 50% to 69% of the students, an “s” is included next to the data for that country. When teacher responses were available for fewer than 50% of the students, an “x” replaces the data.

Another consequence of the desire to minimize the teacher response burden was that teacher questionnaires had to be as short as possible. Since science is not emphasized as much as mathematics in primary school in many countries, relatively fewer questions pertaining to science were included in the teacher questionnaires.

WHO DELIVERS SCIENCE INSTRUCTION?

This section provides information about the science teaching force in each of the participating countries, in terms of certification, degrees, age, gender, and years of teaching experience.

Table 5.1 summarizes information gathered from each country about the requirements for the certification held by the majority of the third- and fourth-grade teachers. In many countries, the type of education required for qualification includes a university degree. In other countries, study at a teacher training institution is required, or even both a university degree and study at a teacher training institution. The number of years of post-secondary education required for a teaching qualification ranged from two years in Iran and Singapore to as much as six years in Canada, although many countries reported three or four years. All of the countries except Greece and Kuwait reported that teaching practice was required. A large number of countries reported that an evaluation or examination was required for certification. The countries not having such a requirement included Canada, Greece, Iran, Israel, Korea, Portugal, and the United States.

Table 5.2 contains teachers’ reports on their age and gender. If a constant supply of teachers were entering the teaching force, devoting their careers to the classroom, and then retiring, one might expect approximately equal percentages of students taught by teachers in their 20s, 30s, 40s, and 50s, and this does appear to hold for some countries. In most countries, however, the majority of the fourth-grade students were

Table 5.1**Requirements for Certification Held by the Majority of Lower- and Upper-Grade (Third and Fourth Grade*) Teachers¹**

Country	Type of Education Required for Qualification	Number of Years of Post-Secondary Education Required	Teaching or Practice Experience Required	Evaluation or Examination Required
Australia	University or Teacher Training Institution	3–4	yes	yes
Austria	Teacher Training Institution	3	yes	yes
Canada	University	4–6	yes	no
Cyprus	Teacher Training Institution	3	yes	yes
Czech Republic	University	4	yes	yes
² England	University or Higher Education Institution	3–5	yes	yes
³ Greece	Post-Secondary Non-University Teacher Training Institution	4	no	no
Hong Kong	Teacher Training Institution	2 or 3	yes	yes
Hungary	Teacher Training Institution	3	yes	yes
Iceland	University	3	yes	yes
Iran	Teacher Training Institution	2	yes	no
Ireland	University College	3	yes	yes
Israel	Teacher Training Institution	3	yes	no
Japan	University	4	yes	yes
Korea	University	4	yes	no
Kuwait	University	4	no	yes
Latvia	Teacher Training Institution	3	yes	yes
Netherlands	Teacher Training Institution	3 ⁴	yes	yes
New Zealand	Teacher Training Institution	3	yes	yes
Norway	Teacher Training Institution	3 ⁵	yes	yes
Portugal	Teacher Training Institution	3 ⁶	yes	no
Scotland	University or Teacher Training Institution	4	yes	yes
Singapore	Teacher Training Institution	2	yes	yes
Slovenia	University	4	yes	yes
Thailand	University or Teacher Training Institution	4	yes	yes
⁷ United States	University	4	yes	no

*Third and fourth grades in most countries; see Table 2 for more information about the grades tested in each country.

¹ Certification pertains to the majority (more than 50%) of teachers of lower- and upper-grade students in each country.

² England: The majority of teachers of primary schools students will have studied education and their specialist subject concurrently for 4 years with honors) or 3 years (B. Ed without honors). Some, however, will have studied their specialist subject for a degree (B. Sc. or B.A.) for 3 or 4 years followed by a one-year post graduate course. All teachers who qualified since 1975 are graduates. Some teachers who qualified before this date hold teachers' certificates but are not graduates.

³ Greece: The vast majority of primary school teachers are Post-Secondary Non-University Teacher Training Institute graduates (last graduates 1990). Only a small fraction of existing teachers are graduates of the newly founded University Education Departments (first graduates 1989).

⁴ Netherlands: As of August 1984 a 4-year teacher training program integrating training for kindergarten and primary education is required. Before August 1994, 3 years of teacher training were required for primary education.

⁵ Norway: Until 1965 2 years of post-secondary education were required. Between 1965 and 1995 3 years were required.

As of 1996, new certified teachers are required to have completed 4 years of post-secondary education.

⁶ Portugal: Until 1986 2 years of post-secondary education were required. As of 1986 3 years are required.

⁷ United States: Certification requirements vary considerably according to state in the United States. Information in this table represents the most typical requirements across states.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

Table 5.2**Teachers' Reports on Their Age and Gender
Science - Upper Grade (Fourth Grade*)**

Country	Percent of Students Taught by Teachers				Percent of Students Taught by Teachers	
	29 Years or Under	30 - 39 Years	40 - 49 Years	50 Years or Older	Female	Male
<i>Australia</i>	21 (3.0)	31 (3.4)	35 (3.4)	12 (2.2)	65 (4.0)	35 (4.0)
<i>Austria</i>	10 (2.6)	29 (4.6)	47 (5.0)	15 (3.4)	78 (4.3)	22 (4.3)
Canada	6 (1.6)	25 (3.8)	43 (3.1)	26 (2.6)	74 (3.5)	26 (3.5)
Cyprus	47 (5.9)	20 (4.4)	22 (5.3)	11 (3.3)	69 (4.5)	31 (4.5)
Czech Republic	13 (3.2)	21 (3.4)	21 (3.6)	45 (4.1)	95 (1.8)	5 (1.8)
England	16 (3.8)	17 (4.0)	50 (5.1)	17 (3.3)	75 (3.5)	25 (3.5)
Greece	12 (2.8)	41 (4.3)	33 (4.1)	14 (2.9)	49 (4.6)	51 (4.6)
Hong Kong	- -	- -	- -	- -	- -	- -
<i>Hungary</i>	8 (2.3)	43 (4.7)	29 (3.8)	21 (3.7)	90 (2.7)	10 (2.7)
Iceland	10 (1.7)	34 (5.5)	47 (5.1)	8 (2.1)	83 (3.8)	17 (3.8)
Iran, Islamic Rep.	42 (4.2)	43 (4.5)	14 (2.8)	1 (0.8)	54 (4.3)	46 (4.3)
Ireland	17 (3.3)	31 (4.1)	31 (4.5)	22 (4.1)	69 (3.9)	31 (3.9)
<i>Israel</i>	24 (4.6)	46 (5.9)	21 (4.4)	9 (2.7)	95 (1.6)	5 (1.6)
Japan	12 (2.7)	40 (4.1)	38 (4.5)	11 (2.3)	61 (3.9)	39 (3.9)
Korea	22 (3.2)	29 (3.0)	33 (3.9)	16 (2.8)	64 (3.8)	36 (3.8)
<i>Kuwait</i>	22 (4.1)	50 (4.8)	20 (3.7)	8 (2.9)	57 (2.9)	43 (2.9)
<i>Latvia (LSS)</i>	23 (4.0)	37 (4.1)	15 (3.2)	26 (4.1)	98 (1.2)	2 (1.2)
<i>Netherlands</i>	17 (3.3)	29 (4.1)	40 (4.6)	14 (3.4)	35 (4.3)	65 (4.3)
New Zealand	21 (3.4)	27 (3.3)	37 (4.3)	15 (2.5)	69 (3.5)	31 (3.5)
Norway	8 (2.6)	14 (3.6)	42 (4.7)	36 (4.8)	78 (3.9)	22 (3.9)
Portugal	6 (2.3)	21 (3.5)	48 (4.2)	25 (3.8)	95 (1.9)	5 (1.9)
Scotland	19 (3.1)	21 (3.6)	40 (4.6)	19 (3.4)	92 (2.1)	8 (2.1)
Singapore	38 (4.1)	15 (2.7)	28 (3.5)	19 (2.7)	78 (2.9)	22 (2.9)
<i>Slovenia</i>	12 (3.1)	34 (4.9)	30 (4.5)	24 (4.6)	92 (2.6)	8 (2.6)
<i>Thailand</i>	4 (2.3)	54 (5.2)	29 (4.7)	13 (4.1)	57 (6.1)	43 (6.1)
United States	17 (2.8)	22 (2.9)	37 (4.3)	24 (4.0)	86 (2.5)	14 (2.5)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

() 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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

taught science by teachers in their 30s or 40s. Very few countries seemed to have a comparatively younger teaching force, with only Cyprus, Iran, and Singapore having 25% or more of the students with science teachers in their 20s or younger. Twelve countries (Australia, Cyprus, Greece, Hungary, Iran, Israel, Japan, Korea, Kuwait, Latvia (LSS), Singapore, and Thailand) had the majority of students with teachers in their 30s or younger. Countries with comparatively larger percentages of older teachers included Canada, the Czech Republic, Latvia (LSS), Norway, and Portugal, where 25% or more of the fourth-grade students had science teachers in their 50s or older.

In every country except Greece and the Netherlands, the majority of fourth-grade students were taught science by female teachers. Countries with particularly large percentages of female teachers included the Czech Republic, Hungary, Israel, Latvia (LSS), Portugal, Scotland, and Slovenia, where 90% or more of the fourth-grade students were taught science by female teachers.

As might be expected from the differences in teachers' ages from country to country, the TIMSS data indicate differences in teacher experience across countries (see Table 5.3). The countries with younger teaching forces tended to have more students taught by less experienced teachers. At least half the fourth-grade students in Cyprus, Iran, and Kuwait had science teachers with 10 years or less of experience. In all of the other countries, the majority of students were taught science by teachers with more than 10 years of teaching experience. In the Czech Republic and Portugal more than half the students had science teachers with over 20 years of experience.

The relationship between years of teaching experience and science achievement is not clear in many countries. In about one-fourth of the countries, the fourth-grade students with the most experienced teachers (more than 20 years) had higher science achievement than did those with less experienced teachers (five years or fewer). This may reflect the practice of giving teachers with more seniority the more advanced classes. However, there were also several countries where the students with less experienced teachers had higher achievement than did those with the most experienced teachers.

Table 5.3**Teachers' Reports on Their Years of Teaching Experience
Science - Upper Grade (Fourth Grade*)**

Country	0 - 5 Years		6-10 Years		11-20 Years		More than 20 Years	
	Percent of Students	Mean Achievement						
<i>Australia</i>	r 14 (2.3)	572 (5.6)	23 (3.1)	556 (6.0)	38 (3.5)	566 (5.6)	25 (3.4)	560 (5.6)
<i>Austria</i>	10 (2.7)	566 (8.5)	11 (3.3)	571 (6.0)	31 (4.1)	552 (6.8)	47 (4.9)	571 (5.6)
Canada	10 (1.7)	537 (7.0)	17 (2.9)	553 (8.4)	27 (3.3)	545 (6.4)	46 (3.5)	554 (4.5)
<i>Cyprus</i>	s 53 (6.2)	485 (5.8)	12 (3.5)	470 (12.7)	9 (3.0)	471 (10.3)	27 (5.2)	482 (9.6)
<i>Czech Republic</i>	r 16 (3.1)	541 (7.7)	9 (2.6)	541 (8.1)	18 (3.0)	561 (6.7)	56 (4.4)	561 (5.5)
England	18 (3.5)	555 (8.0)	16 (3.6)	556 (12.6)	34 (4.0)	548 (5.5)	33 (4.2)	553 (7.3)
Greece	11 (2.5)	503 (21.8)	22 (3.3)	493 (5.0)	31 (4.1)	498 (6.3)	36 (4.0)	505 (6.3)
Hong Kong	- -	- -	- -	- -	- -	- -	- -	- -
<i>Hungary</i>	7 (2.6)	529 (12.7)	11 (2.9)	526 (9.6)	42 (4.6)	534 (4.3)	40 (4.7)	533 (6.6)
Iceland	23 (4.0)	513 (3.4)	21 (4.6)	504 (9.9)	34 (5.5)	508 (5.8)	22 (4.5)	501 (7.0)
Iran, Islamic Rep.	33 (4.1)	400 (10.7)	19 (3.9)	416 (7.0)	40 (4.6)	425 (7.0)	8 (2.6)	443 (9.1)
Ireland	10 (2.9)	527 (17.9)	14 (3.4)	532 (7.7)	32 (4.1)	542 (5.6)	44 (4.6)	543 (5.8)
<i>Israel</i>	r 35 (5.3)	503 (7.5)	13 (3.6)	515 (9.4)	32 (4.9)	506 (6.1)	20 (4.0)	486 (8.2)
Japan	11 (2.8)	570 (6.1)	10 (2.5)	570 (4.9)	57 (3.6)	575 (2.2)	22 (3.0)	574 (4.2)
Korea	12 (2.6)	594 (7.7)	23 (3.4)	601 (3.3)	27 (3.5)	598 (4.0)	38 (3.8)	594 (3.1)
<i>Kuwait</i>	s 21 (3.9)	401 (6.9)	29 (4.0)	404 (9.4)	44 (5.0)	397 (6.5)	6 (1.8)	439 (12.9)
<i>Latvia (LSS)</i>	15 (3.5)	487 (9.5)	16 (3.2)	501 (12.6)	33 (4.5)	510 (8.7)	36 (4.8)	527 (8.6)
<i>Netherlands</i>	14 (2.5)	548 (8.6)	11 (2.9)	550 (7.9)	39 (3.9)	563 (3.7)	36 (4.8)	556 (6.2)
New Zealand	23 (3.8)	525 (11.2)	15 (2.9)	539 (14.6)	39 (4.6)	523 (8.0)	22 (3.3)	550 (7.7)
Norway	10 (3.0)	529 (9.8)	8 (2.7)	517 (9.6)	32 (4.8)	531 (5.4)	50 (5.4)	527 (5.0)
Portugal	6 (2.0)	444 (20.7)	9 (2.0)	468 (9.0)	15 (3.0)	479 (8.2)	70 (3.9)	484 (4.9)
Scotland	25 (3.8)	526 (8.5)	19 (3.3)	550 (8.1)	33 (4.3)	531 (9.8)	23 (3.9)	546 (8.2)
Singapore	34 (4.1)	555 (9.5)	9 (2.2)	561 (16.2)	11 (2.4)	557 (17.7)	46 (3.7)	535 (6.1)
<i>Slovenia</i>	10 (2.7)	538 (10.8)	14 (3.5)	542 (8.1)	32 (4.9)	543 (6.9)	44 (4.9)	547 (4.8)
<i>Thailand</i>	r 28 (4.5)	457 (11.1)	16 (4.1)	477 (14.8)	45 (6.9)	478 (8.9)	12 (5.1)	507 (38.8)
United States	21 (2.8)	558 (6.7)	18 (2.8)	578 (4.8)	29 (2.6)	574 (5.5)	32 (3.0)	569 (6.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

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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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

HOW DO SCIENCE TEACHERS SPEND THEIR SCHOOL-RELATED TIME?

Countries vary considerably in the degree of emphasis placed on science instruction in the primary school years. While in some countries science occupies a prominent position in the fourth-grade curriculum, in others science instruction is just beginning, and is sometimes integrated with other subjects such as social or environmental studies. In TIMSS, teachers were asked about the average amount of time science is taught to their class each week. The results, displayed in Table 5.4, confirm the picture of international differences in instructional time for science at the fourth grade.

In half the countries, a large majority of students were taught by teachers who reported that science is taught for less than two hours in their classrooms. Countries where teachers reported the least amount of science teaching included Australia, Ireland, Latvia (LSS), the Netherlands, New Zealand, Norway, and Scotland. In Austria, Japan, Korea, Kuwait, and Singapore the norm for science teaching was between two and three hours, with more than 95% of students taught by teachers who reported teaching science for this amount of time. In five countries, Canada, England, Portugal, Thailand, and the United States, more than 20% of students had three hours or more of science weekly. The relationship within countries between time spent teaching science and student achievement was inconsistent.

Since science teaching is sometimes integrated with other instructional activities in primary school, teachers were asked whether or not science is taught mainly as a separate subject in their class in many of the countries. A large majority of students were taught science as a separate subject, including Israel, Japan, Korea, Kuwait, and Singapore, where this was true for 100% of fourth-grade students (Table 5.5). Among countries where large percentages of students were not taught science as a separate subject were Iceland, Ireland, New Zealand, Norway, Portugal, Scotland, and Thailand. In countries where teacher reports indicated that either approach may be found, generally there were no large differences in the time spent teaching science between those to whom science is taught as a separate subject and the others.

In many countries around the world, primary school classes are taught by a single teacher who is responsible for teaching all subjects in the curriculum. However, there are also many variations on this model, and in some countries it is customary for the classroom teacher to call on specialized teachers to teach particular subjects, such as science, music, or art. Figure 5.1 classifies the TIMSS countries according to the percentage of students who were taught both mathematics and science by a single classroom teacher. In most of the countries, almost all students were taught by teachers who teach both mathematics and science. The major exceptions were Hong Kong, Israel, and Kuwait, where most students had different teachers for mathematics and science.

In addition to the time spent in class on science instruction, teachers were asked about the number of hours per week spent on selected school-related activities outside the regular school day. Table 5.6 presents the results. For example, on average, fourth-grade students in Australia had science teachers who spent 1.1 hours per week preparing

Table 5.4**Teachers' Reports on Average Number of Hours Science is Taught Weekly to Their Science Class - Upper Grade (Fourth Grade*)**

Country	Less Than 1 Hour		1 Hour to < 2		2 Hours to < 3		3 Hours or More	
	Percent of Students	Mean Achievement						
<i>Australia</i>	r 35 (3.9)	556 (5.0)	55 (4.0)	568 (5.9)	5 (1.5)	562 (18.1)	5 (2.1)	562 (8.4)
<i>Austria</i>	0 (0.0)	~ ~	0 (0.0)	~ ~	97 (1.8)	566 (3.6)	3 (1.8)	540 (30.3)
Canada	8 (2.0)	536 (10.1)	42 (3.8)	542 (5.1)	27 (3.3)	567 (5.4)	23 (3.2)	550 (4.6)
Cyprus	x x	x x	x x	x x	x x	x x	x x	x x
Czech Republic	2 (1.1)	~ ~	79 (3.6)	557 (3.9)	3 (1.4)	572 (6.8)	16 (3.2)	563 (7.3)
England	6 (1.7)	540 (8.7)	27 (4.1)	548 (7.5)	44 (4.8)	556 (5.9)	23 (3.8)	550 (8.2)
Greece	- -	- -	- -	- -	- -	- -	- -	- -
Hong Kong	13 (3.4)	530 (13.3)	84 (3.7)	534 (4.3)	2 (1.5)	~ ~	1 (0.8)	~ ~
<i>Hungary</i>	6 (2.2)	556 (13.3)	72 (4.1)	529 (3.7)	8 (3.0)	521 (8.4)	14 (3.1)	549 (10.5)
Iceland	r 17 (4.1)	513 (7.3)	41 (5.6)	504 (7.7)	30 (5.1)	499 (6.5)	12 (4.3)	523 (6.8)
Iran, Islamic Rep.	- -	- -	- -	- -	- -	- -	- -	- -
Ireland	47 (5.0)	536 (5.6)	40 (4.4)	540 (5.8)	11 (3.1)	550 (7.1)	2 (0.9)	~ ~
<i>Israel</i>	r 0 (0.0)	~ ~	53 (5.6)	508 (5.5)	32 (5.8)	494 (6.9)	15 (4.3)	493 (10.6)
Japan	2 (1.3)	~ ~	1 (0.6)	~ ~	95 (1.8)	575 (1.8)	2 (1.2)	~ ~
Korea	0 (0.0)	~ ~	1 (0.6)	~ ~	95 (1.8)	597 (1.9)	5 (1.7)	588 (10.3)
<i>Kuwait</i>	s 0 (0.0)	~ ~	1 (0.7)	~ ~	96 (2.0)	402 (3.9)	4 (1.8)	416 (42.2)
<i>Latvia (LSS)</i>	89 (2.9)	505 (5.7)	5 (2.2)	538 (47.2)	5 (2.2)	532 (11.9)	1 (0.8)	~ ~
<i>Netherlands</i>	38 (5.1)	559 (4.0)	44 (4.8)	556 (4.5)	9 (2.6)	556 (7.2)	9 (2.7)	549 (20.1)
New Zealand	r 29 (4.2)	542 (8.3)	48 (4.4)	536 (6.1)	14 (3.1)	537 (17.2)	9 (2.6)	509 (21.2)
Norway	s 73 (5.0)	527 (5.4)	27 (5.0)	535 (7.6)	0 (0.0)	~ ~	0 (0.0)	~ ~
Portugal	2 (1.1)	~ ~	3 (1.4)	486 (28.2)	12 (3.1)	474 (8.8)	84 (3.6)	481 (4.8)
Scotland	r 35 (4.7)	543 (5.9)	44 (4.7)	534 (6.4)	14 (3.3)	531 (13.2)	7 (2.5)	529 (12.5)
Singapore	0 (0.0)	~ ~	4 (1.5)	548 (18.9)	96 (1.5)	547 (5.1)	0 (0.0)	~ ~
<i>Slovenia</i>	3 (1.9)	544 (18.9)	60 (5.3)	541 (4.6)	18 (4.0)	550 (9.5)	19 (3.4)	548 (6.8)
<i>Thailand</i>	r 2 (1.2)	~ ~	9 (3.5)	463 (21.5)	17 (6.1)	469 (16.5)	73 (6.6)	477 (6.5)
United States	r 9 (2.1)	562 (11.5)	16 (2.9)	550 (10.2)	33 (3.8)	578 (5.9)	42 (4.1)	565 (5.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

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A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

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% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.5**Teachers' Reports on Whether Science is Taught Mainly as a Separate Subject – Upper Grade (Fourth Grade*)**

Country	Yes		No	
	Percent of Students	Average Hours of Science Taught Weekly	Percent of Students	Average Hours of Science Taught Weekly
<i>Australia</i>	r 51 (4.4)	1.0 (0.04)	49 (4.4)	1.4 (0.17)
<i>Austria</i>	- -	- -	- -	- -
Canada	68 (3.6)	2.2 (0.11)	32 (3.6)	2.3 (0.31)
Cyprus	x x	x x	x x	x x
Czech Republic	95 (1.6)	1.8 (0.05)	5 (1.6)	1.8 (0.30)
England	74 (4.9)	2.2 (0.08)	26 (4.9)	2.2 (0.24)
Greece	- -	- -	- -	- -
Hong Kong	91 (2.7)	1.1 (0.03)	9 (2.7)	1.5 (0.28)
<i>Hungary</i>	87 (2.7)	1.8 (0.09)	13 (2.7)	2.9 (0.59)
Iceland	r 21 (4.5)	1.3 (0.17)	79 (4.5)	1.9 (0.15)
Iran, Islamic Rep.	- -	- -	- -	- -
Ireland	16 (3.1)	0.9 (0.14)	84 (3.1)	1.0 (0.07)
<i>Israel</i>	r 100 (0.0)	2.4 (0.22)	0 (0.0)	~ ~
Japan	100 (0.0)	2.2 (0.02)	0 (0.0)	~ ~
Korea	100 (0.0)	2.7 (0.03)	0 (0.0)	~ ~
<i>Kuwait</i>	s 100 (0.0)	2.2 (0.03)	0 (0.0)	~ ~
<i>Latvia (LSS)</i>	99 (1.0)	0.8 (0.03)	1 (1.0)	~ ~
<i>Netherlands</i>	81 (3.7)	1.2 (0.08)	19 (3.7)	1.5 (0.21)
New Zealand	46 (4.9)	1.4 (0.13)	54 (4.9)	1.4 (0.13)
Norway	0 (0.0)	~ ~	100 (0.0)	0.8 (0.04)
Portugal	22 (4.0)	4.0 (0.25)	78 (4.0)	4.4 (0.18)
Scotland	18 (3.1)	1.1 (0.10)	82 (3.1)	1.3 (0.12)
Singapore	100 (0.0)	2.0 (0.01)	0 (0.0)	~ ~
<i>Slovenia</i>	72 (5.0)	2.0 (0.10)	28 (5.0)	2.3 (0.28)
<i>Thailand</i>	r 1 (1.0)	~ ~	99 (1.0)	4.1 (0.26)
United States	r 83 (2.7)	2.7 (0.13)	17 (2.7)	2.6 (0.23)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

() 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. A tilde (~) indicates insufficient data to report achievement.

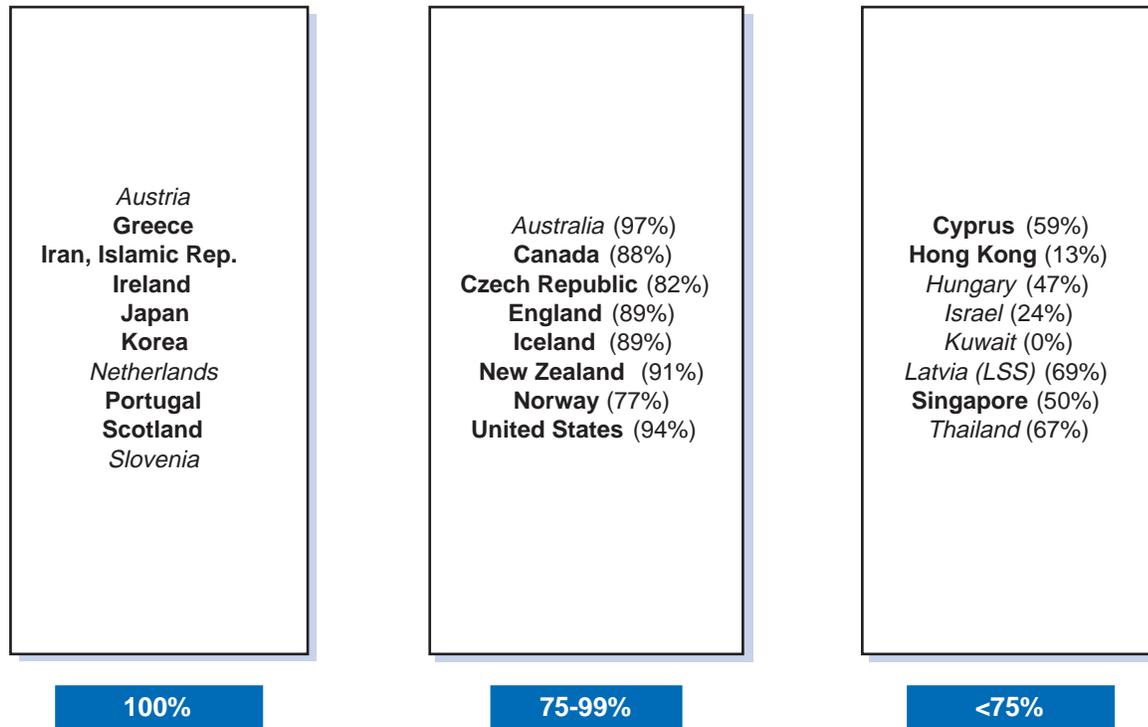
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

An "x" indicates teacher response data available for <50% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.1

Percent of Students Who Are Taught Both Mathematics and Science by a Single Classroom Teacher¹ - Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

¹Based on information provided by schools. Teachers were classified as teaching: (1) mathematics, (2) science, or (3) both mathematics and science to the sampled classes. Percentages reflect those students taught by category (3) teachers.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.6

**Average Number of Hours¹ Students' Teachers Spend on Various School-Related Activities Outside the Formal School Day During the School Week
Science - Upper Grade (Fourth Grade*)**

Country	Preparing or Grading Tests	Reading and Grading Student Work	Planning Lessons by Self	Meeting with Students Outside Classroom Time	Meeting with Parents	Professional Reading and Development	Keeping Students' Records	Administrative Tasks
<i>Australia</i>	r 1.1 (0.1)	2.8 (0.1)	r 2.9 (0.1)	r 0.7 (0.1)	r 0.8 (0.1)	1.4 (0.1)	1.3 (0.1)	3.0 (0.1)
<i>Austria</i>	2.6 (0.2)	4.0 (0.1)	3.3 (0.1)	0.3 (0.0)	0.8 (0.1)	1.5 (0.1)	1.1 (0.1)	1.5 (0.1)
Canada	1.7 (0.1)	2.8 (0.1)	2.9 (0.1)	1.0 (0.1)	0.6 (0.0)	1.1 (0.1)	1.3 (0.1)	2.3 (0.1)
Cyprus	s 2.2 (0.1)	s 2.5 (0.2)	s 3.3 (0.2)	s 0.3 (0.2)	s 0.7 (0.1)	s 1.4 (0.2)	s 0.9 (0.1)	s 1.3 (0.1)
Czech Republic	r 2.7 (0.1)	r 3.1 (0.1)	r 3.5 (0.2)	r 1.2 (0.1)	r 0.5 (0.0)	r 1.8 (0.1)	r 1.1 (0.1)	r 1.0 (0.1)
England	r 0.9 (0.1)	4.0 (0.1)	3.5 (0.1)	1.0 (0.1)	0.8 (0.1)	1.3 (0.1)	1.5 (0.1)	3.3 (0.1)
Greece	2.5 (0.1)	2.1 (0.1)	r 1.9 (0.1)	r 0.3 (0.0)	0.9 (0.0)	1.9 (0.1)	r 0.5 (0.1)	r 1.1 (0.1)
Hong Kong	- -	- -	- -	- -	- -	- -	- -	- -
<i>Hungary</i>	2.6 (0.1)	2.8 (0.1)	3.6 (0.1)	1.6 (0.1)	0.9 (0.0)	2.0 (0.1)	0.7 (0.1)	2.2 (0.1)
Iceland	1.0 (0.1)	3.0 (0.2)	3.7 (0.1)	0.6 (0.1)	0.7 (0.1)	1.3 (0.1)	1.3 (0.1)	2.3 (0.2)
Iran, Islamic Rep.	2.2 (0.1)	2.2 (0.1)	2.0 (0.1)	1.2 (0.1)	1.3 (0.1)	1.0 (0.1)	1.7 (0.1)	1.1 (0.1)
Ireland	1.2 (0.1)	2.1 (0.2)	1.6 (0.1)	0.3 (0.0)	0.4 (0.0)	0.6 (0.1)	0.8 (0.1)	1.0 (0.1)
<i>Israel</i>	3.1 (0.2)	2.9 (0.2)	3.7 (0.2)	r 1.3 (0.1)	1.1 (0.1)	r 3.3 (0.1)	r 1.7 (0.2)	1.9 (0.2)
Japan	2.4 (0.1)	3.0 (0.1)	2.7 (0.1)	1.3 (0.1)	0.4 (0.0)	2.1 (0.1)	1.7 (0.1)	2.4 (0.1)
Korea	1.5 (0.1)	2.2 (0.1)	2.1 (0.1)	1.4 (0.1)	0.5 (0.0)	1.5 (0.1)	1.3 (0.1)	2.0 (0.1)
<i>Kuwait</i>	s 2.3 (0.1)	s 2.4 (0.1)	s 2.1 (0.2)	s 0.3 (0.1)	s 0.9 (0.1)	s 1.1 (0.1)	s 1.6 (0.2)	s 1.4 (0.1)
<i>Latvia (LSS)</i>	1.9 (0.1)	2.6 (0.1)	2.7 (0.1)	2.1 (0.2)	1.0 (0.1)	1.4 (0.1)	r 1.0 (0.1)	1.2 (0.1)
<i>Netherlands</i>	1.5 (0.1)	3.8 (0.1)	2.6 (0.1)	0.9 (0.1)	0.8 (0.0)	1.1 (0.1)	0.9 (0.1)	2.8 (0.1)
New Zealand	1.3 (0.1)	2.6 (0.1)	3.1 (0.1)	0.7 (0.1)	0.7 (0.0)	1.5 (0.1)	1.7 (0.1)	3.3 (0.1)
Norway	r 1.3 (0.1)	r 2.4 (0.1)	r 3.9 (0.1)	r 0.6 (0.1)	r 0.7 (0.1)	r 0.7 (0.1)	r 0.8 (0.0)	r 1.7 (0.1)
Portugal	2.4 (0.1)	2.7 (0.1)	2.4 (0.1)	0.6 (0.1)	0.7 (0.0)	1.4 (0.1)	0.9 (0.1)	1.5 (0.1)
Scotland	r 0.8 (0.1)	r 3.2 (0.1)	3.3 (0.1)	0.2 (0.0)	r 0.4 (0.0)	1.1 (0.1)	1.1 (0.1)	2.5 (0.1)
Singapore	3.0 (0.1)	4.1 (0.1)	2.5 (0.1)	2.0 (0.1)	0.6 (0.0)	1.6 (0.1)	1.2 (0.1)	2.4 (0.1)
<i>Slovenia</i>	2.3 (0.1)	2.1 (0.1)	3.7 (0.2)	1.1 (0.1)	1.3 (0.1)	2.2 (0.2)	0.8 (0.1)	1.9 (0.1)
<i>Thailand</i>	r 2.4 (0.2)	2.5 (0.2)	r 2.9 (0.2)	r 1.8 (0.2)	r 1.7 (0.2)	r 1.9 (0.2)	r 1.6 (0.2)	1.9 (0.2)
United States	2.2 (0.1)	3.1 (0.1)	2.5 (0.1)	0.9 (0.1)	0.7 (0.0)	1.3 (0.1)	1.5 (0.1)	2.2 (0.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

¹Average hours based on: No time = 0, Less than 1 hour = .5, 1-2 hours = 1.5; 3-4 hours = 3.5; More than 4 hours = 5.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

() 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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

or grading tests, and another 2.8 hours per week reading and grading student work. Their teachers spent 2.9 hours per week on lesson planning and 1.5 hours combined on meeting students and parents. They spent 1.4 hours on professional reading and development, and 4.3 hours on record-keeping and administrative tasks combined. Across countries, teachers reported that grading tests, grading student work, and lesson planning were the most time-consuming activities, averaging as much as almost 10 hours per week in Singapore. In general, teachers also reported several hours per week spent on keeping students' records and other administrative tasks.

Opportunities to meet with colleagues to plan curriculum or teaching approaches enable teachers to expand their views of science, their resources for teaching, and their repertoire of teaching and learning skills. Table 5.7 contains teachers' reports on how often they meet with other teachers in their subject area to discuss and plan curriculum or teaching approaches. Teachers of the majority of the students reported weekly or even daily planning meetings in 17 countries, with the largest percentages in the Czech Republic, England, Hungary, Japan, Kuwait, and Norway. In the remaining countries, however, most students were taught science by teachers who reported only limited opportunities to plan curriculum or teaching approaches with other teachers (monthly or even yearly meetings).

Most educational systems provide curriculum guides on either a national or regional basis to ensure that teachers, parents, and other interested parties have a clear understanding of what is intended to be taught in each subject. Table 5.8 displays the percentage of students taught by teachers who reported varying degrees of familiarity with national and regional guides in science. Generally teachers reported a fairly high degree of familiarity with one or another curriculum guide. Countries where more than a third of the students were taught by teachers who reported that they were unfamiliar with their country's curriculum guides included Austria, the Czech Republic, Japan, and the United States.

Table 5.7

Teachers' Reports on How Often They Meet with Other Teachers in Their Subject Area to Discuss and Plan Curriculum or Teaching Approaches Science - Upper Grade (Fourth Grade*)

Country	Percent of Students Taught by Teachers			
	Never or Once/ Twice a Year	Monthly or Every Other Month	Once, Twice, or Three Times a Week	Almost Every Day
<i>Australia</i>	7 (1.8)	32 (3.5)	51 (3.8)	10 (2.7)
<i>Austria</i>	19 (4.4)	23 (4.6)	36 (4.6)	22 (4.1)
Canada	33 (3.4)	34 (3.5)	27 (2.5)	6 (1.8)
<i>Cyprus</i>	13 (3.4)	13 (4.5)	64 (5.6)	11 (4.0)
<i>Czech Republic</i>	3 (1.5)	13 (2.7)	31 (4.4)	52 (4.7)
England	4 (1.6)	12 (3.0)	72 (4.1)	13 (3.0)
Greece	32 (3.9)	26 (3.3)	26 (3.7)	16 (3.3)
Hong Kong	- -	- -	- -	- -
<i>Hungary</i>	2 (1.0)	13 (3.1)	45 (4.5)	41 (4.5)
Iceland	16 (1.5)	13 (4.1)	69 (4.1)	1 (1.2)
Iran, Islamic Rep.	4 (1.5)	26 (4.3)	54 (4.9)	16 (3.2)
Ireland	46 (5.0)	42 (4.7)	7 (2.0)	5 (1.5)
<i>Israel</i>	10 (3.6)	42 (5.9)	41 (6.4)	7 (3.3)
Japan	5 (1.7)	14 (3.0)	61 (4.2)	20 (3.9)
Korea	17 (3.0)	24 (3.5)	41 (4.2)	18 (3.2)
<i>Kuwait</i>	7 (2.5)	1 (0.9)	75 (4.0)	17 (3.8)
<i>Latvia (LSS)</i>	14 (3.3)	28 (4.1)	32 (4.6)	26 (3.8)
<i>Netherlands</i>	36 (4.4)	33 (4.4)	29 (3.8)	2 (1.5)
New Zealand	10 (2.4)	17 (3.3)	60 (4.4)	13 (2.6)
Norway	4 (1.5)	7 (2.5)	82 (3.5)	7 (2.7)
Portugal	10 (2.6)	62 (4.4)	17 (3.4)	11 (2.8)
Scotland	9 (2.3)	37 (4.3)	40 (4.0)	14 (2.9)
Singapore	11 (2.0)	64 (3.7)	21 (3.2)	4 (1.6)
<i>Slovenia</i>	4 (2.3)	33 (4.9)	31 (4.4)	32 (4.7)
<i>Thailand</i>	62 (5.7)	23 (5.3)	13 (4.5)	1 (0.9)
United States	19 (3.4)	21 (3.4)	49 (3.6)	11 (2.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

() 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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.8

**Teachers' Reports on Their Familiarity With National and Regional Science Curriculum Guides
Science - Upper Grade (Fourth Grade*)**

Country	Percent of Students by Teachers' Familiarity With					
	National Curriculum Guide			Regional Curriculum Guide		
	Not Familiar	Fairly Familiar	Very Familiar	Not Familiar	Fairly Familiar	Very Familiar
<i>Australia</i>	r 43 (4.0)	42 (4.1)	15 (2.8)	r 15 (3.3)	54 (4.7)	31 (4.3)
<i>Austria</i>	--	--	--	40 (4.9)	28 (4.3)	32 (4.9)
Canada	--	--	--	11 (2.5)	38 (3.3)	51 (2.6)
Cyprus	s 6 (1.9)	39 (6.0)	55 (6.1)	--	--	--
Czech Republic	r 44 (4.9)	43 (4.5)	13 (3.1)	r 92 (2.6)	7 (2.5)	1 (0.8)
England	--	--	--	--	--	--
Greece	r 26 (3.3)	54 (4.2)	20 (3.4)	--	--	--
Hong Kong	--	--	--	--	--	--
<i>Hungary</i>	--	--	--	--	--	--
Iceland	17 (5.0)	69 (5.8)	14 (3.6)	--	--	--
Iran, Islamic Rep.	31 (4.6)	46 (5.3)	23 (4.1)	--	--	--
Ireland	4 (2.0)	58 (4.7)	38 (4.5)	--	--	--
<i>Israel</i>	r 11 (3.8)	40 (6.0)	50 (5.5)	r 37 (5.1)	29 (5.3)	34 (4.7)
Japan	34 (4.0)	61 (4.3)	5 (2.1)	58 (4.1)	41 (4.2)	1 (1.0)
Korea	18 (3.2)	58 (4.0)	24 (3.9)	56 (3.8)	37 (3.9)	7 (2.2)
<i>Kuwait</i>	s 0 (0.0)	18 (4.2)	82 (4.2)	--	--	--
<i>Latvia (LSS)</i>	6 (2.2)	35 (4.5)	60 (4.8)	r 46 (5.1)	25 (4.5)	29 (5.1)
<i>Netherlands</i>	19 (3.6)	69 (4.2)	12 (3.2)	--	--	--
New Zealand	9 (1.9)	59 (4.1)	32 (4.0)	76 (3.6)	20 (3.5)	5 (1.5)
Norway	2 (1.2)	69 (4.6)	29 (4.5)	r 61 (4.5)	29 (5.0)	10 (3.3)
Portugal	32 (4.4)	17 (3.2)	52 (4.4)	--	--	--
Scotland	--	--	--	--	--	--
Singapore	2 (0.9)	54 (3.5)	44 (3.6)	--	--	--
<i>Slovenia</i>	47 (4.7)	36 (4.6)	17 (3.7)	3 (2.1)	11 (3.7)	86 (4.2)
<i>Thailand</i>	r 22 (4.8)	28 (5.5)	50 (5.7)	r 56 (7.6)	34 (7.5)	10 (3.7)
United States	--	--	--	r 36 (2.8)	39 (2.7)	25 (3.3)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country. Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

() 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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

HOW ARE SCIENCE CLASSES ORGANIZED?

Instructional organization can subsume many factors, including the diversity of the students placed into classrooms, economic factors such as the array of instructional resources available to the student population as well as for use within classrooms, the typical size of classes, and practices regarding in-class grouping. Often, how instruction is organized can influence the implemented curriculum and the opportunities of students.

Figure 5.2 provides information on teacher reports about several factors that might limit how they teach their science classes. The results are presented visually via pie graphs. The percentage of teachers reporting that a particular factor limited how they teach science either “quite a lot” or “a great deal” also is shown next to each graph. In most countries, the challenge of dealing with students of differing academic abilities is mentioned most often, with Greece, Hungary, Iceland, and Iran in the lead. Since tracking or streaming is relatively rare in the primary grades, it is perhaps not surprising that many teachers reported that the differing academic abilities of their students limited how they teach science. Also mentioned frequently as limiting factors were disruptive students (Iceland, Korea, and Portugal), and, in some countries, the burden of dealing with students with special needs (Greece, Hungary, Iceland, Iran, Kuwait, and Portugal). Inadequate physical facilities, and shortage of equipment for use in demonstrations, were reported to limit teaching in Greece, Iran, Kuwait, Latvia (LSS), and Thailand.

In some countries, large classes and high student/teacher ratios cause problems for teachers in carrying out their professional duties. The majority of students in almost half the countries (Australia, Greece, Iceland, Iran, Ireland, Korea, Kuwait, New Zealand, Portugal, and Slovenia) were taught by teachers who reported that high student/teacher ratios limited their teaching approach. Even among the other countries, however, only the teachers in Austria and Latvia (LSS) reported that student/teachers ratios affected instruction for fewer than 20% of the students.

Table 5.9 presents teachers’ reports about the size of fourth-grade science classes for the TIMSS countries. The data reveal rather large variations from country to country. Norway had the smallest fourth-grade science classes, with an average of 19 students per class and 57% of students in classes of 20 or fewer students. According to teachers, science classes were relatively small in a number of countries. The average number of students in class was 25 or fewer in 13 countries. For example, 90% or more of the students were in science classes of 30 or fewer students in Austria, Canada, the Czech Republic, Greece, Hungary, Iceland, Latvia (LSS), Norway, Portugal, Slovenia, and the United States. At the other end of the spectrum, the average size of science classes in Korea was 43 students, and 69% of the students in that country were in science classes with more than 40 students. In Hong Kong, Japan, Korea, and Singapore, more than two-thirds of the students were in classes with more than 30 students (more than 90% in Korea and Singapore).

Figure 5.2**Teachers' Reports on What Factors Limit How They Teach Class Science - Upper Grade (Fourth Grade*)**

Country	Percent of Students Whose Teachers Report Each Factor Limiting How They Teach Class "Quite A Lot" or "A Great Deal"					
	Students with Different Academic Abilities	Students with Special Needs	Disruptive Students	Shortage of Equipment for Use in Demonstrations and Other Exercises	Inadequate Physical Facilities	High Student/Teacher Ratio
<i>Australia</i>	r 45	r 27	r 38	r 31	r 24	r 51
<i>Austria</i>	47	1	10	7	7	15
Canada	49	27	47	30	26	45
Czech Republic	r 64	r 23	r 40	r 48	r 28	r 38
Greece	81	r 60	44	r 65	50	64
<i>Hungary</i>	r 93	s 55	s 42	r 47	s 38	r 47
Iceland	86	r 53	55	r 50	r 46	68
Iran, Islamic Rep.	81	75	45	79	55	58
Ireland	69	28	37	28	20	54
Japan	60	-	-	28	-	41

Percent for "Quite a Lot" or "A Great Deal" →

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country. Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

A dash (-) indicates data are not available.

Countries where data were not available or where teacher response data were available for <50% of students are omitted from figure (Cyprus, England Hong Kong, Israel, and Singapore).

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

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.2 (Continued)**Teachers' Reports on What Factors Limit How They Teach Class Science - Upper Grade (Fourth Grade*)**

Country	Percent of Students Whose Teachers Report Each Factor Limiting How They Teach Class "Quite A Lot" or "A Great Deal"					
	Students with Different Academic Abilities	Students with Special Needs	Disruptive Students	Shortage of Equipment for Use in Demonstrations and Other Exercises	Inadequate Physical Facilities	High Student/Teacher Ratio
Korea	69	41	64	54	27	62
<i>Kuwait</i>	^s 65	^s 58	^s 49	^s 73	^s 53	^s 81
<i>Latvia (LSS)</i>	30	13	22	77	64	13
<i>Netherlands</i>	63	21	31	18	19	^r 35
New Zealand	45	26	27	31	25	59
Norway	^r 56	^r 34	^r 25	^r 38	^r 13	^r 45
Portugal	74	66	74	59	23	^r 53
Scotland	63	32	31	11	21	39
<i>Slovenia</i>	24	16	50	61	46	52
<i>Thailand</i>	^r 70	^r 44	^r 21	^r 71	^r 65	^r 50
United States	^r 41	^r 19	^r 32	^r 24	^r 15	^r 39

Percent for "Quite a Lot" or "A Great Deal" →

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

A dash (-) indicates data are not available.

Countries where data were not available or where teacher response data were available for <50% of students are omitted from figure (Cyprus, England Hong Kong, Israel, and Singapore).

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

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.9**Teachers' Reports on Average Size of Science Class
Upper Grade (Fourth Grade*)**

Country	1 - 20 Students		21 - 30 Students		31 - 40 Students		41 or More Students		Average Number of Students
	Percent of Students	Mean Achievement							
<i>Australia</i>	r 17 (3.1)	582 (5.3)	64 (4.9)	558 (5.3)	19 (4.8)	555 (9.2)	0 (0.0)	~ ~	r 25 (0.6)
<i>Austria</i>	50 (5.0)	572 (5.8)	50 (5.0)	557 (4.2)	0 (0.0)	~ ~	0 (0.0)	~ ~	20 (0.5)
Canada	21 (3.0)	567 (8.0)	72 (3.0)	547 (2.8)	7 (1.4)	549 (8.6)	0 (0.2)	~ ~	24 (0.4)
Cyprus	x x	x x	x x	x x	x x	x x	x x	x x	x x
Czech Republic	32 (3.6)	544 (4.5)	65 (3.7)	560 (3.5)	3 (1.4)	636 (38.0)	0 (0.0)	~ ~	22 (0.4)
England	9 (2.7)	559 (13.7)	53 (4.9)	549 (5.2)	38 (5.0)	557 (6.5)	0 (0.0)	~ ~	28 (0.5)
Greece	45 (3.9)	496 (6.0)	53 (4.0)	499 (5.3)	2 (1.1)	~ ~	0 (0.0)	~ ~	21 (0.4)
Hong Kong	0 (0.4)	~ ~	13 (4.2)	516 (19.0)	74 (4.9)	536 (4.5)	13 (3.2)	559 (7.3)	36 (0.5)
<i>Hungary</i>	40 (3.6)	517 (5.6)	55 (3.9)	542 (4.2)	5 (2.1)	539 (17.4)	0 (0.0)	~ ~	22 (0.4)
Iceland	45 (4.9)	503 (4.5)	55 (4.9)	510 (5.1)	0 (0.0)	~ ~	0 (0.0)	~ ~	20 (0.4)
Iran, Islamic Rep.	17 (3.7)	379 (8.4)	24 (3.9)	413 (5.9)	38 (4.2)	436 (7.5)	21 (3.7)	430 (8.0)	32 (0.9)
Ireland	27 (2.8)	539 (5.5)	33 (4.3)	536 (6.9)	41 (4.7)	546 (4.6)	0 (0.0)	~ ~	26 (0.6)
<i>Israel</i>	r 7 (2.9)	512 (18.8)	46 (5.5)	502 (6.3)	46 (6.0)	499 (6.3)	0 (0.0)	~ ~	r 30 (0.6)
Japan	3 (0.8)	577 (7.8)	29 (3.5)	570 (3.2)	67 (3.6)	575 (2.2)	1 (1.1)	~ ~	32 (0.4)
Korea	2 (1.0)	~ ~	6 (1.6)	574 (6.4)	24 (3.6)	590 (3.9)	69 (3.5)	602 (2.5)	43 (0.6)
<i>Kuwait</i>	s 0 (0.0)	~ ~	39 (5.2)	404 (7.1)	58 (4.9)	402 (5.5)	3 (2.2)	405 (15.3)	s 32 (0.4)
<i>Latvia (LSS)</i>	51 (4.1)	506 (7.6)	45 (3.8)	520 (7.5)	3 (1.6)	517 (17.7)	1 (0.9)	~ ~	21 (0.8)
<i>Netherlands</i>	29 (4.0)	558 (4.7)	52 (5.5)	552 (5.0)	19 (4.4)	567 (4.8)	0 (0.0)	~ ~	24 (0.7)
New Zealand	13 (2.4)	539 (9.0)	37 (4.2)	516 (9.8)	50 (4.4)	543 (6.0)	0 (0.0)	~ ~	29 (0.5)
Norway	57 (4.6)	528 (4.5)	43 (4.6)	527 (6.0)	0 (0.0)	~ ~	0 (0.0)	~ ~	19 (0.5)
Portugal	39 (3.8)	475 (7.3)	60 (3.7)	481 (5.1)	1 (0.6)	~ ~	0 (0.0)	~ ~	21 (0.4)
Scotland	15 (2.3)	553 (6.4)	70 (3.5)	531 (5.6)	14 (3.3)	540 (7.0)	1 (1.0)	~ ~	26 (0.5)
Singapore	0 (0.0)	~ ~	2 (0.8)	~ ~	68 (3.3)	542 (5.5)	30 (3.2)	566 (10.5)	39 (0.2)
<i>Slovenia</i>	32 (4.5)	537 (6.7)	68 (4.5)	548 (3.8)	0 (0.0)	~ ~	0 (0.0)	~ ~	23 (0.4)
<i>Thailand</i>	28 (4.2)	477 (5.3)	29 (5.0)	478 (11.2)	36 (5.7)	478 (11.9)	7 (5.2)	438 (2.7)	28 (2.0)
United States	r 23 (3.5)	563 (7.0)	67 (3.7)	575 (4.0)	9 (1.7)	527 (9.3)	1 (0.5)	~ ~	r 24 (0.4)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

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

A tilde (~) indicates insufficient data to report achievement.

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% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Extensive research about class size in relation to achievement indicates that the existence of such a relationship is dependent on the situation. Dramatic reductions in class size can be related to gains in achievement, but the chief effects of smaller classes often are in relation to teacher attitudes and instructional behaviors. The TIMSS data illustrate the complexity of this issue. Across countries, two of the three highest-performing countries at the fourth grade – Korea and Japan – are among those with the largest science classes. Within countries, several show little or no relationship between achievement and class size, sometimes because students are almost all in classes of similar size. Within others, there appears to be a curvilinear relationship, or the students with higher achievement appear to be in larger classes. In some countries, larger classes may represent the more usual situation for teaching science, with smaller classes used primarily for students needing remediation or for students in the less-advanced tracks.

Teachers can adopt a variety of organizational and interactive approaches in science class. Whole-class instruction can be very efficient, because it requires less time on management functions and provides more time for developing science concepts. Teachers can make presentations, conduct discussions, or demonstrate procedures and applications to all students simultaneously. Both whole-class and independent work have been standard features of science classrooms. Students also can benefit from the type of cooperative learning that occurs with effective use of small-group work. Because they can help each other, students in groups can often handle challenging situations beyond their individual capabilities. Further, the positive affective impact of working together mirrors the use of science in the workplace.

Figure 5.3 provides a pictorial view of the emphasis on individual, group, and whole-class work as reported by the science teachers in the TIMSS countries. Because learning may be enhanced with teacher guidance and monitoring of individual and small-group activities, the frequency of lessons using each of these organizational approaches is shown both with and without assistance from the teacher. Internationally, teachers reported that working together as a class with the teacher teaching the whole class is a frequently used instructional approach. In more than half of the countries, 50% or more of the fourth-grade students were taught this way during most or all lessons. Students working individually with assistance from the teacher is also a popular approach, as is working in pairs or small groups with teacher assistance. Working without teacher assistance is less common in most countries. Working together as a class with students responding to one another was a common approach in Japan, Korea, and the Netherlands.

Figure 5.3**Teachers' Reports About Classroom Organization During Science Lessons
Upper Grade (Fourth Grade*)**

Country	Percent of Students Whose Teachers Report Using Each Organizational Approach "Most or Every Lesson"					
	Work Together as a Class with Students Responding to One Another	Work Together as a Class with Teacher Teaching the Whole Class	Work Individually with Assistance from Teacher	Work Individually without Assistance from Teacher	Work in Pairs or Small Groups with Assistance from Teacher	Work in Pairs or Small Groups without Assistance from Teacher
<i>Australia</i>	15	24	12	6	28	19
<i>Austria</i>	5	47	28	5	23	12
Canada	21	36	18	5	35	14
Czech Republic	22	64	32	25	8	8
England	18	17	14	4	34	7
Greece	8	71	39	8	21	4
Hong Kong	15	67	22	0	11	0
<i>Hungary</i>	19	77	43	8	16	4
Iceland	1	29	26	2	17	6
Iran, Islamic Rep.	32	61	59	5	41	5
Ireland	15	59	14	7	5	2
<i>Israel</i>	30	42	40	21	37	23
Japan	51	68	18	4	24	12

Percent for "Most or Every Lesson" →

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country. Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

Cyprus omitted from the figure; teacher response data available for <50% of students.

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

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.3 (Continued)**Teachers' Reports About Classroom Organization During Science Lessons
Upper Grade (Fourth Grade*)**

Country	Percent of Students Whose Teachers Report Using Each Organizational Approach "Most or Every Lesson"					
	Work Together as a Class with Students Responding to One Another	Work Together as a Class with Teacher Teaching the Whole Class	Work Individually with Assistance from Teacher	Work Individually without Assistance from Teacher	Work in Pairs or Small Groups with Assistance from Teacher	Work in Pairs or Small Groups without Assistance from Teacher
Korea	49	59	64	17	65	24
<i>Kuwait</i>	^s 9	^s 48	^s 52	^s 6	^s 56	^s 8
<i>Latvia (LSS)</i>	39	91	60	35	23	12
<i>Netherlands</i>	47	75	17	9	8	9
New Zealand	28	18	21	14	39	20
Norway	^r 38	^r 57	^r 20	^r 1	^r 19	^r 6
Portugal	20	65	54	12	42	12
Scotland	^r 5	^r 15	^r 5	^r 4	^r 29	^r 7
Singapore	21	67	51	15	43	18
<i>Slovenia</i>	13	53	64	35	36	26
<i>Thailand</i>	^r 6	^r 49	^r 41	^r 8	^r 34	^r 13
<i>United States</i>	^r 35	^r 47	^r 20	^r 6	^r 26	^r 10

Percent for "Most or Every Lesson" →

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).

Cyprus omitted from the figure; teacher response data available for <50% of students.

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

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

