THIRD INTERNATIONAL MATHEMATICS AND SCIENCE STUDY
First National Report
Part 2

Wendy Keys, Sue Harris, and Cres Fernandes

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Patterns of Mathematics and Science Teaching in Lower Secondary Schools in England and Ten Other Countries

Wendy Keys, Sue Harris and Cres Fernandes

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SUMMARY

1. Introduction

England is one of over 40 countries which took part in the Third International Mathematics and Science Study (TIMSS), a large-scale international comparative study of educational performance. TIMSS was organised by the International Association for the Evaluation of Educational Achievement (IEA). The study in England was funded by the Department for Education and Employment (DFEE) and carried out by the National Foundation for Educational Research (NFER).

Part 1 of the First National Report on TIMSS, which was published in November 1996 (Keys *et al.*, 1996a) compared the mathematics and science performance of 13-year-old students (Years 8 and 9 in England) with that of students of the same age in other countries. Its main finding was that students in England achieved relatively *high mean scores in science* and *relatively low mean scores in mathematics.*

Part 2 of the First National Report extends the findings of the first part of the report. Its main purpose is to compare the responses to the TIMSS questionnaires of students, teachers and headteachers in England with those of their counterparts in ten other countries: Canada; France; Germany; Hungary; Japan; Scotland; Singapore; Sweden; Switzerland and the United States. The results for Year 9 are described below; those for Year 8 were similar.

2. Main findings

Time spent in mathematics and science lessons

- Compared with their counterparts in most of the ten other countries Year 9 students in England spent, on average:
  - *slightly less time* in mathematics lessons
  - *slightly more time* in science lessons.
- Comparisons with previous international studies suggest that the average amount of time spent per week by lower secondary school students in England has:
  - *decreased slightly* for mathematics
  - *increased slightly* for science.
- Across countries, there was a slight positive association between mean scores in both mathematics and science and lesson time in these subjects, i.e. there was a slight tendency for students in countries where more time, on average, was spent on a subject to achieve higher mean scores in that subject but the pattern was not consistent over all countries.

Class size

- Mathematics classes in England were, on average, slightly larger than science classes (26 compared with 24 students), possibly because of the additional space per student required for practical activities in science and the constraints of laboratory size.
- Mathematics class sizes in England were, on average:
  - smaller than those in Japan and Singapore
  - larger than those in Switzerland, Hungary and Sweden
  - similar to those in about half of the countries selected for our comparisons.
- Science classes in England were, on average:
  - smaller than those in Japan, Singapore and Canada
  - larger than those in Scotland, Switzerland and Hungary
  - similar to those in France and Germany.
- Across countries, there was no association between either mathematics or science scores and class size.

Classroom organisation

- Whole class teaching in mathematics in England was:
  - about *as frequent* as in half of the countries selected for our comparisons
  - *less frequent* than in Japan, Germany, Singapore and Hungary
  - *more frequent* than in Canada and Scotland.
- Whole class teaching in science in England was:
  - *less frequent* than in most of the other countries selected for our comparisons
  - about *as frequent* as in Canada
  - slightly *more frequent* than in Scotland.

Homework

- The study included a number of questions for teachers and students about homework: how frequently teachers set homework; how long students spent on homework; and how teachers followed up homework. In England, these measures were found to have slight but positive associations with students' mathematics and science scores, i.e. a greater emphasis on homework appeared to be associated with higher achievement.
- Compared with their counterparts in the other countries selected for our comparisons:

- mathematics teachers in England tended to set homework *less frequently*
- science teachers tended to set homework *more frequently.*

The use of calculators in mathematics

- Compared with the other countries selected for our comparisons:
  - calculators were used *more frequently* in mathematics classes in England
  - calculators were also used fairly frequently in another five countries including Singapore, the highest-scoring country
  - in Japan calculators were used *infrequently.*

Practical activities in science

- Practical activities were *more frequent* in science classes in England than in any of the other countries selected for comparison.
- Practical activities were *relatively frequent* in Scotland and Singapore.

Teachers' attitudes

- Compared with their counterparts in other countries, mathematics and science teachers in England tended to be:
  - *more likely* to say they would like to change to another career, given the chance
  - *less likely* to believe that society appreciated their work (although teachers in Hungary were even more negative).

Teachers' school-related activities out of school hours

- Compared with their counterparts in most other countries, teachers in England tended to spend:
  - more time marking students' work
  - more time on administration
  - less time preparing tests.

Students' out-of-school activities

- The average time spent on homework in all subjects each day by Year 9 students in England was about 1.5 hours. Students' out-of-school activities (in order of frequency) were:
  - watching television or videos
  - socialising with friends
  - homework

- playing sports
- playing computer games
- reading for pleasure
- helping at home.

Students' attitudes

- Compared with their counterparts in most of the other countries selected for our comparison, Year 9 students in England tended to:
  - hold *more positive* attitudes towards mathematics and science
  - be *more likely* to believe that they usually did well in mathematics and science. In mathematics, this was despite the fact that their scores were, on average, below those of students in many other countries.
- In general, students in the four English-speaking countries tended to say they liked science slightly more than those in the other countries selected for our comparisons.
- Students in England, and in most of the other selected countries selected for comparison, tended to think:
  - that memorising notes was a *more important* factor for doing well in science than in mathematics
  - that doing well in mathematics would be *more important* than doing well in science when it came to getting a job or getting into a desired university or college.
- Nearly three-quarters of the Year 9 students in England said that they intended to remain in education after the end of Year 11.

Patterns of teaching

- The study found that the emphasis placed on different teaching practices and activities varied between the countries selected for our comparisons.
- It found no outstanding features or approaches which were common to the higher-scoring countries and which distinguished these countries from the others.
- There were some common features amongst the English-speaking countries (in particular, England, Scotland and Canada) in, for example: the strong emphasis on practical activities in science; the frequent use of calculators in mathematics; the positive attitudes towards mathematics and science expressed by students; and the students' relatively high perceptions of their own performance in these subjects.

CHAPTER 1
Introduction to the Study

The structure of this report

- **This chapter provides brief descriptions of the design and administration of TIMSS and the content covered by the school, teacher and student questionnaires.**
- **Chapter 2 focuses on the secondary schools taking part in TIMSS in England and compares school-level mathematics and science provision in England and the other ten countries selected for comparison.**
- **Chapter 3 describes mathematics teachers' perceptions of mathematics lessons and provides information on the teaching approaches adopted in England and the other ten countries.**
- **Chapter 4 describes the Year 9 students' perceptions of mathematics lessons and provides further information on teaching approaches and learning activities in mathematics.**
- **Chapters 5 and 6 provide similar information about science lessons.**
- **Chapter 7 focuses on the professional background and attitudes of the mathematics and science teachers.**
- **Chapter 8 focuses on student and home background factors, and students' out-of-school activities and aspirations.**
- **Chapter 9 describes students' attitudes towards mathematics and science.**
- **Annex A provides additional tables to support the results described in the text.**

Part 1 of this report (Keys *et al.*, 1996a) compared the performance of 13-year-olds in England on the TIMSS mathematics and science tests with the performance of students of the same age in other countries. A companion volume of technical appendices (Keys *et al.*, 1996b) provides more detailed information on the design and administration of the study.

1.1 Preface

England is one of over 40 countries taking part in the Third International Mathematics and Science Study (TIMSS), a large-scale international comparative study of educational performance. TIMSS is organised by the International Association for the Evaluation of Educational Achievement (IEA). The study in England was funded by the Department for Education and Employment (DFEE) and carried out by the National Foundation for Educational Research (NFER).

Part 1 of the First National Report on TIMSS was published in November 1996. It compared the mathematics and science performance of students in Years 8 and 9 in England with that of students of the same age in other countries. Its main finding was that students in England achieved relatively *high mean scores in science* and relatively *low mean scores in mathematics*.

Part 2 of the First National Report on TIMSS extends the findings of the first part of the report. Its main purpose is to compare the responses to the TIMSS questionnaires (described in Section 1.3 below) of students, teachers and headteachers in England with those of their counterparts in a small number of other countries in order to identify any factors or patterns of behaviour which might differentiate between high- and low-scoring countries.

Much of the information contained in this report has been drawn from the first international reports on TIMSS (Beaton *et al.*, 1996a, 1996b). Additional sources of information are unpublished analyses carried out by the International Study Center and analyses carried out by NFER on the TIMSS national dataset. Where appropriate, comparisons have been made with the results of previous large-scale comparisons of achievement.

In order to provide clear and coherent comparisons, it was decided to focus many of the comparisons in this report on the following 11 countries whose results were described in detail in Part 1 of this report.

- Canada
- England
- France
- Germany
- Hungary
- Japan
- Scotland
- Singapore
- Sweden
- Switzerland
- USA

These countries represent the four main groups of countries taking part in TIMSS: Western European countries; English-speaking countries; Eastern European countries; and countries from the (Asian) Pacific Rim. These countries' mean scores on the TIMSS tests illustrate very clearly the wide range of mean scores achieved by the industrialised nations taking part in TIMSS.

1.2 Design and administration of TIMSS

The international research focused on three different stages of education: upper primary (nine-year-olds), lower secondary (13-year-olds) and pupils in their final year of schooling (mainly 17-year-olds). England participated in the survey of two age groups only: nine-year olds (Years 4 and 5 in England) and 13-year-olds (Years 8 and 9 in England) and in the Performance Assessment (practical activities) for 13-year-olds. A brief summary of the design and administration of the TIMSS survey of 13-year-olds (TIMSS Population 2), which forms the subject of this report, is given below. Full details can be found in the companion volume of appendices (Keys *et al.*, 1996b), which also includes information on the design and administration of the survey of nine-year-olds (TIMSS Population 1) and of the Performance Assessment.

Age groups

TIMSS Population 2 consisted of students in all maintained and independent schools (excluding special schools) who were in international seventh and eighth grades (equivalent to Years 8 and 9 in England). The two grades selected included the highest proportion of 13-year-olds in most participating countries. At the time of testing (early March 1995) the age of the Population 2 students taking part in the study in England ranged from 12 years seven months to 14 years six months.

The schools and students

The randomly selected samples of schools and students taking part in TIMSS in each country were required to conform to rigorous procedures. Each country's sampling plans and all details of samples had to be documented and approved by an independent sampling referee. A total of 127 schools took part in the study of 13-year-olds (Population 2) in England (85 first-choice schools and 41 replacement schools). The response rate for Population 2 was 85 per cent including replacement schools (57 per cent from first-choice schools). The characteristics of the schools taking part in TIMSS closely reflected the national student population in terms of GCSE results and school type (Keys *et al.*, 1996b). Tests and questionnaires were completed by 3,579 pupils, 485 mathematics teachers, 599 science teachers and 110 headteachers. The tests and questionnaires were administered in schools by teachers in early March 1995.

1.3 The tests and questionnaires

The tests of mathematics and science

The TIMSS curriculum frameworks for mathematics and science were developed from analyses of the science and mathematics curricula in participating countries (Robitaille, 1993). These frameworks provided a structure which ensured that the tests were as relevant as possible to the curricula of the countries taking part in the study. A further check of

curricular relevance, the Test-curriculum Matching Analysis, was carried out in each country. Full details in the volume of appendices (Keys *et al.*, 1996b).

Each student completed a total of 90 minutes of testing in two sessions. Mathematics and science items were included in both testing sessions. A mathematics and science test score was computed for each student.

Mean mathematics and science scores

The mean mathematics and science scores given in this report have each been expressed in terms of a scale with a mean of 500 and a standard deviation of about 100 based on the performance of students in two year groups (equivalent to Years 8 and 9 in England) in all participating countries. The international mean mathematics scores were: 484 for Year 8; and 513 for Year 9. The international mean science scores were: 479 for Year 8; and 516 for Year 9. Further information is given in the volume of appendices to the national reports (Keys *et al.*, 1996b) and in the international reports (Beaton *et al.*, 1996a, 1996b).

The school questionnaires

The school questionnaire sought general background information on the schools taking part in the study. Information provided by schools included:

- **General background information:** location; length of school week and teaching week; admissions criteria.
- **Teaching staff:** stability of teaching staff; proportions teaching these subjects for three-quarters or more of their teaching time.
- **Students:** number of boys and girls on roll; number of students eligible for free school meals, from ethnic minorities, needing English as a second language (ESL) support and with statements of special educational needs; stability of student population; rates of absenteeism.
- **Resources:** number of computers available to students; shortages or inadequacy of any other resources.
- **Organisational features:** existence of written curriculum plans for mathematics and science; extent of streaming, setting or banding for mathematics and science; teaching time per week for mathematics and science; remedial and/or enrichment provision in mathematics and science.

The teacher questionnaires

The students' mathematics and science teachers completed background questionnaires designed to collect biographical details and information on teaching and learning approaches. Information collected included:

- **Biographical details:** age, gender, educational background, teaching experience.

- **How they spent their time:** teaching time for different subjects; lesson preparation time; other timetabled activities.
- **Teaching approaches and resources:** size of classes; extent of whole class, group and individual work; developing students' skills; setting homework; use of textbooks and schemes of work; use of calculators and computers.
- **Teachers' attitudes:** views on mathematics or science as subjects; views on teaching and learning mathematics or science; views on teaching as a career.

The student questionnaires

Each student also completed a questionnaire, designed to obtain background information. Information collected from the students in England included:

- **The students themselves:** age; gender; country of birth; language spoken at home; out-of-school activities, including time spent on homework; perceived ability in mathematics and science; educational aspirations.
- **Home background:** parents' educational background; parents' country of birth; surrogate measures to provide an indication of the educational status of the family, such as the approximate number of books in the home.
- **Students' attitudes:** liking for mathematics and science; views about mathematics and science.
- **Perceptions of mathematics and science lessons:** teaching approaches used by teachers; activities undertaken by students including practical work and the use of calculators and computers; behaviour in mathematics classes.

1.4 Interpreting the results

This report draws upon the wealth of data collected by means of the school, teacher and student questionnaires and selects those responses which best illustrate the similarities and differences between teaching practices in different countries.

In some chapters, we have indicated that there were systematic associations between a particular variable and students' mathematics or science scores. It is important to remember that such associations do not necessarily imply that the variable concerned is a causal factor in raising students' achievement.

It is also important to remember that about 40 countries took part in TIMSS. These countries vary a great deal in terms of a number of factors including the age at which students start school, the extent of differentiation by ability

and the use of subject specialists in mathematics and science in the lower secondary school. Details of the ways in which mathematics and science teaching are organised in the education systems taking part in TIMSS are given in Robitaille(1997), which is required reading for those interested in understanding and interpreting the TIMSS data.

Translations were carefully validated in TIMSS, and the International Study Center provided guidance notes on the intended meaning of each question in the questionnaires so that researchers could add explanatory sentences where necessary. Nevertheless, it is possible that some questions may have been interpreted in different ways in different countries or cultures. Even within a country, some questions may have been interpreted differently in different schools. For example, pupils could have interpreted the word *test* in many ways; some pupils may have thought of a brief test of mental mathematics, others of a teacher-made short answer test, and so on. In a self-completion questionnaire, it is simply not possible to cover a wide range of topics *and* follow up every question in order to identify the precise meaning of every response while keeping the questionnaire to an acceptable length.

For these reasons, the TIMSS self-completion questionnaires can only provide a broad-brush picture of what happens in mathematics and science classrooms. More in-depth research, drawing on classroom observations and interviews with teachers and students, is required to build up a detailed understanding of teaching and learning in mathematics and science.

CHAPTER 2
Mathematics and Science in Schools

Summary of main points

- **Compared with their counterparts in most of the ten other countries, Year 9 students in England spent, on average:**
  - ***slightly less time* in mathematics lessons**
  - ***slightly more time* in science lessons.**
- **Comparisons with previous studies suggest that the average amount of time per week spent on mathematics in English schools has decreased slightly, whereas the average amount of time spent on science has increased slightly.**
- **Across countries, there was a slight positive association between mean scores in both mathematics and science and lesson time in these subjects. i.e. there was a slight tendency for students in countries where more time, on average, was spent on a subject to achieve higher mean scores in that subject, but the pattern was not consistent over all countries.**
- **In England, mathematics classes were, on average, slightly larger than science classes (26 compared with 24 students), possibly because of the additional space per student required for practical activities in science and the constraints of laboratory size.**
- **The size of mathematics classes in England tended to be**
  - **smaller than those in Japan and Singapore**
  - **larger than those in Switzerland and Hungary, Germany and Sweden**
  - **similar to those in most of the other countries selected for comparison.**
- **Science classes in England tended to be**
  - **smaller than those in Japan, Singapore and Canada**
  - **larger than those in Scotland, Switzerland and Hungary**
  - **similar to those in most of the other countries.**
- **Across countries, there was no association between either mathematics or science achievement and class size.**
- **Schools in England were more likely to have their own written statements of the curriculum content to be covered in mathematics and science than any of the ten other countries selected for comparison.**

2.1 Preface

The main purpose of this chapter is to describe and compare school-level mathematics and science provision in England and the ten countries selected for comparison.

Issues covered include: time allocations; class size; and the provision of learning support and enrichment. The main sources of information were the background questionnaires completed by the schools and teachers of mathematics and science taking part in the study.

In interpreting the results described in this chapter, it should be remembered that TIMSS selected probability samples of students, not schools. The schools taking part in TIMSS were not, therefore, a true random sample of schools but the schools attended by a probability sample of students. Similarly, the teachers' responses should be regarded as the responses of teachers of a probability sample of students. Thus, this chapter does not describe the characteristics of a sample of schools but instead describes the school characteristics experienced by a probability sample of students. Similarly, Chapters 3, 5 and 7 describe the characteristics of the mathematics and science teachers experienced by a probability sample of students.

2.2 School background factors

Background information on the schools taking part in the study in terms of type of school, size of school and type of community served by the schools is shown in Table A2.1 in Annex A. Information is also provided in Table A2.1 on school background factors, such as the proportion of students eligible for free school meals and from ethnic minorities, student and staff stability, absenteeism. Information on schools' admissions criteria is given in Table A2.2 in Annex A.

MATHEMATICS

2.3 Information provided by mathematics teachers and schools: *time allocations for mathematics*

The median time allocated to mathematics for students in grades equivalent to Year 9 in England and the ten selected countries is shown in Table 2.3.1. The median time in England for Year 9 was 180 minutes (three hours) per week.

Table 2.3.1 Information provided by mathematics teachers: *time allocations for mathematics in Year 9*

COUNTRY	*Mean mathematics score*	Median minutes per week	Inter quartile range	Weeks per year*
Singapore	*643*	200	175-210	40
Japan	*605*	200	200-200	35**
Switzerland	*545*	235	225-270	39-40
France	*538*	220	220-240	36
Hungary	537	180	180-200	38-40
Canada	*527*	240	200-250	36-40
Sweden	*519*	160	160-160	34
Germany	*509*	180	180-180	38
England	***506***	**180**	**175-200**	**38**
United States	*500*	225	220-250	35-38
Scotland	*498*	210	200-220	38

Source: analyses provided by the TIMSS International Study Center

**Source: Robitaille 1997*

***Note: Japan had a five-and-a-half-day week.*

Comparisons with other countries

Students in England spent, on average, slightly less time per week in mathematics lessons than their counterparts in most of the other countries selected for comparison. The length of the school year in the 11 countries ranged from 34 to 40 weeks.

Across countries, there was a slight positive association between mean scores in mathematics and mathematics lesson time, i.e. there was a slight tendency for students in countries where more time, on average, was spent on mathematics to achieve higher mean mathematics scores, but the pattern was not consistent over all countries. For example, students in the five countries in the top half of the table (i.e. those with the highest mean mathematics scores) spent, on average, slightly more time than most of the countries with lower mean scores; however, two of the lower scoring countries (Scotland and the United States) spent about the same amount of time as the five highest-scoring countries.

Comparisons with previous studies

Comparisons with previous international studies suggest that the average amount of time per week spent on mathematics in England has decreased slightly since the earlier studies were carried out (Table 2.3.2).

Table 2.3.2 Comparisons with previous studies: *average curriculum time per week for mathematics in schools in England*

Date	Study	Minutes/week
1964	Husen, 1967	210 (14%)
1980-82	Robitaille and Garden, 1989	195 (13%)
1991	Lapointe *et al.*, 1992a	190
1995	TIMSS	180*

**median*

2.4 Size of mathematics classes

The size of mathematics classes in England varied widely: 18 per cent of the students taking the TIMSS tests were in mathematics classes containing 20 or fewer students; 62 per cent were in classes of 21-30 students; and 20 per cent were in classes of 31-40 students. The median size of mathematics classes for Year 9 students in England was 26 students. The median size of mathematics classes in England tended to be slightly larger than the median size of science classes: 26 students compared with 24 (Table 2.8):

Table 2.4 Comparisons between 11 countries: *teachers' reports on mathematics class size in international eighth grade (Year 9 in England)*

COUNTRY	*Mean mathematics score*	1-20 students %	21-30 students %	31-40 students %	41 or more students %	Median* size of mathematics class
Singapore	*643*	1	10	72	18	36
Japan	*605*	0	4	88	8	36
Switzerland	*545*	56	44	0	0	19
France	*538*	11	86	3	0	25
Hungary	*537*	37	57	6	0	23
Canada	*527*	11	65	23	1	27
Sweden	*519*	36	61	2	0	23
Germany	*509*	25	72	3	0	24
England	***506***	**18**	**62**	**20**	**0**	**26**
United States	*500*	24	59	12	4	25
Scotland	*498*	12	80	8	0	25

Source: Beaton et al., 1996b

**Medians were calculated from grouped data.*

Percentages may not sum to 100 because results are rounded to the nearest whole number.

Comparisons with other countries

The median size of mathematics classes in England tended to be:

- smaller than those in Japan and Singapore
- larger than those in Switzerland and Hungary, Germany and Sweden
- similar to those in most of the other countries selected for comparison.

Across countries, there was no association between either mathematics or science achievement and class size: some of the highest-scoring countries had relatively large classes whilst others had relatively small classes.

There is a widespread belief amongst parents, teachers and others that pupils learn more effectively in small classes (Mortimore and Blatchford, 1993). However, previous research into the relationship between class size and achievement at the secondary level has produced inconsistent results, possibly because of the difficulty of controlling for ability and the tendency for schools to group less able students together in smaller classes. As Beaton *et al.*, 1996b comment: 'The chief effects of smaller classes are often in relation to teacher attitudes and instructional behaviours.' The results of this study illustrate the complexity of the issue. In several countries, the relationship between mathematics and class size was negligible, possibly because there was very little variation in class size within these countries. In some countries, the relationship was curvilinear, whereas in others, including England, there was a slight tendency for students in larger classes to achieve higher mean mathematics scores than those in smaller classes (Beaton *et al.*, 1996b).

2.5 Information provided by schools: *learning support and enrichment provision in mathematics*

The majority (93 per cent) of schools in England provided some form of learning support for students with learning difficulties in mathematics. This was usually provided by forming groups within normal mathematics classes or, less often, by withdrawing students from their normal mathematics classes (Table A2.3 in Annex A).

About 60 per cent of schools in England provided some form of enrichment or extension teaching for very able students in mathematics. In most cases this was provided either by forming groups within normal mathematics classes or, less often, by providing extra activities before or after school (Table A2.4 in Annex A).

2.6 Information provided by schools: *written statements of curriculum content to be taught in mathematics*

The majority (92 per cent) of students in England were in schools which had their own written statement of the content to be taught in mathematics, other than the national or regional curriculum guides (Table A2.5 in Annex A).

Table 2.6 Information provided by schools: *percentage of schools with their own written statement of the curriculum content to be covered in mathematics*

COUNTRY	*Mean mathematics score*	School has own written statement of the curriculum content to be covered in mathematics
Singapore	*643*	59
Japan	*605*	29
Switzerland	*545*	8
France	*538*	0
Hungary	*537*	12
Canada	*527*	50
Sweden	*519*	47
Germany	*509*	1
England	***506***	**92**
United States	*500*	77
Scotland	*498*	85

Source: analyses provided by the TIMSS International Study Center

Comparisons with other countries

Students in England were more likely than those in the other ten countries to be in schools which had their own written statements of the curriculum content in mathematics (Table 2.6). There was no obvious association between the mean mathematics score of students in a country and the prevalence of school-level written statements of the curriculum in that country.

SCIENCE

2.7 Information provided by schools: *time allocations for science*

The time allocated for science in England and nine of the ten selected countries is shown in Table 2.7.1. Information provided by the schools was used, since many students had more than one teacher for science; this meant that a teacher's answer to the question *How many minutes per week do you teach science to the class?* did not provide a measure of the total number of minutes per week the class was taught science.

Median times are shown for students in schools which provided the same course of science for all students. The median time in England for Year 9 was 210 minutes per week.

Table 2.7.1 Information provided by schools: *time allocations for science in Year 9*

COUNTRY	*Mean science score*	Median minutes per week	Inter quartile range	Weeks per year*
Singapore**	*607*	210	210-210	40
Japan	*571*	150	150-150	35
England	***552***	**210**	**180-225**	**38**
Sweden	*535*	200	180-220	34
United States	*534*	225	220-250	35-38
Canada	*531*	180	146-210	34-40
Germany	*531*	180	135-270	38
Switzerland	*522*	180	90-200	39-40
Scotland	*517*	165	160-180	38
France	*498*	190	165-210	35

Source: analyses provided by the TIMSS International Study Center
**Source: Robitaille 1997*

Note: no information was available for Hungary.
Note: Japan had a five-and-a-half-day week.
Note: these figures relate to schools in which all students follow the same course of study. In most countries this was the majority of schools.
*** In Singapore, only 20 per cent of schools provided the same course for all students; however, the median time for science was 210 minutes for the most advanced and least advanced courses.*

Comparisons with other countries

Students in England spent, on average, slightly more time in science lessons than their counterparts in most of the other countries.

In countries devoting, on average, more time to science, there was a slight tendency for students to achieve higher mean scores. However, the pattern was not consistent over all countries: students in Japan, for example, who spent the least time per week on science, had relatively high mean science scores.

Comparisons with previous studies

Comparisons with previous studies suggest that the average amount of time per week spent on science in England has increased slightly since the earlier studies were carried out (Table 2.7.2).

Table 2.7.2 Comparisons with previous studies: *average curriculum time per week for science in schools in England*

Date	Study	Minutes/week
1970-71	Comber and Keeves, 1973	192 (3.2 hours)
1984	Postelthwaite and Wiley, 1992	192 (3.2 hours)
1991	Lapointe *et al.*, 1992b	194
1995	TIMSS	210*

**median*

2.8 The size of science classes

The size of science classes in England varied: 25 per cent of the students taking the TIMSS tests were in science classes containing 20 or fewer students; 66 per cent were in classes of 21-30 students; and nine per cent were in classes of 31-40 students (Table 2.8). The median size of science classes in England was slightly smaller than the median size of mathematics classes (24 students compared with 26).

Table 2.8 Comparisons between nine countries: *teachers' reports on science class size in international eighth grade (Year 9 in England)*

COUNTRY	*Mean science score*	1-20 students %	21-30 students %	31-40 students %	41 or more students %	Median* size of science class
Singapore	*607*	0	9	72	19	36
Japan	*571*	0	4	88	8	36
Hungary	*554*	40	56	4	0	22
England	***552***	**25**	**66**	**9**	**0**	**24**
Canada	*531*	10	62	25	3	27
Germany.	*531*	20	73	6	0	25
Switzerland	*522*	50	47	3	0	21
Scotland	*517*	99	1	0	1	<20
France	*498*	16	83	1	0	25

Source: Beaton et al., 1996a and additional national analysis

** Medians were calculated from grouped data.*

Percentages may not sum to 100 because results are rounded to the nearest whole number.

Comparisons with other countries

The median size of science classes in England tended to be:

- smaller than those in Japan, Singapore and Canada
- larger than those in Scotland, Switzerland and Hungary
- similar to those in most of the other selected countries.

Across countries, there was no association between either mathematics or science achievement and class size: some of the highest scoring countries had relatively large classes whilst others had relatively small classes.

2.9 Information provided by schools: *learning support and enrichment provision in science*

The majority (83 per cent) of schools in England provided some form of learning support for students with learning difficulties in science. This was usually provided by forming groups within normal science classes (Table A2.6 in Annex A).

About 43 per cent of schools in England provided some form of enrichment or extension teaching for very able students in science, compared with 60 per cent in mathematics (Section 2.5). In most cases this was provided either by forming groups within normal mathematics classes or by providing extra activities before or after school (Table A2.7 in Annex A).

2.10 Information provided by schools: *written statements of curriculum content to be taught in science*

The majority (92 per cent) of students were in schools which had their own written statement of the content to be taught in science, other than the national or regional curriculum guides (Table A2.8 in Annex A).

Table 2.10 Information provided by schools: *percentage of schools with their own written statement of the curriculum content to be covered in science*

COUNTRY	*Mean science score*	School has own written statement of the curriculum content to be covered in science
Singapore	*607*	59
Japan	*571*	30
Hungary	*554*	15
England	***552***	**90**
Sweden	*535*	46
United States	*534*	74
Canada	*531*	49
Germany	*531*	3
Switzerland	*522*	9
Scotland	*517*	80
France	*498*	0

Source: analyses provided by the TIMSS International Study Center

Comparisons with other countries

Students in England were more likely than those in the other ten countries to be in schools which had their own written statements of the curriculum content in science (Table 2.10). There was no obvious association between the mean science score of students in a country and the prevalence of school-level written statements of the curriculum in that country.

CHAPTER 3

Mathematics Lessons: *Teachers' Perspectives*

Summary of main points

- **Across countries, there were no associations between students' mean mathematics scores and the extent to which teachers emphasised the following approaches:**
  - **students working together as a class with the teacher teaching the whole class**
  - **students working individually with assistance from the teacher**
  - **teachers setting reasoning tasks**
  - **students' practising computational skills.**
- **Whole class teaching in mathematics in England was:**
  - **about as frequent as in half of the countries selected for comparison**
  - **less frequent than in Japan, Germany, Singapore and Hungary**
  - **more frequent than in Canada and Scotland.**
- **Comparisons suggest that the following practices and activities were *less frequent* in mathematics classes in England than in most of the other countries:**
  - **practising computational skills**
  - **teachers setting mathematics homework.**
- **Comparisons suggest that the following practices and activities were *more frequent* in mathematics classes in England and Scotland than in most of the other countries:**
  - **students using calculators**
  - **students using computers.**

  However, the use of computers in mathematics was not widespread in England or Scotland.
- **Within England, there were positive associations between students' mathematics scores and: the frequency with which their teachers set homework; the extent to which they gave feedback on or followed up students' homework. However, none of the associations was very strong.**

3.1 Preface

The purpose of this chapter is to provide information on the teaching approaches and learning activities associated with high achievement in mathematics. It focuses on the questionnaire responses of mathematics teachers in England and the ten other countries selected for comparison. The results will be examined in order to answer three key questions:

- Which teaching approaches were used most frequently in England?
- Across countries, were there any systematic associations between particular teaching approaches or activities and students' mean mathematics scores?
- Were there any common factors or patterns within the high-scoring countries which differentiated their teaching approaches from those used in England?

In order to answer these questions, the chapter describes the responses of teachers in England to a range of questions concerned with teaching approaches; and compares the responses of teachers in England with those of teachers in the ten other countries.

In most of the questions reported in this chapter, teachers were asked to respond using a four-point scale, such as: *never/almost never; some lessons; most lessons, every lesson.* In most cases, their responses have been reported in terms of the combined percentage opting for *most/every lesson(s).*

In interpreting the results described in this chapter, it should be remembered that TIMSS selected probability samples of students, not teachers or schools (Chapter 2, Section 2.1). The teachers' responses have been weighted[1] to take account of the number of tested students taught by each teacher. TIMSS in England selected 32 students randomly from each school: 16 from Year 8 and 16 from Year 9 (Keys *et al.*, 1996b). Selected students could, therefore, be drawn from any of the mathematics sets/ classes in a year group. In a large school with ten mathematics sets, say, up to ten mathematics teachers could have been selected, some of whom would have taught only one or two of the selected students. In order to reduce the burden on schools, only those teachers who taught three or more of the selected students were sent a questionnaire (this met the requirements of the International Study Center). This meant that only about 65 per cent of the students were linked to a mathematics teacher (and a similar proportion to a science teacher).

[1] *This is explained in the Appendices to the National Reports (Keys, et al., 1996b).*

3.2 Mathematics teachers' reports: *classroom organisation*

It has been suggested (Reynolds and Farrell, 1996; Bierhoff and Prais, 1995, for example) that one of the reasons that students in other countries out-perform those in England is that teachers in high-performing countries tend to adopt a 'whole class interactive' approach to teaching mathematics. The mathematics teachers taking part in TIMSS were asked to indicate how frequently they used the various types of classroom organisation shown in Table 3.2 (below). Teachers were asked to respond in terms of *every lesson, most lessons, some lessons, never.* Thus, information about the proportion of each lesson a teacher devoted to each approach was not available.

Table 3.2 shows the teachers' responses on the most frequent ways students were grouped for mathematics in the 11 countries. Full details of the responses of teachers in England are given in Table A3.5 in Annex A. In England, the two most frequent forms of classroom organisation were *working individually with the assistance of the teacher* and *working together as a class with the teacher teaching the whole class*, each of which was experienced in most/every lesson(s) by about half of the Year 9 students taking part in the study. Working individually without assistance from the teacher was experienced in most/every lesson by about a quarter of the students. Opportunities for students to interact with each other were less frequent.

Table 3.2 Comparisons between 11 countries: *teachers' reports on how students were grouped in class for most/every lesson(s) in mathematics in international eighth grade (Year 9 in England)*

COUNTRY	*Mean mathematics score*	Work together as a class		Work individually		Work in pairs or small groups	
		with students responding to each other %	with the teacher teaching the whole class %	with assistance from the teacher %	without assistance from the teacher %	with assistance from the teacher %	without assistance from the teacher %
Singapore	*643*	15	61	48	27	20	6
Japan	*605*	22	78	27	15	7	1
Switzerland	*545*	4	48	61	25	35	20
France	*538*	11	48	56	26	17	4
Hungary	*537*	11	60	65	22	7	1
Canada	*527*	12	37	57	25	28	14
Sweden	*519*	24	50	72	1	43	5
Germany	*509*	23	70	54	15	20	9
England	***506***	**19**	**46**	**57**	**25**	**14**	**8**
United States	*500*	22	49	50	19	26	12
Scotland	*498*	5	34	62	28	7	3

Row percentages do not sum to 100 since teachers could use more than one approach in most of their lessons.

Source: Beaton et al., 1996b

Comparisons with other countries

Across countries, there were no obvious associations between the teaching approaches used and students' mean mathematics scores (Table 3.2). For example, teachers in three of the five countries in the top half of Table 3.2 (i.e. the countries with the highest mean scores) indicated that *students working together as a class with the teacher teaching the whole class* was used more frequently than in England, Scotland or the United States. But, teachers in the other two countries in the top half of the table (Switzerland and France) said they used this approach about as frequently as those in England, Scotland and the United States.

Working together as a class with the students responding to each other (which could, possibly, be considered to be similar to whole class interactive teaching) was relatively infrequent in all 11 countries. However, it is possible that this statement was interpreted differently in different countries.

3.3 Mathematics teachers' reports: *developing students' reasoning skills*

Teachers were asked how frequently they used a range of different approaches in teaching mathematics to their students. Full details of the responses of teachers in England are shown in Table A3.6 in Annex A.

Comparisons with other countries

In the international report (Beaton *et al.*, 1996b) a composite measure was derived from teachers' most frequent responses for three approaches relating to reasoning tasks:

- explaining the reasoning behind an idea
- representing and analysing relationships using tables, charts or graphs
- working on problems for which there was no obvious method of solution.

Table 3.3 compares the responses of teachers in ten of the 11 countries on this composite measure concerned with the frequency of reasoning tasks (no results were reported for Scotland). Across countries, there was no association between the extent to which teachers asked students to do reasoning tasks and students' mean mathematics scores: for example, teachers in the highest-scoring country (Singapore) said they gave their students reasoning tasks least often whereas those in the next highest scoring country (Japan) used reasoning tasks most frequently.

Table 3.3 Comparisons between ten of the 11 countries: *teachers' reports on the proportion of Year 9 students asked to do reasoning tasks most/every* lesson(s)

COUNTRY	*Mean mathematics score*	Students do reasoning tasks in most/every lesson(s) %
Singapore	*643*	65
Japan	*605*	92
Switzerland	*545*	67
France	*538*	68
Hungary	*537*	92
Canada	*527*	81
Sweden	*519*	64
Germany	*509*	75
England	***506***	**74**
United States	*500*	76

Source: Beaton et al., 1996b

3.4 Mathematics teachers' reports: *practising computational skills*

Teachers' responses to a question concerned with practising computational skills are shown in Table 3.4.1. Within England, students whose teachers said they never practised computational skills and those whose teachers said they did so every lesson had slightly higher mean mathematics scores than those who practised computational skills in some or most lessons. Possibly those students who never practised computational skills were already competent in them.

Table 3.4.1 Teachers' reports: *how often they asked Year 9 students to practise computational skills*

ACTIVITY	Never/ almost never	Some lessons	Most lessons	Every lesson
Students practise computational skills	7%	52%	34%	8%
Mean mathematics score	*539*	*515*	*505*	*539*

Comparisons with other countries

The international report also compared the responses of teachers in different countries in terms of how often they asked their students to practise computational skills. Students in all but one (Germany) of the seven other countries (no results are reported for Japan, Sweden or

Scotland) appear to be asked to practise computational skills more frequently than those in England (Table 3.4.2). Across countries, however, there was no association between the extent to which teachers asked students to practise computational skills and students' mean mathematics scores.

Table 3.4.2 Comparisons between eight countries: *teachers' reports of the proportion of Year 9 students asked to practise computational skills most/every lesson(s)*

COUNTRY	*Mean mathematics score*	Students practise computational skills in most/every lesson(s) %
Singapore	*643*	49
Switzerland	*545*	75
France	*538*	51
Hungary	*537*	86
Canada	*527*	60
Germany	*509*	32
England	***506***	**42**
United States	*500*	59

Source: Beaton et al., 1996b

3.5 Mathematics teachers' reports: *use of textbooks*

Virtually all of the teachers in England used textbooks or published schemes to some extent with their mathematics students (Table A3.1). A wide variety of textbooks was used. The most frequently used was School Mathematics Project 11–16 (SMP,1983–), which was used by 44 per cent of the students taking part in the study. No other textbook was used by more than ten per cent of the students.

Teachers were asked to estimate the percentage of teaching time they based on textbooks or schemes of work; 39 per cent of Year 9 teachers based more than three-quarters of their teaching time on a textbook or scheme and a further 45 per cent based between half and three-quarters of their teaching time on a textbook or scheme (Table A3.2 in Annex A). Within England, there was a weak positive association between the percentage of teaching time teachers based on textbooks and students' mathematics scores for Year 9, but not for Year 8.

Comparisons with other countries.

As in England, textbooks were used by virtually all teachers in most of the other countries selected for comparison (Beaton *et al.*, 1996b).

3.6. Mathematics teachers' reports: *use of calculators and computers*

Calculators were widely available to students in England: the teachers of 80 per cent of the students said that calculators were available to almost all the students during their mathematics lessons (Table A3.3 in Annex A).

Calculators were used for a variety of purposes in mathematics classes in England. The frequency with which they were used for each task in Year 9 is given below in terms of the proportion of students using calculators *once or twice a week or more:*

- routine computation (96 per cent)
- checking answers (86 per cent)
- solving complex problems (72 per cent)
- developing number concepts (55 per cent)
- tests and exams (42 per cent).

Full details are given in Table A3.4 in Annex A.

Computers were used infrequently in mathematics lessons in England: 46 per cent of the teachers said they used computers *once in a while* but only two per cent used them *more frequently* (Beaton *et al.*, 1996b).

Comparisons with other countries

Comparisons between the ten countries in terms of how often students use calculators for routine computations are shown in Table 3.6. (No results were available for Scotland.)

Table 3.6.3 Comparisons between ten countries: *mathematics teachers' reports on percentage of students using calculators once or twice a week or more for routine calculations in mathematics in international eighth grade (Year 9 in England)*

COUNTRY	*Mean mathematics score*	Calculators for routine calculations once or twice a week or more %
Singapore	*643*	83
Japan	*605*	3
Switzerland	*545*	48
France	*538*	82
Hungary	*537*	43
Canada	*527*	82
Sweden	*519*	57
Germany	*509*	72
England	***506***	**96**
United States	*500*	68

Source: Beaton et al., 1996b

Students in England use calculators for routine calculations more frequently than those in the other countries; and students in Singapore, France and Canada do so fairly frequently. In fact, only one of the 11 countries, Japan, makes minimal use of calculators for routine computations.

Across countries, there was no association between the frequency with which calculators were used for routine computation and students' mean mathematics scores.

3.7 Mathematics teachers' reports: *homework*

In the questionnaire, teachers were asked a number of questions relating to homework, including: how often they set homework; the average amount of homework they set each time; how often they used homework as a basis for class discussion; and how often they gave feedback on homework to the whole class. Within England, all these measures were found to be positively associated with students' achievement (Table A3.10 in Annex A).

Over 90 per cent of the teachers in England set mathematics homework for their Year 9 students *once or twice a week*; these teachers were evenly divided between those who set up to 30 minutes each time and those who set more than 30 minutes each time (Tables A3.7 and A3.8 in Annex A).

The most frequent types of tasks set for homework in England are shown in Table A3.9 in Annex A. These were:

- problems set in the textbook
- a worksheet or workbook
- small investigations or gathering data
- working individually on long-term projects or experiments.

Students were occasionally asked to find one or more uses for the content covered or to read a textbook or supplementary materials.

Comparisons with other countries

According to the teachers, students in eight of the other countries were given mathematics homework more frequently each week than those in England, Scotland and Sweden (Table 3.7). It is possible, however, that frequency of mathematics homework is a function of the number of mathematics lessons each week. No information was collected in TIMSS about the frequency and length of mathematics lessons in different countries.

Table 3.7 Comparisons between 11 countries: *teachers' reports on the frequency with which they set homework to Year 9 students*

COUNTRY	*Mean mathematics score*	Never %	Less than once a week %	Once or twice a week %	Three times a week or more %
Singapore	*643*	0	1	14	84
Japan	*605*	0	31	47	22
Switzerland	*545*	0	2	30	67
France	*538*	0	2	11	87
Hungary	*537*	0	1	2	97
Canada	*527*	2	3	24	72
Sweden	*519*	0	26	71	3
Germany	*509*	1	1	22	76
England	***506***	**0**	**4**	**91**	**5**
United States	*500*	0	3	10	87
Scotland	*498*	0	24	52	24

Source: Beaton et al., 1996b

Percentages may not sum to 100 because results are rounded to the nearest whole number.

CHAPTER 4

Mathematics Lessons: *Students' Perspectives*

Summary of main points

- **Comparisons between responses of students in the 11 countries selected for comparison revealed a diversity of practice. There were few clear patterns which differentiated practices in the higher-scoring countries from those in lower-scoring countries, such as England, with regard to the frequency with which teachers were said to use the following teaching approaches:**
  - **teachers showing students how to do mathematics problems**
  - **teachers beginning a new topic by explaining the rules and definitions**
  - **students being given tests in mathematics lessons**
  - **completed homework being discussed in class**
  - **students copying notes from the board.**
- **Comparisons indicate that the following activities were more frequent in mathematics classes in England than in many other countries, including the five highest-scoring countries in the selected group:**
  - **working from work cards or textbooks on their own**
  - **working in pairs or small groups**
  - **doing mathematics projects[1]**
  - **using things from everyday life to solve mathematics problems**
  - **using calculators**
  - **using computers.**

  However, with the exception of calculator use, none of the above practices/activities was very widespread in England. Calculators were used fairly frequently in the highest-scoring country, Singapore.
- **Within England, there was a positive association between time spent by students on mathematics homework and their mean mathematics scores on the TIMSS tests.**

[1] *although sudents in one of the five highest-scoring countries, Hungary, said they worked on mathematics projects more frequently than students in England.*

4.1 Preface

The purpose of this chapter is to provide further evidence on the teaching approaches and learning activities associated with high achievement in mathematics. It draws upon the students' responses to the questionnaire in order to supplement the teachers' reports described in Chapter 3. The students' perceptions of their mathematics lessons are described, and the responses of students in England are compared with those of their counterparts in the ten other countries selected for comparison.

Topics covered included explaining and questioning, small-group and project work, the use of work cards or textbooks, calculators and computers, homework and testing. The main sources of information were the students' responses to two questions: one focusing on the range of teaching approaches and activities they experienced in their mathematics lessons; and the other on the approaches used by their teachers when introducing new topics. For both questions, students were presented with a list of approaches and activities and asked to estimate how often each took place in their mathematics classes, using a four-point scale: *almost always; quite often; once in a while;* and *never.*

In most cases, comparisons between the responses of students in different countries have been made in terms of the combined percentages responding *almost always* and *quite often.* It should be remembered that the information provided in this chapter is based on students' perceptions of the activities which took place in their mathematics lessons, and that it provides a broad-brush picture of school mathematics lessons in England and elsewhere. It should also be remembered that students in different countries may have interpreted some of the questions in different ways.

4.2 Students' reports: *explaining and questioning in mathematics lessons*

The students were asked about teaching approaches involving explaining or questioning by the teacher (Tables A4.1 and A4.2 in Annex A). Half of the Year 9 students in England said that their teacher *almost always* showed them how to do mathematics problems in their mathematics lessons, and a further 40 per cent said that this was done *quite often.* By far the most frequent approach used by teachers in England when introducing new topics in mathematics was *explaining the rules and definitions* (nearly three-quarters of the students said that their teachers *almost always* used this approach). A fairly frequent approach was to *ask students to solve a related example* (almost half said their teachers *almost always* used this approach); a less frequently used approach was to *ask students what they knew about the new topic.*

Table 4.2 Comparisons between 11 countries: percentages of Year 9 students agreeing that their teachers almost always: *(a) showed them how to do mathematics problems in their mathematics lessons; and (b) explained rules and definitions when introducing a new topic*

COUNTRY	*Mean mathematics score*	Almost always	
		In lessons teacher shows how to do mathematics problems %	New topic: teacher explains rules and definitions %
Singapore	*643*	66	73
Japan	*605*	58	54
Switzerland	*545*	42	48
France	*538*	47	49
Hungary	*537*	37	69
Canada	*527*	59	66
Sweden	*519*	49	70
Germany	*509*	37	42
England	***506***	**50**	**73**
United States	*500*	78	60
Scotland	*498*	46	—

Source: analyses provided by the TIMSS International Study Center

Comparisons with other countries.

Comparisons amongst the 11 countries (Table 4.2) revealed a wide diversity of practice. There were no clear patterns differentiating teaching practices in higher-scoring countries from those in lower-scoring countries, such as England. *Showing students how to do mathematics problems* was less frequent in Hungary and Germany than in any of the other countries. *Explaining the rules and definitions when introducing a new topic* was more frequent in England and Singapore than in any of the other countries.

4.3 Students' reports: *small-group and project work in mathematics*

Students were asked about teaching and learning approaches involving small-group and/or project work (Table 4.3). These approaches were not used frequently in mathematics lessons in England. About a third of the Year 9 students in England said that they *worked in pairs or small groups almost always* or *quite often* in their mathematics lessons or when starting a new topic. A similar proportion said they *almost always* or *quite often* worked on *mathematics projects*.

Comparisons with other countries

According to the students, *working in small groups* was *more frequent* in England than in all but one (United States) of the other ten countries selected for comparison (although, as noted above, it was not used very frequently in England); *project work* was also *more frequent* in England than in all but one (Hungary) of the other ten countries.

Table 4.3 Comparisons between 11 countries: *percentages of Year 9 students agreeing that they almost always or quite often in their mathematics lessons (a) worked in small groups; and (b) did mathematics projects*

COUNTRY	*Mean mathematics score*	Almost always or quite often	
		Small groups %	Projects %
Singapore	*643*	16	5
Japan	*605*	14	8
Switzerland	*545*	24	21
France	*538*	9	26
Hungary	*537*	8	52
Canada	*527*	30	23
Sweden	*519*	23	32
Germany	*509*	18	15
England	***506***	**32**	**37**
United States	*500*	42	27
Scotland	*498*	23	19

Source: analyses provided by the TIMSS International Study Center

4.4 Students' reports: *use of textbooks and copying from the board in mathematics*

Nearly 60 per cent of the Year 9 students in England said that they *almost always* worked from *work cards or textbooks* on their own in their mathematics lessons, and nearly a third said that they did so *quite often*. *Textbooks, worksheets or work cards* were also used quite frequently to aid the introduction of new topics: more than three-quarters of the students said that this type of approach, with or without the teacher talking about the topic, was used *almost always or quite often*.

Copying notes from the board was used less frequently: a quarter of the Year 9 students in England said that they *almost always* copied notes from the board in their mathematics lessons and a further 39 per cent said that they did so *quite often*.

Table 4.4 **Comparisons between 11 countries: *percentages of Year 9 students agreeing that they almost always (a) copied notes from the board; and (b) used textbooks or work cards in their mathematics lessons***

COUNTRY	*Mean mathematics score*	Almost always	
		Copy notes from the board %	Work on own from textbooks or work cards %
Singapore	*643*	27	28
Japan	*605*	74	9
Switzerland	*545*	16	33
France	*538*	55	18
Hungary	*537*	41	21
Canada	*527*	26	61
Sweden	*519*	12	64
Germany	*509*	37	17
England	***506***	**25**	**57**
United States	*500*	43	58
Scotland	*498*	27	70

Source: analyses provided by the TIMSS International Study Center

Full details of the responses of students in England are given in Tables A4.1 and A4.2 in Annex A.

Comparisons with other countries

Analyses of the students' responses suggest that *copying notes from the board* was *relatively infrequent* in Singapore, the highest-scoring country, but *relatively frequent* in Japan, another high-scoring country. It was *relatively infrequent* in England (Table 4.4).

Students in the four English-speaking countries said *they worked on their own from work cards and textbooks* in mathematics lessons *more frequently* than students in about half of the other countries selected for comparison. Across countries there was a slight negative association between the extent to which students worked on their own from textbooks and work cards and students' mean mathematics score.

4.5 Students' reports: *use of things from everyday life in mathematics*

Two of the approaches presented to the students involved the use of things from everyday life in order to help students understand mathematics topics or problems.

Just over half of the Year 9 students said that they discussed a practical problem related to everyday life when solving mathematics problems in their mathematics lessons *almost always* or *quite often*. Within England, the association between mathematics achievement and the use of things from everyday life when solving mathematics problems was weak and non-linear (Table A4.1 in Annex A).

Just over 60 per cent said that the class discussed practical problems related to everyday life *almost always* or *quite often* when starting a new topic in mathematics (Table A4.2 in Annex A) and nearly 30 per cent used it *once in a while*. Year 9 students whose teachers used this approach *once in a while* tended to achieve slightly higher mathematics scores than those whose teachers used this approach more or less frequently.

Table 4.5 Comparisons between 11 countries: *percentages of Year 9 students agreeing that they quite often/almost always used things from everyday life in solving problems in their mathematics lessons*

COUNTRY	*Mean mathematics score*	Almost always or quite often
		Using things from everyday life to solve problems %
Singapore	*643*	40
Japan	*605*	18
Switzerland	*545*	32
France	*538*	38
Hungary	*537*	24
Canada	*527*	51
Sweden	*519*	30
Germany	*509*	29
England	***506***	**53**
United States	*500*	52
Scotland	*498*	48

Source: Beaton et al., 1996b

Comparisons with other countries

As Table 4.5 shows, using *things from everyday life* to solve problems in their mathematics lesson was a technique used *more frequently* in the English-speaking countries (England, Scotland, Canada and the United States) than in any of the other countries.

There was some variation in practice amongst the five highest-achieving countries (those in the top half of Table 4.5); *things from everyday life* were used *more frequently* in Singapore than in the other countries and *least frequently* in Japan. However, teachers in all five countries used this approach less frequently than in England.

4.6. Students' reports: *use of calculators and computers in mathematics*

Students were asked to indicate approximately how frequently they used calculators in their mathematics lessons. Over 90 per cent of the Year 9 students in England said that calculators were used *almost always* or *quite often* in their mathematics lessons (Table 4.6.1).

Within England, students who said they used calculators more frequently in mathematics lessons tended to achieve higher scores on the mathematics tests than those who used calculators less frequently (i.e. there was a *weak positive association* between mathematics achievement and the frequency of using calculators (Table 4.6.1).

Table 4.6.1 Year 9 students' reports: *frequency of using calculators in mathematics lessons*

ACTIVITY	Almost always	Quite often	Once in a while	Never
We use calculators	45%	46%	9%	0%
Mean mathematics score	*517*	*507*	*467*	–

About 90 per cent of the Year 9 students in England and Scotland indicated that they had a computer at home (Beaton *et al.*, 1996a). However, it is possible that this is an overestimate since about 60 per cent of the households with dependent children aged 5-16 had a home computer in 1992 (Great Britain. Central Statistical Office, 1994). Some students who did not have a computer at home may have mis-classified a computer games machine as a computer.

Students were asked to indicate how frequently they used computers in their mathematics lessons (Table A4.1 in Annex A). Computers were used *at least once in a while* in mathematics classes by about 55 per cent of the Year 9 students in England, although the proportion using them frequently (*almost always* or *quite often*) was only about ten per cent. Students in England who used computers in mathematics lessons appeared to enjoy doing so (Table A4.5 in Annex A).

In England, computers appeared to be used more frequently with lower-achieving students: the ten per cent of Year 9 students who used computers *almost always or quite often* in their mathematics lessons tended to have lower mean mathematics scores than those who used computers *once in a while or never* (Table A4.1 in Annex A). Possibly this is because of the relatively widespread availability of specially designed software for low attainers in mathematics.

Table 4.6.2 Comparisons between 11 countries: *percentages of students agreeing that, in their mathematics lessons, they (a) almost always or quite often used calculators; (b) used computers at least once in a while.*

COUNTRY	*Mean mathematics score*	Almost always or quite often	At least once in a while
		Calculators used %	Computers used %
Singapore	*643*	83	10
Japan	*605*	3	23
Switzerland	*545*	32	18
France	*538*	70	12
Hungary	*537*	41	8
Canada	*527*	71	18
Sweden	*519*	54	39
Germany	*509*	55	16
England	***506***	**91**	**55**
United States	*500*	70	31
Scotland	*498*	81	46

Source: Beaton et al., 1996b

Comparisons with other countries

Previous research (Foxman, 1992) has shown that the use of calculators in mathematics is more widespread, and begins at an earlier stage, in England than in most other countries. The results of TIMSS (Table 4.6.2) confirm the earlier research: calculators were used *more frequently* in mathematics lessons in England than in any of the other ten countries.

The use of calculators has been put forward as one of the reasons for children in England performing badly in mathematics (Reynolds and Farrell, 1996). In this regard, it is important to note that calculators were used *fairly frequently* in Singapore, the highest-scoring country, and in France, which also did well in the mathematics tests.

Computers were used *more frequently* in mathematics lessons in England than in any of the other ten countries selected for comparison (Table 4.6.2). However, even in England the use of computers was infrequent, with only ten per cent of the Year 9 students reporting using them *almost always or quite often* in their mathematics lessons (Table A4.1 in Annex A).

4.7 Students' reports: *homework in mathematics*

The students were asked a number of questions about mathematics homework. Their responses (Tables A4.1 and A4.3 in Annex A and Table 4.7.1 below) reveal that:

- Over 90 per cent of the Year 9 students in England said that their teachers *almost always* or *quite often* gave them mathematics homework.
- Over 60 per cent of the Year 9 students said that they *almost always* or *quite often* discussed their completed homework in class.
- Almost all the Year 9 students said they spent some time each week doing mathematics homework, with the majority spending either less than one hour (44 per cent) or one-to-two hours (46 per cent) each week. The results for Year 8 were similar, although the younger students spent less time than those in Year 9 (Table A4.3 in Annex A).
- Within England, there was a positive association between time spent on mathematics homework and mathematics scores; students who spent a longer time each week on mathematics homework tended to achieve higher scores on the TIMSS tests than those who spent less time.

Table 4.7.1 Year 9 students' responses: *hours per week spent on mathematics homework*

HOURS/WEEK	%	*Mean mathematics score*
no time	4	*438*
less than 1 hour	44	*488*
1-2 hours	46	*530*
3-5 hours	7	*544*

Comparisons with other countries

Students were asked to indicate approximately how frequently they discussed their completed homework in mathematics lessons (Table 4.7.2). Discussion of completed homework in class was approximately as frequent in England as in most of the other ten countries. In two countries (Hungary and the United States) such discussion took place more often than in England, and in one country (Japan) *much less frequently*. It should be noted that teachers in Japan tended to set less mathematics homework, possibly because the majority of their students attended private supplementary classes after school.

Table 4.7.2 Comparisons between 11 countries: *percentages of Year 9 students agreeing that, in their mathematics lessons they almost always or quite often discussed their completed homework in class.*

COUNTRY	*Mean mathematics score*	Almost always or quite often
		Homework discussed in class %
Singapore	*643*	57
Japan	*605*	22
Switzerland	*545*	62
France	*538*	44
Hungary	*537*	71
Canada	*527*	58
Sweden	*519*	40
Germany	*509*	68
England	***506***	**61**
United States	*500*	78
Scotland	*498*	46

Source: analyses provided by the TIMSS International Study Center

4.8 Students' reports: *assessment in mathematics*

Students were asked to indicate how frequently they were given a test in their mathematics lessons. As Table 4.8.1 shows, about half of the Year 9 students in England said that they were given tests *almost always* or *quite often* in their mathematics lessons. However, as noted below, no information is available about the types of test they were given.

Within England, there was no systematic association between the frequency of testing in mathematics classes and students' mean mathematics scores (Table 4.8.1).

Table 4.8.1 Year 9 Students' reports: *frequency of tests in mathematics classes.*

ACTIVITY	Almost always	Quite often	Once in a while/ Never
We have a test	10%	40%	50%
Mean mathematics score	*479*	*511*	*511*

Table 4.8.2 Comparisons between 11 countries: *percentages of Year 9 students agreeing that they quite often/almost always had tests in their mathematics lessons*

COUNTRY	*Mean mathematics score*	Tests almost always or quite often %
Singapore	*643*	73
Japan	*605*	41
Switzerland	*545*	59
France	*538*	71
Hungary	*537*	20
Canada	*527*	72
Sweden	*519*	56
Germany	*509*	34
England	***506***	**50**
United States	*500*	85
Scotland	*498*	37

Source: Beaton et al., 1996b

Comparisons with other countries

As Table 4.8.2 shows, there was a wide range of practice in the countries selected for comparison. England was mid-ranking: compared with England, testing was *more frequent* in four countries (United States, France, Canada and Singapore), about as frequent in three countries and less frequent in four countries (Hungary, Germany, Scotland and Japan). Across countries, there was no association between the frequency of testing in mathematics lessons and students' mean mathematics scores.

In interpreting these results, it is important to remember that no information was available about the types of testing used in different countries. Students in different countries may have interpreted the word *test* differently. Some may be referring to a short test of mental arithmetic, others to a teacher-made written tests, others to standardised multiple choice tests, and so on.

CHAPTER 5

Science Lessons: *Teachers' Perspectives*

Summary of main points

- **Across countries, there were no associations between students' mean science scores and the extent to which teachers emphasised the following approaches:**
  - **students working together as a class with the teacher teaching the whole class**
  - **students working individually**
  - **teachers setting reasoning tasks.**
- **Comparisons indicate that the following practices and activities were *more frequent* in science classes in England than in most of the other countries:**
  - **students working in pairs or small groups**
  - **teachers setting reasoning tasks**
  - **teachers setting science homework.**
- **Whole class teaching in science in England was:**
  - **less frequent than in most of the other countries selected for comparison**
  - **about as frequent as in Canada**
  - **slightly more frequent than in Scotland.**
- **Working as a class with the students responding to each other was used infrequently in all 11 of the selected countries.**

5.1 Preface

The purpose of this chapter is to provide information on the teaching approaches and learning activities associated with high achievement in science. It focuses on the questionnaire responses of science teachers in England and ten other countries. The results will be examined in order to answer three key questions:

- Which teaching approaches were used most frequently in science lessons in England?
- Across countries, were there any associations between particular teaching approaches or activities and students' mean science scores?
- Were there any common factors or patterns within the high-scoring countries which differentiated their teaching approaches from those used in England?

In order to answer these questions, the chapter will describe the responses of science teachers in England to a range of questions concerned with teaching approaches and compare their responses with those of teachers in the ten other countries.

In most of the questions reported in this chapter, teachers were asked to respond using a four-point scale, such as: *never/almost never; some lessons; most lessons; every lesson.* In most cases their responses have been reported in terms of the combined percentage opting for *most/every lesson(s).*

The teachers were not asked about the use of practical activities or laboratory work. This issue was, however, covered in the questionnaire for students described in Chapter 6.

In interpreting the results described in this chapter, it should be remembered that, as in the previous chapter, the science teachers who participated in the study were not a true random sample of science teachers but teachers of probability samples of students; this chapter, therefore, describes the teacher characteristics experienced by a probability sample of students. As in Chapter 3, the teachers' responses have been weighted to take account of the number of tested students taught by each teacher (see Chapter 3, Section 3.1 for a fuller explanation).

5.2 Science teachers' reports: *classroom organisation*

Science teachers were asked to indicate how frequently they used each of the types of classroom organisation shown in Table 5.2. They were asked to respond in terms of a scale: *every lesson; most lessons; some lessons; never or almost never.* They were not asked about the proportion of each lesson for which they used each type of classroom organisation.

Table 5.2 shows the teachers' responses on the most frequent ways students were grouped for science in the 11 countries. In England, the three most frequent methods were:

- working together as a class with the teacher teaching the whole class
- working in pairs or small groups with assistance from the teacher
- working individually with assistance from the teacher.

Full details of the responses of science teachers in England are given in Table A5.1 in Annex A.

Table 5.2 Comparisons between nine countries: *teachers' reports on how the students were grouped in class for most/every lesson(s) in science in international eighth grade (Year 9 in England)*

COUNTRY	*Mean science score*	Work together as a class		Work individually		Work in pairs or small groups	
		with students responding to each other %	with the teacher teaching the whole class %	with assistance from the teacher %	without assistance from the teacher %	with assistance from the teacher %	without assistance from the teacher %
Singapore	*607*	12	59	41	17	40	19
Japan	*571*	19	79	12	8	12	6
Hungary	*554*	7	80	54	13	11	2
England	***552***	**15**	**45**	**30**	**14**	**41**	**18**
Canada	*531*	17	28	26	23	33	24
Germany	*531*	30	69	28	7	19	5
Switzerland	*522*	3	56	21	6	30	8
Scotland	*519*	7	22	27	11	56	19
France	*498*	16	57	34	16	27	12

Raw percentages do not sum to 100 since teachers could use more than one approach in most of their lessons.

Source: Figure 5.3, Beaton et al.(1996a) and additional national analyses

Comparisons with other countries

There was a wide range of practice in the nine countries for which information was available. Across countries, there were no systematic associations between the teaching approaches used and students' mean science scores (Table 5.2).

- Working in pairs or small groups with the assistance of the teacher was most frequent in Scotland, England and Singapore. This accords with the students' responses described in Chapter 6; students in these three countries were more likely to report doing experiments in science.
- Working as a class with the teacher teaching the whole class was most frequent in Japan and Hungary and least frequent in Scotland and Canada. England was mid-ranking in this regard.
- Working as a class with the students responding to each other was used infrequently in all 11 of the selected countries.

5.3 Science teachers' reports: *developing students' skills*

Science teachers were asked how frequently they asked their students to practise different skills in science lessons. The responses of science teachers in England are shown in Table A5.2 in Annex A.

In the international report (Beaton *et al.*, 1996b) a composite measure was derived from teachers' most frequent response for:

- explaining the reasoning behind an idea
- representing and analysing relationships using tables, charts or graphs
- working on problems for which there was no obvious method of solution
- writing explanations about what was observed and why it happened
- putting events or objects in order and giving a reason for the order.

It is not possible to make direct comparisons between the responses of mathematics and science teachers, since the international composite variable for mathematics included a slightly different set of statements.

Comparisons with other countries

Table 5.3 compares the responses of teachers in eight of the 11 countries (those which normally provided integrated science courses) on this composite measure concerned with the frequency of reasoning tasks. In all eight countries, three-quarters or more of the students were asked to do

reasoning tasks in most/every science lesson. However, according to their science teachers, students in England were more likely than those in most other countries to be given reasoning tasks in science lessons. Across countries, there was no systematic association between the extent to which teachers asked students to do reasoning tasks and students' mean science scores.

Table 5.3 Comparisons between eight countries: *teachers' reports of the proportion of Year 9 students asked to do reasoning tasks most/every lesson(s)*

COUNTRY	*Mean science score*	Students do reasoning tasks in most/every lesson(s) %
Singapore	*607*	73
Japan	*571*	83
Hungary	*554*	96
England	***552***	**89**
Canada	*531*	87
Germany	*531*	76
Switzerland	*522*	81
France	*498*	77

Source: Beaton et al., 1996a

5.4 Science teachers' reports: *use of textbooks*

Virtually all (96 per cent) of the science teachers in England used textbooks or published schemes to some extent with their Year 9 students (Table A5.3 in Annex A). A wide variety of textbooks was used, only four of which were used by more than ten per cent of the students.

Science teachers were asked to estimate the percentage of teaching time they based on textbooks or schemes of work; 48 per cent of the science teachers of Year 9 students in England based a quarter or less of their teaching time on a textbook or scheme; 17 per cent between a quarter and a half; 15 per cent between half and three-quarters; and 20 per cent more than three-quarters of their teaching time (Table A5.4 in Annex A). The responses from teachers of Year 8 were similar.

Comparisons with other countries.

As in England, textbooks were used by the majority of teachers in most of the other ten countries (Beaton *et al.*, 1996a).

5.5 Science teachers' reports: *use of calculators and computers*

Calculators were not used widely in Year 9 science classes in England or in equivalent classes in any of the other countries taking part in TIMSS (Beaton *et al.*, 1996a). Possibly, this reflects the fact that the science curriculum at this level does not normally require students to perform a large number of mathematical calculations.

The frequency with which calculators were used for different tasks in England is given below in terms of the proportion of students using calculators for each purpose *once or twice a week or more*:

- routine computation (30 per cent)
- checking answers (28 per cent)
- solving complex problems (13 per cent)
- tests and exams (12 per cent)
- developing number concepts (9 per cent).

Full details of the responses of science teachers in England are given in Tables A5.5 in Annex A.

Computers were used infrequently in science lessons in England: 30 per cent of teachers said they used computers *once in a while*; none used computers more frequently. Computers were used even less frequently in science lessons in most other countries (Beaton *et al.*, 1996a).

5.6 Science teachers' reports: *homework*

In the questionnaire, science teachers were asked a number of other questions relating to homework, including how often they set homework; the amount of homework they set each time; how often they gave students feedback on homework; and how often they followed up written homework with class discussion (Tables A5.6, A5.7 and A5.9 in Annex A). Within England, all these measures were found to be positively associated with students' science scores, although none of the individual associations was very strong

Nearly 90 per cent of the teachers in England set their Year 9 students science homework *once or twice a week*; two-thirds said they set their students up to 30 minutes of homework each time; and about one-third set more than this.

The most frequent types of tasks set for homework in England are shown in Table A5.8 in Annex A. These were:

- writing definitions or other short writing assignments
- problems set in the textbook
- a worksheet or workbook
- small investigations or gathering data
- finding one or more uses for the content covered.

Table 5.6 Comparisons between nine countries: *teachers' reports on the frequency with which they set homework to the Year 9 students*

COUNTRY	*Mean science score*	Never %	Less than once a week %	Once or twice a week %	Three times a week or more %
Singapore	*607*	0	17	77	6
Japan	*571*	10	69	17	4
Hungary	*554*	2	28	22	48
England	***552***	**0**	**12**	**86**	**2**
Canada	*531*	4	20	55	20
Germany	*531*	3	41	43	12
Switzerland	*522*	4	46	41	9
Scotland	*519*	2	66	32	0
France	*498*	2	34	60	5

Source: Beaton et al., 1996a

Comparisons with other countries

According to the teachers, students in England were given science homework more often than those in many of the other selected countries (Table 5.6). Only in Hungary and, possibly, Canada did teachers give students science homework slightly more frequently than in England. Science homework was given about as frequently in Singapore as in England.

CHAPTER 6

Science Lessons: *Students' Perspectives*

Summary of main points

- **Comparisons between responses of students in the seven selected countries which offered integrated science courses revealed a diversity of practice. There were few clear patterns differentiating practices in the higher-scoring countries, such as England, from those in lower-scoring countries with regard to the frequency with which students said their teachers used the following teaching approaches:**
  - **teachers showing students how to do science problems**
  - **teachers beginning a new topic by explaining the rules and definitions**
  - **students being given tests in science lessons**
  - **completed homework being discussed in class**
  - **students copying notes from the board**
  - **students working from work cards or textbooks on their own.**
- **Comparisons suggest that the following activities were most frequent in science classes in England and, to a slightly lesser extent, in the other English-speaking countries:**
  - **students doing experiments or practical investigations**
  - **students working in pairs or small groups**
  - **students doing science projects**
  - **students using things from everyday life to solve science problems.**
- **Practical activities tended to be more frequent in countries providing integrated science courses at Year 9 or equivalent levels than in those teaching the science subjects separately.**

6.1 Preface

The purpose of this chapter is to provide further evidence on the teaching approaches and learning activities associated with high achievement in science. It draws upon the students' responses to the questionnaire in order to supplement the teachers' reports described in Chapter 5. In this chapter:

- The students' perceptions of their science lessons are described.
- The responses of students in England are compared with those of their counterparts in six of the ten other countries. The other four countries (France, Germany, Sweden and Hungary) did not offer integrated science courses for students in the grades equivalent to Year 9 in England.

Topics covered in this chapter include explaining and questioning, experiments and practical investigations, small-group and project work, the use of work cards or textbooks, calculators and computers, homework and assessment. Main sources of information were the students' responses to two questions: one focusing on the range of teaching approaches and activities they experienced in their science lessons; and the other on the approaches used by their teachers when introducing new topics. For both questions, students were asked to estimate how often each of a list of teaching approaches or activities took place in their science classes, using a four-point scale: *almost always; quite often; once in a while;* and *never.*

In most cases, comparisons between the responses of students in different countries have been made in terms of the combined percentages responding *almost always* and *quite often.* It should be remembered that the information provided in this chapter is based on students' perceptions of the activities which took place in their science lessons, and that it provides a broad brush picture of school science lessons in England and elsewhere. It should also be remembered that students in different countries may have interpreted some of the questions in different ways.

6.2 Students' reports: *explaining in science lessons*

The students were asked about teaching approaches involving explaining on the part of the teacher (Table A6.1 and A6.2 in Annex A).

- Just over 40 per cent of the Year 9 students in England said that their teacher *almost always* showed them how to do science problems in their science lessons and a further 45 per cent said that this was done *quite often.*

- By far the most frequent approach used by teachers in England when introducing new topics in science was: explaining the rules and definitions (just over 60 per cent of the students said that their teachers *almost always* used this approach).

Comparisons with other countries

Comparisons amongst the seven countries revealed a diversity of practice (Table 6.2). There were no clear patterns differentiating teaching practices in higher-scoring countries such as England from those in lower-scoring countries.

- Showing students how to do problems was *most frequent* in England and Scotland and *least frequent* in Switzerland. However, in interpreting these results, it is important to remember that students in different countries may have interpreted the term *science problems* in different ways.

- Explaining the rules and definitions when introducing a new topic was *most frequent* in England and Singapore and *least frequent* in Switzerland.

Table 6.2 Comparisons between seven countries: percentages of Year 9 students agreeing that their teachers almost always: *(a) showed them how to do science problems in their science lessons; and (b) explained rules and definitions when introducing a new topic*

COUNTRY	*Mean science score*	Almost always	
		In lessons teacher shows how to do problems %	New topic: teacher explains rules and definitions %
Singapore	*607*	32	61
Japan	*571*	28	46
England	***552***	**41**	**61**
United States	*534*	36	49
Canada	*531*	34	54
Switzerland	*522*	19	25
Scotland	*517*	41	—

Source: analyses provided by the TIMSS International Study Center

6.3 Students' reports: *experiments and practical investigations in science*

Over 90 per cent of the Year 9 students in England said that they did experiments or practical investigations *almost always/quite often* in their science lessons. The responses of Year 8 students were similar. Full details of the students' responses are given in Table A6.1 in Annex A.

Comparisons with other countries

Practical work has long been a feature of science lessons in England, and previous studies (Postlethwaite and Wiley, 1992) have shown that students in England spend more time on practical activities than those in most other countries. The results of TIMSS confirm the findings of this earlier research.

Table 6.3 Comparisons between seven countries: *percentages of Year 9 students agreeing that, in their science lessons, they almost always or quite often did experiments.*

COUNTRY	*Mean science score*	Almost always or quite often	
		Students do experiments %	Teacher gives a demonstration %
Singapore	*607*	85	86
Japan	*571*	77	66
England	***552***	**91**	**90**
United States	*534*	62	68
Canada	*531*	70	73
Switzerland	*522*	35	51
Scotland	*517*	87	89

Table 6.3 shows the responses of students in seven countries which offered integrated science courses for students in grades equivalent to Year 9:

- Students in England did experiments or practical investigations *more frequently* than students in any of the other countries selected for comparison. Their teachers were also more likely to demonstrate experiments.
- Furthermore, both practical activities and teacher demonstrations were *more frequent* in England than in any of the other countries taking part in TIMSS (Beaton *et al.*, 1996a).
- In general, practical activities were *more frequent* in countries providing integrated science courses than in those providing separate courses in the various science subjects (Beaton *et al.*, 1996a).

6.4 Students' reports: *small-group and project work in science*

Students were asked about teaching and learning approaches involving small-group and/or project work.

- Eighty-five per cent of the Year 9 students in England said that they worked in pairs or small groups *almost always* or *quite often* in their science lessons.
- About 55 per cent said they *almost always* or *quite often* worked on science projects.

Full details of the responses of students in England are given in Table A6.1 in Annex A.

Comparisons with other countries

Practical investigations in science are frequently carried out in pairs or small groups, so it is scarcely surprising that students in England and Scotland, who did more practical work, were *more likely* to say that they worked in pairs or small groups than those in other countries. Working in pairs or small groups was also *quite frequent* in the two other English-speaking countries (Table 6.4).

Project work was also *most frequent* in the four English-speaking countries; it was *least frequent* in Singapore and Japan (high-scoring countries) and in Switzerland (a relatively low-scoring country).

Table 6.4 Comparisons between seven countries: *percentages of Year 9 students agreeing that they worked in small groups almost always or quite often in their science lessons*

COUNTRY	*Mean science score*	Almost always or quite often	
		Small groups %	Projects %
Singapore	*607*	51	21
Japan	*571*	36	28
England	***552***	**85**	**55**
United States	*534*	65	61
Canada	*531*	67	62
Switzerland	*522*	45	37
Scotland	*517*	87	44

Source: analyses provided by the TIMSS International Study Center

6.5 Students' reports: *use of textbooks or work cards and copying from the board in science*

Analyses of the students' responses revealed that:

- Only about 15 per cent of the Year 9 students in England said that they *almost always* worked from work cards or textbooks on their own in their science lessons and about a third said that they did so *quite often*.
- Textbooks or work cards were used quite frequently to aid the introduction of new topics: over half the students said that this type of approach was used *almost always/quite often* when they started a new topic.
- Nearly half of the Year 9 students in England said that they *almost always* copied notes from the board in their science lessons and a further 43 per cent said that they did so *quite often*.

Full details of the responses of students in England are given in Tables A6.1 and A6.2 in Annex A.

Table 6.5 Comparisons between seven countries: *percentages of Year 9 students agreeing that they almost always (a) copied notes from the board; and (b) used textbooks or work cards in their science lessons*

COUNTRY	*Mean science score*	Almost always	
		Copy notes from the board %	Work on own from work cards or textbooks %
Singapore	*607*	39	26
Japan	*571*	80	5
England	***552***	**47**	**15**
United States	*534*	45	45
Canada	*531*	46	32
Switzerland	*522*	23	15
Scotland	*517*	34	45

Source: analyses provided by the TIMSS International Study Center

Comparisons with other countries

Copying notes from the board was *moderately frequent* in science lessons in England, the United States and Canada (Table 6.5). In Singapore, the highest-scoring country, this activity was *less frequent* than in England, whereas in Japan, another high-scoring country, it was *more frequent*.

Students in England worked on their own from work cards and textbooks in science lessons *less frequently* than students in most of the countries for which information was available. This practice was least frequent in Japan. Working from work cards or textbooks was *most frequent* in science classes in the United States and Scotland, two relatively low-scoring countries.

6.6 Students' reports: *use of things from everyday life in science*

Two of the approaches presented to the students involved the use of things from everyday life in order to help students understand science topics or problems. About half of the students in England said that they used things from everyday life when solving science problems in their science lessons *almost always* or *quite often*. (Table 6.6). About 70 per cent said that they discussed a practical problem relating to everyday life *almost always* or *quite often* when starting a new topic in science (Table A6.2 in Annex A).

Table 6.6 Comparisons between seven countries: *percentages of Year 9 students agreeing that they quite often/almost always used things from everyday life in solving problems in their science lessons*

COUNTRY	*Mean science score*	Almost always or quite often
		Using things from everyday life to solve problems %
Singapore	*607*	59
Japan	*571*	23
England	***552***	**51**
United States	*534*	51
Canada	*531*	52
Switzerland	*522*	40
Scotland	*517*	57

Source: Beaton et al., 1996b

Comparisons with other countries

As Table 6.6 shows, using things from everyday life to solve problems in their science lesson was a technique used *more frequently* in Singapore and the English-speaking countries than in either Japan or Switzerland. This is quite similar to the pattern found for mathematics.

6.7 Students' reports: *use of calculators and computers in science*

Calculators were not used extensively in science lessons in England: very few (about 15 per cent) of the Year 9 students in England said that they used calculators *almost always* or *quite often* in their science lessons (Table A6.1 in Annex A).

Computers were used infrequently in science lessons in England: about 31 per cent of the students used them *once in a while* but the proportion using them frequently (*almost always* or *quite often*) was only five per cent. Students who used computers in science lessons appeared to enjoy doing so (Table A6.5 in Annex A).

Comparisons with other countries

Computers were used slightly *more frequently* in science lessons in England, Scotland and the United States than in most of the other countries taking part in TIMSS (Beaton *et al.*, 1996a). However, it is important to note that this is only relative since computers were not used frequently in science lessons in any country.

6.8 Students' reports: *homework in science*

The students' responses (Table A6.1 in Annex A and 6.8.1 below) reveal that:

- About 90 per cent of the students in England said that their teachers *almost always* or *quite often* gave them science homework.
- Almost all the Year 9 students said they spent some time each week doing science homework, with the majority spending either less than one hour (46 per cent) or one-to-two hours (42 per cent) each week. The results for Year 8 were similar, although the younger students spent slightly less time (Table A6.3 in Annex A).
- Half of the students said that they *almost always* or *quite often* discussed their completed homework in class.

Table 6.8.1 Year 9 students' responses: *hours per week spent on science homework*

HOURS/WEEK	%	*Mean science score*
no time	5	500
less than one hour	46	535
1-2 hours	42	577
3 hours or more	8	587

Within England, there was a positive systematic association between students' scores on the science test and:

- time spent by students on science homework (Table 6.8.1)
- the frequency with which homework was set by science teachers (Table A6.4 in Annex A).

However, neither association was very strong.

Table 6.8.2 Comparisons between six countries: *percentages of Year 9 students agreeing that, in their science lessons, they almost always or quite often discussed their completed homework in class.*

COUNTRY	*Mean science score*	Almost always or quite often
		Homework discussed in class %
Singapore	*607*	62
Japan	*571*	12
England	***552***	**50**
United States	*534*	63
Canada	*531*	56
Switzerland	*522*	45

Source: analyses provided by the TIMSS International Study Center

Comparisons with other countries

According to the students, discussion of completed homework in class was approximately as frequent in England as in most of the other countries (Table 6.8.2). In Japan such discussion took place *much less frequently*. Across countries, there was no association between the extent to which students' completed homework was discussed in class and students' mean science score.

6.9 Students' reports: *assessment in science*

As Table 6.9.1 shows, about half of the Year 9 students in England said that they were given tests *almost always* or *quite often* in their science lessons. Across countries, there was no association between frequency of testing in science classes and students' mean science score.

Table 6.9.1 Year 9 students' reports: *frequency of tests in science classes*

ACTIVITY	Almost always	Quite often	Once in a while	Never
We have a test	10%	44%	45%	1%
Mean science score	*511*	*556*	*563*	–

Comparisons with other countries

As Table 6.9.2 shows, there was a range of practice in the seven countries. England was mid-ranking: compared with England, testing was more frequent in the United States and Singapore and less frequent in Japan. Across countries, there was no association between frequency of testing in science lessons and students' mean science score. In interpreting these results, it is important to remember that no information was available from the students about the types of testing they were given.

Table 6.9.2 Comparisons between seven countries: *percentages of Year 9 students agreeing that they quite often/almost always had tests in their science lessons*

COUNTRY	*Mean science score*	Tests almost always or quite often %
Singapore	*607*	74
Japan	*571*	32
England	*552*	**54**
United States	*534*	77
Canada	*531*	60
Switzerland	*522*	49
Scotland	*517*	46

Source: Beaton et al., 1996b

CHAPTER 7

Mathematics and Science Teachers: *Background and Attitudes*

Summary of main points

- About 60 per cent of the mathematics and science teachers in England were aged 40 or over. The proportions of older teachers were similar in most of the other selected countries; exceptions were France (for mathematics only) and Germany, both of which had higher proportions of older teachers; and Japan, which had lower proportions of older teachers.
- About 45 per cent of the mathematics teachers and 40 per cent of the science teachers in England were female. The proportions of female teachers of both subjects were higher in Hungary and Singapore but lower in Switzerland Japan.
- About 90 per cent of the teachers teaching mathematics and science to Year 9 students in England were graduates. The proportion of graduates teaching these subjects to Year 8 students was slightly lower.
- The majority of Year 9 mathematics and science teachers in England, Scotland and France spent more than 75 per cent of their time teaching their own subjects (i.e. they were likely to be subject specialists). In the remaining eight countries, students were taught mathematics and science by teachers who taught other subjects for at least 25 per cent of their time.
- Mathematics and science teachers in England were more likely than those in other countries to say they would like to change to another career, given the chance.
- With the exception of those in Hungary, teachers in England were least likely to believe that society appreciated their work.
- When asked about the qualities necessary for students to be good at mathematics, teachers in England were mid-ranking, compared with those in other countries, in terms of the importance they attached to the ability to provide reasons to support their solutions and to remember formulae and procedures.

- **When asked a similar question about the qualities necessary for students to be good at science, teachers in England attached a relatively high level of importance to the ability to provide reasons to support their solutions. Science teachers in England were amongst the least likely to agree that it was important to give students prescriptive and sequential directions for doing science experiments.**
- **Teachers in England were much less likely than teachers in most other countries to believe that the ability to think creatively was necessary to be good at mathematics or science.**
- **Compared with their counterparts in most other countries, teachers in England tended to spend more time marking students' work, more time on administration and less time preparing tests.**

7.1 Preface

The purpose of this chapter is to provide background information on the mathematics and science teachers of the students who took part in the study. The first section of the questionnaire completed by the teachers sought background information, including biographical details and particulars of teachers' subject-related backgrounds, their attitudes towards teaching and mathematics or science and their time spent on activities outside the classroom. Where appropriate, comparisons have been made with teachers in the ten other countries selected for comparison.

7.2 Biographical details

The age distributions of the mathematics and science teachers of the students taking part in the study in England were similar: about 60 per cent of teachers of both subjects were aged 40 or over. Their length of teaching experience matched their age profiles: more than two-thirds had more than ten years' teaching experience. The majority (over 90 per cent) of teachers of both subjects in England were full-time (Tables A7.3 and A7.9 in Annex A). Slightly more of the mathematics teachers were female: 45 per cent compared with about 40 per cent of the science teachers (Tables A7.1 and A7.7 in Annex A).

Table 7.2 Comparisons between 11 countries: *proportions of female mathematics and science teachers teaching Year 9 students*

COUNTRY	*Mean mathematics score*	Female mathematics teachers %	*Mean science score*	Female science teachers %
Singapore	*643*	60	*607*	69
Japan	*605*	28	*571*	20
Switzerland	*545*	13	*522*	14
France	*538*	43	*498*	51
Hungary	*537*	87	*554*	74
Canada	*527*	38	*531*	37
Sweden	*519*	33	*535*	37
Germany	*509*	33	*531*	39
England	***506***	**45**	***552***	**39**
United States	*500*	65	*534*	54
Scotland	*498*	45	*517*	37

Sources: Beaton et al., 1996b, 1996a

Comparisons with other countries

The proportions of teachers aged 40 or more in Germany (over 80 per cent for both subjects) and France (over 70 per cent for mathematics) were higher than in England. The proportions of teachers aged 40 or over in

Japan (about a third for both subjects) were much lower. In the other selected countries, proportions of mathematics and science teachers aged 40 or more ranged from 52 to 67 per cent (Beaton *et al.*, 1996b, 1996a).

The proportions of female mathematics and science teachers varied considerably amongst the 11 countries. England was mid-ranking for both subjects (Table 7.2). The highest proportions of female teachers were in Hungary and the United States (for mathematics) and in Singapore (for science); the lowest were in Japan and Switzerland (both subjects).

7.3 Teachers' educational background

Eighty-six per cent of the mathematics teachers teaching Year 9 students in England were graduates: just over ten per cent with a higher degree (evenly divided between those with and without teacher training); about two-thirds with either a BA/BSc (plus a PGCE) or a BEd; just under ten per cent per cent with a BA/BSc without teacher training. Fourteen per cent were non-graduates (Table A7.1 in Annex A).

The qualifications of the science teachers were similar to those of the mathematics teachers, except that a slightly higher proportion (16 per cent compared with 11 per cent) held higher degrees and a slightly lower proportion (eight per cent compared with 14 per cent) were non-graduates (Table A7.7 in Annex A).

At the time of testing, as well as teaching Year 9, about 90 per cent of the mathematics teachers were teaching mathematics to students in Years 10 and 11; about two-thirds were teaching Years 7 and 8; about a third were teaching Year 12; and a quarter were teaching Year 13 (Table A7.2 in Annex A). The pattern was similar for the science teachers (Table A7.8 in Annex A).

The majority of the teachers teaching mathematics to the Year 9 students in England were mathematics specialists; nearly 70 per cent spent three-quarters or more of their timetabled time teaching mathematics, and a further 21 per cent spent 50 to 75 per cent of their time in this way (Beaton *et al.*, 1996b). The pattern was similar for the science teachers (Beaton *et al.*, 1996a).

Comparisons with other countries

There was a wide range of practice in the ten other countries with regard to the use of specialist mathematics teachers (Beaton *et al.*, 1996b). The majority of teachers in France and Scotland, as in England, tended to spend most of their time teaching mathematics. However, in the other countries, the majority of teachers taught mathematics for less than three-quarters of their time (i.e. they were less likely to be mathematics specialists). The pattern was similar for science (Beaton *et al.*, 1996a).

7.4 Attitudes towards teaching as a career

The questionnaires for mathematics and science teachers included sections focusing on teachers' attitudes towards teaching as a career (Tables A7.4 and A7.10 in Annex A). The results reported below are for teachers of Year 9 students. Those for teachers of Year 8 students were similar.

- The mathematics teachers were *more likely* than those teaching science to say that teaching had been their first choice as a career when beginning their higher education (57 per cent compared with 42 per cent).
- Over 40 per cent of the teachers indicated that they would change to another career if they had the opportunity. Science teachers were *slightly more likely* to wish to change (46 per cent compared with 41 per cent of the mathematics teachers).
- Only about a quarter of the teachers thought that society appreciated their work. The mathematics teachers' responses were *slightly more positive* than those of the science teachers.
- About 70 per cent of the teachers in England said they thought that their students appreciated their work. The mathematics teachers' responses were *slightly more positive* than those of the science teachers.

When asked to rank a randomly presented list of nine occupations in order of social status/prestige, the mathematics and science teachers ranked the occupations in the same order.

equal
- Doctor
- Lawyer

- Senior civil servant
- Accountant
- Engineer
- Secondary school teacher

equal
- Primary school teacher
- Nurse

- Unskilled manual worker

Table 7.4. Year 9 mathematics and science teachers' reports: *views about teaching as a career in England compared with teachers in four other countries*

COUNTRY	Teaching first choice %	Would change to another career %	Believes society appreciates his/her work %	Believes students appreciates his/her work %
MATHEMATICS				
England	**57**	**41**	**27**	**73**
Hungary	88	23	4	85
Germany	87	20	49	79
Canada	69	21	52	85
Switzerland	77	24	84	92
SCIENCE				
England	**43**	**46**	**22**	**67**
Hungary	83	27	8	87
Germany	80	18	39	77
Canada	63	23	44	79
Switzerland	70	29	80	93

Source: analyses provided by the TIMSS International Study Center

These questions were not asked in the other six countries.

Comparisons with other countries

Only four of the other selected countries included this set of questions in the questionnaires for mathematics and science teachers. The majority of mathematics and science teachers in these countries, including England, believed that their students appreciated their work, although the responses of teachers in England were slightly less positive than those of the teachers in the other countries (Table 7.4). Compared with their counterparts in these countries, mathematics and science teachers in England were:

- *less likely* to say that teaching had been their *first choice* of career when beginning higher education
- *more likely* to say that they would change to another career if they had the opportunity
- *less likely* than those in three of the other four countries to believe that society appreciated their work.

Teachers in Hungary were far more negative about this issue; those in Switzerland were the most positive. It is pertinent to note that teaching in Hungary is not a high status profession and that teachers are amongst the lowest paid of government employees (Krolopp and Vari, 1997), whereas in Switzerland the economic status of teachers is said to be excellent (Moser *et al.*, 1997).

7.5 Attitudes towards mathematics and mathematics teaching

The mathematics teachers were presented with a list of six ways of thinking and asked to indicate on a three-point scale (*not important, somewhat important, very important*) the importance of each way of thinking for success in mathematics at school. The responses of Year 9 teachers in England, in terms of the proportions opting for *very important*, are shown in Table 7.5.1. Full details are given in Table A7.5 in Annex A.

Table 7.5.1 Year 9 mathematics teachers' reports: *importance of various attributes for students to be good at mathematics in school*

To be good at mathematics in school how important do you think it is for students to:	Students whose teachers responded 'very important' %
understand mathematical concepts, principles and strategies?	84
think in a sequential and procedural manner?	70
*be able to provide reasons to support their solutions?	68
*remember formulae and procedures?	41
*understand how mathematics is used in the real world?	40
*be able to think creatively?	31

Sources: Beaton et al., 1996b and additional national analyses

** comparisons with other countries available*

The mathematics teachers were also asked to indicate on a four-point scale (*strongly disagree, disagree, agree, strongly agree*) the extent to which they agreed with each of a list of eight statements about mathematics and mathematics teaching. The responses of Year 9 teachers in England are shown in Table 7.5.2. Full details are given in Table A7.6 in Annex A.

Comparisons with other countries

International comparisons were available for the statements marked with a star in Tables 7.5.1 and 7.5.2 (Beaton *et al.*, 1996b). Compared with their counterparts in other countries, mathematics teachers in England were:

- *mid-ranking* in terms of the importance they attached to *providing reasons to support solutions* and *remembering formulae and procedures*
- in the *lowest third* of countries in terms of their ranking of the importance of *understanding how mathematics is used in the real world*

- amongst the *least likely* to agree that *being able to think creatively* was important for being good at mathematics
- mid-ranking in terms of the importance they attached to the four statements in Table 7.5.2 for which published data were available (those marked with a *).

Table 7.5.2 Year 9 mathematics teachers' reports: *views about mathematics and mathematics teaching*

STATEMENT	Students whose teachers responded 'strongly agree/agree' %
*More than one representation (picture, concrete material, symbol set, etc.) should be used in teaching a mathematics topic	95
*Some students have a natural talent for mathematics and others do not	90
Mathematics is primarily a practical and structured guide for addressing real situations	79
*Mathematics is primarily a formal way of representing the real world	63
*If students are having difficulty, an effective approach is to give them more practice by themselves in class	46
Mathematics is primarily an abstract subject	26
Mathematics should be learned as sets of algorithms or rules to cover all possibilities	18
Basic computational skills on the part of the teacher are sufficient for teaching primary school mathematics	18

Sources: Beaton et al., 1996b and additional national analyses

** comparisons with other countries available*

7.6 Attitudes towards science and science teaching

The science teachers were presented with a list of six ways of thinking and asked to indicate on a three-point scale (*not important, somewhat important, very important*) the importance of each way of thinking for success in science at school. Their responses, in terms of the proportions opting for *very important*, are shown in Table 7.6.1. Full details are given in Table A7.11 in Annex A.

Table 7.6.1 Year 9 science teachers' reports: *importance of various attributes for students to be good at science in school*

To be good at science in school, how important do you think it is for students to:	Students whose teachers responded 'very important' %
understand mathematical concepts, principles and strategies?	90
*be able to provide reasons to support their solutions?	85
*think in a sequential and procedural manner?	72
*understand how science is used in the real world?	56
*be able to think creatively?	33
remember formulae and procedures?	27

** comparisons with other countries available*

Sources: Beaton et al., (1996a) and unpublished almanac

The science teachers were also asked to indicate on a four-point scale (*strongly disagree, disagree, agree, strongly agree*) the extent to which they agreed with each of a list of eight statements about science and science teaching. Their responses are shown in Table 7.6.2. Full details are given in Table A7.12 in Annex A.

Table 7.6.2 Year 9 science teachers' reports: *views about science and science teaching*

STATEMENT	Students whose teachers responded 'strongly agree/agree' %
*Science is primarily a practical and structured guide for addressing real situations	84
*Science is primarily a formal way of representing the real world	78
If students get into debates in class about ideas or procedures covering the sciences, it can harm their learning	6
*It is important for teachers to give students prescriptive and sequential directions for doing science experiments	50
Focusing on rules is a bad idea. It gives the impression that the sciences (physics, chemistry, biology and earth science) are a set of procedures to be memorised	47
Students see a science task as the same task when it is represented in two different ways (picture, concrete material, symbol set, etc.)	28
Science is primarily an abstract subject	13

** comparisons with other countries available*

Sources: Beaton et al., 1996a and analyses provided by the TIMSS International Study Center

Comparisons with other countries

International comparisons were available for the statements marked with a star in Tables 7.6.1 and 7.6.2 (Beaton *et al.*, 1996a).

Compared withh their counterparts in other countries, science teachers in England were:

- in the *top third of countries* in terms of the importance they attached to students being able to *provide reasons to support solutions*
- in the *lowest third of countries* in terms of their ranking of the importance of *understanding how science is used in the real world*
- in the *lowest third of countries* in terms of their ratings of the importance of students being able to *think in a sequential and procedural manner*
- amongst the *least likely to agree* that *being able to think creatively* was important for being good at science
- *mid-ranking* in terms of their agreement that science is primarily *a practical and structured guide for addressing real situations* and *a formal way of representing the real world*
- *amongst the least likely* to agree that it is *important to give students prescriptive and sequential directions for doing science experiments.*

7.7 How teachers spend their time

The mathematics and science teachers were asked to indicate approximately how many hours per week, on average, they spent on each of the activities shown in Table 7.7. Their responses were given on a five-point scale (*none, less than one hour, one-to-two hours, three-to-four hours, more than four hours).* Means were calculated from this grouped data for the international report. The mean amount of time spent by teachers of Year 9 students in England, together with the range of means for all the countries taking part in the study, is shown in Table 7.7.

Table 7.7 Year 9 mathematics and science teachers' responses: *average number of hours spent on various school-related activities outside the formal school day.*

ACTIVITY	Mean hours per week spent on various activities			
	Mathematics teachers in England	Range in 39 countries	Science teachers in England	Range in 39 countries
Preparing and marking students' tests or exams	2.1	1.5-4.0	2.0	1.5-3.8
Reading and marking students' other work	3.7	0.7-4.1	3.7	1.0-4.0
Planning lessons by self	2.6	1.8-4.2	2.8	1.8-4.1
Seeing students outside class time (e.g. additional help with work, guidance)	1.4	0.3-2.4	1.4	0.3-2.0
Seeing parents	0.6	0.3-1.2	0.6	0.3-1.1
Professional reading and development activities (e.g. courses, conferences)	0.9	0.5-2.8	0.8	0.5-3.3
Keeping students' records up to date	0.7	0.4-2.0	1.1	0.4-1.5
Administrative tasks including staff meetings (e.g. photocopying, displaying students' work)	2.2	0.6-2.6	2.3	0.7-2.6
*Involvement in school clubs, sports, orchestras, etc.	1.2	N/A	1.2	N/A

Sources: Beaton et al., 1996a, 1996b and additional national analyses.

Mean hours based on: no time=0; less than one hour=0.5; one-to-two hours=1.5; two-to-three hours=2.5; three-to-four hours=3.5; more than four hours=5.

**national question, not asked in other countries*

As Table 7.7 shows, the responses of mathematics and science teachers in England were very similar. Compared with their counterparts in most other countries, teachers in England tend to spend:

- *more time* reading and marking students' work; only teachers in Singapore and Hong Kong (both subjects) and the Russian Federation (mathematics) spent more time on this activity
- more time on administration, such as photocopying and displaying students' work, in common with teachers in about a third of the other countries
- *less time* preparing tests.

Mathematics teachers in England spent, on average, about 1.2 hours a week on activities related to school clubs, sports and orchestras, etc. The pattern of response from science teaches was similar. This question was not asked in other countries.

CHAPTER 8
Students' Background

Summary of main points

- **About 3,600 students took part in the study in England. Approximately half were in Year 8 and half in Year 9. The proportions of boys and girls were about equal.**
- **Within England, there was a positive association between the proxy measure for the educational/cultural level of the home (number of books at home) and students' mathematics and science scores.**
- **The average time spent on homework in all subjects each day by Year 9 students in England was about 1.5 hours.**
- **Within England, there was a positive association between time spent on homework in all subjects and students' mathematics and science scores.**
- **The other out-of-school activities of Year 9 students in England (in order of frequency) were:**
  - **watching television or videos**
  - **socialising with friends**
  - **playing sports**
  - **playing computer games**
  - **reading for pleasure.**
- **Most Year 9 students in England said they spent some time each week helping at home, and more than a third of the Year 9 students said they had a paid job (usually for between one and five hours a week).**
- **Nearly three-quarters of the Year 9 students in England said that they intended to remain in education after the end of Year 11**
- **The responses of the Year 8 students in England were quite similar to those of the Year 9 students.**

8.1 Preface

This chapter draws upon the information collected from students by means of the questionnaire which was completed by all the students taking part in TIMSS. The purpose of this chapter is to describe the responses of the students who took part in the study about themselves, their home background, their out-of-school activities and their aspirations.

The Year 9 students' responses to the background questions are summarised below. In most cases, the results were similar for Year 8. Tables A8.1 to A8.3 in Annex A give full details of the responses of students in Years 8 and 9.

8.2 The students

The majority of the 3,579 students taking part in TIMSS at Population 2 were born in 1981 and 1982. At the time of testing, their ages ranged from 12 years seven months to 14 years six months; about half were in Year 8 and half in Year 9. The proportion of girls was about 47 per cent. Ninety-five per cent were born in the United Kingdom and a similar proportion said they *always* or *almost always* spoke English at home (Table A8.1 in Annex A).

8.3 The students' home background

The students' families

About 87 per cent of the students said that their mothers had been born in the UK. A similar proportion had fathers born in the UK. About three-quarters of the students lived with both parents. Most of the remainder lived with their mothers (Table A8.1 in Annex A). The majority (about 95 per cent) of the students lived in homes containing between two and six people (which might include themselves, their parents, brothers, sisters, other relatives or non-relatives); homes containing four people were the most usual (Table A8.1 in Annex A).

The students were asked to indicate whether either of their parents had attended a college, university or polytechnic after leaving school. As expected from previous studies (for instance, Keys and Fernandes, 1993), a relatively high proportion did not know. In Year 9, for example, approximately one-third of the students said that their parents had continued their education after school, one-third said that they had not and one-third did not know (Table A8.1 in Annex A).

Number of books in the home

The number of books in the home has been used in many previous studies as a proxy measure for the educational/cultural level of the home (Comber and Keeves, 1973; Keys, 1987; Cresswell and Gubb, 1987; Robitaille and

Garden, 1989; and Keys and Fernandes, 1993). A question asking students to indicate the approximate number of books in the home was included in the TIMSS questionnaire (Table 8.3.1) for the same purpose. As in previous studies, there were positive associations between the number of books in the home and the students' mathematics and science scores; students who said there were more books in their homes tended to achieve higher scores than students with fewer books.

Table 8.3.1 Year 9 students' responses: *number of books in the home*

NO. OF BOOKS	%	*Mean mathematics score*	*Mean science score*
0-10 books	6	*431*	*472*
11-25 books	13	*463*	*502*
26-100 books	27	*495*	*536*
101-200 books	23	*518*	*564*
more than 200 books	31	*540*	*596*

Educational aids in the home

Students were asked to indicate which of four educational aids (calculator, computer, study desk/table, and dictionary) they had in their homes. The responses of Year 9 students are shown in Table 8.3.2. The pattern for Year 8 was similar.

This question was included in the student questionnaires in every country taking part in TIMSS. In the international analysis, a composite variable, based on the possession of three of these items (dictionary, study desk/table and computer), was derived. Some 80 per cent of the Year 9 students in England had all three educational aids (Beaton *et al.*,1996a, 1996b). This was higher than in any other country taking part in TIMSS. However, as noted in Chapter 4, the proportions of students in England and Scotland indicating that they had computers in their homes were much higher than in most other countries and did not accord with national statistics. It seems possible that students in England and Scotland who did not have a computer at home may have classified a computer games machine as a computer.

Table 8.3.2 Year 9 students' responses: *possessions in the home*

POSSESSION	*Year 9* %
Calculator	99
Computer	89
Study desk/table	90
Dictionary	98

8.4 Out-of-school activities

Students were asked to indicate approximately how much time they spent on a range of out-of-school activities. For some activities, they were asked to respond in terms of hours a day and in others in terms of hours a week (*no time, less than an hour, one- to-two hours, three-to-five hours, more than five hours*). All the means given in this section have, therefore, been calculated from grouped data. The responses of students in England are given in full in Table A8.2 in Annex A.

Homework

Students were asked how much time they spent *each day* on homework in all subjects. and how much time they spent *each week* doing homework in mathematics and science The responses of Year 9 students in England relating to homework in all subjects are shown in Table 8.4; those of Year 8 students are shown in Table A8.2 in Annex A. Students' responses relating to mathematics and science homework are shown in Chapters 4 and 6, respectively.

Year 9 students in England spent, on average, about 1.5 hours a day doing homework in all subjects. There was a positive association between the length of time spent doing homework in all subjects and students' mathematics and science scores (Table 8.4): students who spent longer each day on homework in all subjects tended to achieve higher mathematics and science scores than those who spent less time.

Table 8.4 Year 9 students' responses: *hours per day spent on homework in all subjects*

	No time	<1 hour	1-2 hours	3- hours or more	Mean* hours per day
Homework (all subjects)	1%	29%	55%	15%	1.5
Mean mathematics score	*430*	*472*	*521*	*538*	—
Mean science score	*475*	*521*	*566*	*584*	—

** mean calculated from grouped data*

Only about five per cent of the Year 9 students said that they spent time going to mathematics and science clubs; in most cases this was for up to two hours a week. About ten per cent of Year 9 students said they received extra lessons in mathematics, and seven per cent in science; in most cases this was for less than an hour a week (Table A8.2 in Annex A). The proportions for Year 8 were slightly higher. Students having extra lessons in mathematics tended to achieve lower scores than those who did not (Table A8.2 in Annex A). A similar pattern was found for science. It is probable that the majority of students receiving extra lessons were those who had difficulties with their normal school work.

Students were also asked about their other out-of-school activities. Mean time spent, in terms of hours per day, has been calculated[1] for each activity. These mean times should not be regarded as additive, since some activities (for example, watching television and socialising with friends) can be carried out concurrently. International comparisons, all of which relate to students in grades equivalent to Year 9, are from Beaton *et al.*, 1996a.

Reading a book for pleasure

About two-thirds of the Year 9 students said that they read a book for fun on most school days; in most cases, students read for less than an hour each day, although a small proportion spent longer (Table A8.2 in Annex A). The pattern was similar for the Year 8 students. The mean time spent reading for pleasure was about 0.7 hours a day. In the 44 other countries taking part in the Survey of 13-year-olds, mean time spent by Year 9 students reading ranged from 0.6 – 1.3 hours a day. The mean time spent by students in England was amongst the lowest.

Watching television and videos

The most widespread out-of-school activity was watching television and videos. Almost all of the Year 9 students said they usually spent some time each school day watching television or videos — nearly 20 per cent for less than an hour; just over a third for one to two hours; just under a third for three to five hours; and about one in ten for more than five hours. The mean time spent was about 2.7 hours a day. Means in the 44 countries ranged from 1.3 – 3.3 hours a day. The mean time spent by students in England was amongst the highest.

Socialising with friends

Another popular activity was socialising with friends. Eighty-eight per cent of the Year 9 students spent some time each day in this way, with about half spending up to two hours; a quarter from three to five hours; and 14 per cent more than five hours each day. The mean time spent was about 2.5 hours per day. Means in the 44 countries ranged from 1.2–3.5 hours a day. The mean time spent by students in England was mid-ranking.

Sports

Many students said they participated regularly in sporting activities. About 80 per cent said they played some sort of sport most days: mean time spent was about 1.5 hours a day. Means in the 44 countries ranged from 0.5 – 2.2 hours a day. The mean time spent by students in England was mid-ranking.

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[1] *Mean times were calculated from grouped data as follows: no time=0; less than one hour=0.5; 1-2 hours=1.5; 3-5 hours=4; more than 5 hours=7.*

Playing computer games

Playing computer games was less popular than watching television, socialising with friends or playing sports. However, just under two-thirds of the Year 9 students spent some time most days playing computer games; these students were approximately evenly divided between those who spent less than an hour a day and those who spent more time. Mean time spent was 0.9 hours a day. Means in the 44 countries ranged from 0.2 – 1.0 hours a day. The mean time spent by students in England was amongst the highest.

Doing jobs at home

The majority of students said they helped regularly with jobs at home. Over 80 per cent of the Year 9 students said they spent some time each day doing jobs at home: the majority of these (about 60 per cent of all the students) spent less than an hour a day. The mean time spent was about 0.8 hours a day. Means in the 44 countries ranged from 0.5 – 2.0 hours a day. The mean time spent by students in England was amongst the lowest.

Paid jobs

A smaller proportion (38 per cent) of the Year 9 students had paid jobs. In most cases, those students with paid jobs worked for one to five hours each week.

8.5 Students' educational aspirations

Nearly three-quarters of the Year 9 students said that they intended to go into the sixth form of their present school or to go to college after completing Year 11; nine per cent said that they intended to get a job and 16 per cent were undecided. About half of those intended to remain in education after Year 11 to go to a university of other further or higher education college; 25 per cent intended to get a job and 18 per cent were undecided (Table A8.3 in Annex 1).

CHAPTER 9
Students' Attitudes to Mathematics and Science

Summary of main points

- On average, students in England held more positive attitudes towards mathematics and science than those in most of the other countries selected for comparison.
- Students in England were more likely to believe they did well in mathematics and science than their counterparts in most of the other countries. In mathematics, this was despite the fact that their scores were, on average, below those of students in many of the countries.
- About 90 per cent of students in England rated hard work highly as an important factor in doing well in mathematics and science. Proportions in the other selected countries ranged from 71 to 96 per cent for mathematics and 75 to 98 per cent for science.
- Less than half of the students in England believed that natural talent was an important factor in doing well in mathematics and science. Interestingly, students in Japan, Singapore and Hungary (three relatively high-scoring countries) rated the importance of natural talent much more highly than students in England.
- Memorising notes was considered to be more important for science than for mathematics (56 per cent of the students in England agreed/ strongly agreed that memorising notes was important for science compared with 49 per cent for mathematics). Similar differences were found in most of the other countries.
- Doing well in mathematics was considered to be more important than doing well in science when it came to getting a job or getting into a desired university or college. This was true for students in England and most of the other countries.
- The majority of students in England indicated that students behaved well in mathematics lessons. This set of questions was not asked about science lessons.

9.1 Preface

The purpose of this chapter is to describe the students' attitudes towards mathematics and science and to identify the attitudinal factors which are most strongly related to achievement in those subjects. It draws upon the questionnaire for students, which contained a number of questions designed to elicit students' attitudes towards mathematics and science.

As in previous chapters, the responses of Year 9 students are described. The responses of students in Years 8 and 9 are shown in Tables A9.1 to A9.12 in Annex A, together with the mean mathematics and science scores, as appropriate, for the groups of students selecting each response.

9.2 Liking for mathematics and science

Mathematics

The majority (80 per cent) of Year 9 students in England said they liked mathematics or liked it a lot (Table A9.1 in Annex A).

For the international study, Beaton *et al.* (1996b) developed a composite scale by summing each student's responses to the following statements in the questionnaire:

- I enjoy learning maths
- Maths is boring (scoring reversed)
- Maths is an easy subject
- Maths is important to everyone's life
- I would like a job that involved using maths.

The summed scores were grouped to provide a four-point scale: *strongly negative, negative, positive* or *strongly positive.*

Comparisons with other countries

As Table 9.2.1 shows, students in England held more positive attitudes towards mathematics than those in all but one of the other countries (Singapore).

Table 9.2.1 Comparisons between 11 countries: *Year 9 students' overall attitudes towards mathematics*

COUNTRY	positive/strongly positive %
England	**82**
Singapore	82
Canada	74
Scotland	74
France	70
United States	70
Switzerland	69
Sweden	65
Hungary	60
Germany	56
Japan	51

Source: Beaton et al., 1996b

Science

The majority (79 per cent) of Year 9 students in England said they liked science or liked it a lot (Table A9.7 in Annex A). International comparisons for science were made in terms of the students' responses to the statement *I like science* in countries where integrated science courses predominate for students in grades equivalent to Year 9 or *I like biological science, etc.* in countries where separate science courses predominate.

Comparisons with other countries

Students in England and Scotland held more positive views about science than those in all but one (Singapore) of the other countries selected for comparison (Table 9.2.2).

Table 9.2.2 Year 9 students' reports: *liking for science*

COUNTRY	Like/like a lot %
Singapore	92
England	**78**
Scotland	78
United States	71
Canada	68
Switzerland	67
France	66* (67; –; 65)
Sweden	63* (61; 66; 63)
Hungary	62* (73; 63; 49)
Japan	56
Germany	55* (65; 55; 49)

Source: Beaton et al., 1996a

** In these countries, science was normally taught at this level as two or three separate subjects. Students' ratings have been averaged over two or three subjects as appropriate.*
The percentages of students in these countries responding 'like/like a lot' for the separate science are given in brackets in the following order: Biological science; Earth science; Physical science.

9.3 Students' perceptions of their ability in mathematics and science

Students in England held very positive perceptions of their ability in mathematics and science: over 90 per cent of the Year 9 students *agreed* or *strongly agreed* that they usually did well in mathematics; the proportion (88 per cent) for science was nearly as high. Full details are given in Tables A9.2 and A9.8 in Annex A.

Comparisons with other countries

Comparisons with the responses of students in other countries (Table 9.3) suggest that students in England were more likely to believe that they usually did well in mathematics and science than those in most other countries.

In the case of science, the perception of students in England is more or less in line with their relative achievement. In mathematics, however, students in England believed they were doing well despite the fact that their scores were, on average, below those of students in many other countries.

Table 9.3 Year 9 students' reports: *self-perceptions about usually doing well in mathematics and science*

COUNTRY	Agree/strongly agree	
	Mathematics %	Science %
England	**93**	**88**
Scotland	88	84
United States	86	86
Canada	84	82
Sweden	82	81* (82; 83; 77)
Switzerland	75	76
Hungary	72	74* (82; 76; 63)
Germany	69	71* (79; 70; 63)
France	68	73* (71; –; 74)
Singapore	57	73
Japan	44	45

Source: Beaton et al., 1996a., 1996b

** In these countries, science was normally taught at this level as two or three separate subjects. Students' ratings have been averaged over two or three subjects as appropriate.*
The percentages of students in these countries responding 'agree/strongly agree' for the separate science are given in brackets in the following order: Biological science; Earth science; Physical science.

Students' perceptions of how well they are doing are likely to be influenced by the marks they are given, positive and negative feedback from the teacher and the amount of praise they receive. They are unlikely to be aware of how their standard of work compares with that of students in other countries. It is possible that teachers in England and the other English-speaking countries have been particularly successful in fostering positive perceptions of their own performance amongst their students.

On the other hand, it is possible that there is a cultural response bias to questions concerning perceptions of ability. There was a strong systematic association between the rank orders of countries in terms of their students' perceptions of how well they did in mathematics and science. Furthermore, the proportions of students in the three other English-speaking countries indicating that they usually did well in mathematics and science were almost as high as in England, whereas students in Japan were much more modest about their achievement in both subjects.

9.4 Attributes necessary to do well in mathematics and science

Students were asked about the attributes they believed were necessary to do well in mathematics and science. The responses of Year 9 students are given in terms of the percentage *agreeing/strongly agreeing* that each of the four options listed was important (Table 9.4).

Table 9.4 Comparisons between ten countries: *Year 9 students' reports on attributes necessary to do well in mathematics*

COUNTRY	Percentage of students responding strongly agree or agree							
	Natural talent		Good luck		Hard work		Memorising notes	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
Hungary	95	88	56	56	79	79	47	57
Singapore	84	86	41	40	92	98	32	87
Japan	82	82	59	60	96	97	92	97
Canada	61	61	26	30	87	89	42	52
Switzerland	60	56	22	25	71	75	36	58
Germany	59	57	25	28	76	82	47	70
United States	50	51	32	34	90	90	59	66
Sweden	48	45	24	26	83	87	33	42
England	**45**	**47**	**23**	**25**	**93**	**93**	**49**	**56**
France	40	38	21	23	90	88	95	95

Source: Beaton et al., 1996a, 1996b

No results were available for Scotland.

Comparisons with other countries

The responses of students in England, and most of the other countries, concerning the importance of *natural talent, good luck* and *hard work* were very similar for both subjects.

Over 90 per cent of students in England rated *hard work* highly as an important factor in doing well in mathematics and science. The importance attached to *hard work* by students in Japan, Singapore, France and the United States was similar to England. Students in the other six countries accorded it slightly less importance.

Students in England were amongst the group of countries in which students gave least importance to *natural talent* and *good luck.* Interestingly, students in Japan, Singapore and Hungary (three high-achieving countries) rated the importance of natural talent much more highly than students in England.

Memorising notes was considered to be more important for science than for mathematics (56 per cent of the students *agreed/strongly agreed* that *memorising notes* was important for science compared with 49 per cent for mathematics). This difference was even more marked in Singapore, where 87 per cent of the students *agreed/strongly agreed* that *memorising notes* was important for science compared with 32 per cent for mathematics. Similar differences were found in most of the other countries.

9.5 Students' reasons for doing well in mathematics and science

Students were presented with a list of reasons for doing well in mathematics and science and asked to indicate how strongly they agreed with the importance of each factor. Their responses are shown in Table 9.5.

Table 9.5 Year 9 students' responses: *reasons for doing well in mathematics and science*

COUNTRY	Percentage of students responding strongly agree or agree			
	Mathematics		Science	
	England %	Range in other 10 countries %	England %	Range in other 10 countries %
To get into the college/ university I want	86	65-96	75	35-89
To get the job I want	80	55-86	62	19-71
To please my parent(s)	63	34-80	63	33-79

Source: Beaton et al., 1996a, 1996b

Comparisons with other countries

For both subjects, the responses of students in England were mid-ranking for all three reasons. Interestingly, students in Japan gave the lowest rating to getting the job they wanted and pleasing their parents but one of the highest ratings to getting into their desired college/university (Beaton *et al.*, 1996a, 1996b).

Students in England, and most other countries, believed that doing well in mathematics was more important than doing well in science when it came to getting a job or getting into a desired university or college.

9.6 Behaviour in mathematics classes

Students were asked three questions about the behaviour of the students in their mathematics classes (Table A9.6 in Annex A). The majority of Year 9 mathematics classes in England appear to have been well-behaved and hard-working.

- Nearly 80 per cent of Year 9 students *agreed/strongly agreed* that the students did what the teacher said.
- Two-thirds *agreed/strongly agreed* that the students were orderly and quiet.
- Nearly two-thirds *disagreed/strongly disagreed* that the students neglected their school work.

On the other hand, a minority of students (between a fifth and a third) responded negatively to these questions.

This set of questions was not asked about science classes.

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APPENDIX I
National Steering Committee

Member	Association
Mark Neale (Chairman, 1993–1995)	Department for Education and Employment
Michael Richardson (Chairman 1995–present)	Department for Education and Employment
Robert Wood	Department for Education and Employment
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Andrew George (1996–present)	Welsh Office Education Department

APPENDIX II
Countries Taking Part in Different Components of TIMSS

Continental Western Europe

			PERFORMANCE ASSESSMENT		
	Population 1	*Population 2*	*Population 1*	*Population 2*	*Population 3*
Austria	●	●			●
Belgium *(Flemish)*		●			
Belgium *(French)*		●			
Cyprus	●	●	●	●	●
Denmark		●		●	●
France		●			●
Germany		●			●
Greece	●	●			●
Iceland	●	●			●
[1]Italy		●			
Netherlands	●	●			●
Norway	●	●	●	●	●
Portugal	●	●	●	●	
Spain		●		●	
Sweden		●			●
Switzerland		●		●	●

English-speaking

Australia	●	●	●	●	●
Canada	●	●	●	●	●
England	●	●		●	
Ireland	●	●			
New Zealand	●	●	●	●	●
Scotland	●	●		●	
United States	●	●	●	●	●

[1] *Argentina, Italy and Indonesia were unable to complete the steps necessary for their data to appear in this report. Because the characteristics of its school sample are not completely known, achievement results for the Philippines are not included in the main tables of the international report. Mexico chose not to release its results for the international report.*

Eastern Europe

			PERFORMANCE ASSESSMENT		
	Population 1	*Population 2*	*Population 1*	*Population 2*	*Population 3*
Bulgaria		●			
Czech Republic	●	●	●	●	●
Hungary	●	●	●	●	●
Latvia	●	●			●
Lithuania		●			●
Romania		●		●	
Russian Federation		●			●
Slovak Republic		●			
Slovenia	●	●		●	●
Ukraine		●			

Asia and Pacific Region

Hong Kong	●	●	●	●	
[1]Indonesia	●	●			
Japan	●	●			
Korea	●	●			
[1]Philippines		●			
Singapore	●	●	●	●	
Thailand	●	●			

Other Countries

[1]Argentina		●			
Colombia		●		●	
Iran	●	●	●	●	
Israel	●	●	●	●	●
Kuwait	●	●			
[1]Mexico	●	●			●
South Africa		●			●

[1] *Argentina, Italy and Indonesia were unable to complete the steps necessary for their data to appear in this report. Because the characteristics of its school sample are not completely known, achievement results for the Philippines are not included in the main tables of the international report. Mexico chose not to release its results for the international report.*

ANNEX A
Additional tables to support the text

Precentages in the tables may not always sum to 100. This is because all percentages have been rounded to the nearest whole number.

Treatment of missing data

For each question they analysed, the TIMSS International Study Center based the percentages of respondents selecting each option on the number of respondents who answered that question. In order to ensure comparability, we have followed the same practice in our national analyses. The proportions of respondents in England who omitted to answer particular questions were very low. Omissions rates, which ranged from zero to 13 per cent, were less than four per cent for the majority of questions in the student, teacher and school questionnaires.

[1] *There was one exception. The omission rates for the questions shown in Table A2.2 were about 25 per cent. This should be taken into account whem interpreting the figures in this table.*

Table A2.1 Responses from schools containing Year 9 students: *background criteria*

CATEGORY	YEAR 9 (international eighth grade)		
	%	*Mean mathematics score*	*Mean science score*
SCHOOL SIZE (NO. OF STUDENTS)			
0 – 300	5	*503*	*559*
301 – 600	16	*498*	*541*
601 – 1000	44	*518*	*563*
> 1000	36	*495*	*543*
NO. OF YEAR 8 STUDENTS			
< 126	26	*524*	*574*
126 – 175	30	*498*	*542*
176 – 200	22	*498*	*546*
201	22	*497*	*542*
NO. OF YEAR 9 STUDENTS			
< 126	26	*526*	*575*
126 – 175	27	*504*	*543*
176 – 200	18	*501*	*543*
201 or more	29	*493*	*544*
NO. OF FULL TIME EQUIVALENT TEACHERS – GROUPED			
0 – 40	25	*496*	*542*
41 – 60	36	*509*	*557*
61 or more	40	*508*	*554*
TYPE OF COMMUNITY			
a geographically isolated area	5	*511*	*560*
village or rural (farm) area	9	*512*	*550*
one on the outskirts of a town/city	55	*509*	*558*
one close to the centre of a town/city	32	*495*	*541*
PERCENTAGE OF STUDENTS ELIGIBLE FOR FREE SCHOOL MEALS			
up to 5%	19	*564*	*611*
6 – 10%	24	*515*	*563*
11 – 15%	15	*512*	*555*
16 – 20%	17	*484*	*531*
21 – 100%	24	*463*	*509*
PERCENTAGE OF STUDENTS NEEDING ENGLISH AS A SECOND LANGUAGE SUPPORT			
up to 2%	77	*509*	*557*
3 – 5%	5	*498*	*522*
6 – 10%	8	*501*	*542*
11 – 100%	10	*486*	*537*
PERCENTAGE OF STUDENTS ABSENT ON A NORMAL SCHOOL DAY			
up to 4%	24	*536*	*587*
5 – 9%	56	*501*	*546*
10 – 100%	20	*471*	*522*
PERCENTAGE OF STUDENTS TRANSFERRING INTO SCHOOL EACH YEAR			
up to 2%	59	*513*	*558*
3 – 5%	25	*492*	*543*
6 – 100%	17	*490*	*534*
PERCENTAGE OF STAFF IN SCHOOL FOR LESS THAN FIVE YEARS			
up to 30%	25	*501*	*538*
31 – 40%	26	*514*	*559*
41 – 50%	23	*519*	*574*
51% or more	26	*488*	*539*
PERCENTAGE OF STUDENTS REMAINING IN SCHOOL FOR WHOLE YEAR			
less than 97%	28	*479*	*524*
98%	33	*514*	*563*
99%	40	*516*	*562*

Table A2.2 Responses from schools containing Year 9 students: *admissions criteria*

ADMISSIONS CRITERIA	YEAR 9 (international eighth grade)		
	%	*Mean mathematics score*	*Mean science score*
RESIDENCE IN AREA			
yes	85	*496*	*542*
no	15	*556*	*604*
ACADEMIC PERFORMANCE			
yes	14	573	*620*
no	86	*494*	*541*
INTERVIEW WITH STUDENT			
yes	17	*538*	586
no	83	499	545
INTERVIEW WITH PARENTS			
yes	18	*515*	*564*
no	82	*503*	*549*
FAMLY MEMBERS AT SCHOOL			
yes	56	*501*	*552*
no	44	*510*	*552*
PRIORITY TO EARLY APPLICANTS			
yes	6	*495*	*557*
no	94	*506*	*551*
TEACHER RECOMMENDATION			
yes	6	*579*	*627*
no	94	*500*	*547*
STUDENTS FROM PARTICULAR SCHOOL			
yes	13	*506*	*555*
no	87	*505*	*551*
FORMER STUDENT'S CHILD			
yes	6	*537*	*582*
no	94	*503*	*550*
STANDARDISED TEST			
yes	9	*571*	*625*
no	91	*498*	*544*
ENTRANCE EXAMINATION			
yes	11	*576*	*624*
no	89	*496*	*543*
ORAL EXAMINATION			
yes	4	*551*	*603*
no	96	*503*	*550*
OTHER			
yes	25	*488*	*538*
no	75	*511*	*557*

Note: The omission rate for these questions was about 25 per cent. This should be taken into account whem interpreting the figures in this table.

Table A2.3 Schools' responses: *extent of learning support for students with learning difficulties in mathematics*

LEARNING SUPPORT	YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*
LEARNING SUPPORT IN MATHS		
yes	93	*501*
no	7	*565*
If yes:		
GROUPS IN NORMAL CLASSES		
yes	64	*494*
no	36	*512*
GROUPS WITHDRAWN FROM CLASSES		
yes	32	*496*
no	68	*503*
EXTRA TUITION BEFORE OR AFTER SCHOOL		
yes	18	*523*
no	82	*495*
OTHER ARRANGEMENTS		
yes	57	*500*
no	44	*502*

Table A2.4 Schools' responses: *extent of enrichment activities for very able students in mathematics*

ENRICHMENT ACTIVITIES	YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*
ENRICHMENT ACTIVITIES IN MATHS		
yes	60	*509*
no	40	*501*
If yes;		
GROUPS IN NORMAL CLASSES		
yes	45	*499*
no	55	*517*
GROUPS WITHDRAWN FROM CLASSES		
yes	12	*548*
no	89	*504*
EXTRA TUITION BEFORE OR AFTER SCHOOL		
yes	54	*503*
no	46	*515*
OTHER ARRANGEMENTS		
yes	33	*546*
no	67	*490*

Table A2.5 Schools' responses: *schools' own written curriculum guide in mathematics*

CURRICICULUM GUIDE	YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*
SCHOOL HAS OWN WRITTEN CURRICULUM CONTENT GUIDE FOR MATHEMATICS		
yes	92	*507*
no	8	*477*

Table A2.6 Schools' responses: *extent of learning support for students with learning difficulties in science*

LEARNING SUPPORT	YEAR 9 (international eighth grade)	
	%	*Mean science score*
LEARNING SUPPORT IN SCIENCE		
yes	83	*544*
no	17	*589*
If yes;		
GROUPS IN NORMAL CLASSES		
yes	61	*531*
no	39	*565*
GROUPS WITHDRAWN FROM CLASSES		
yes	10	*538*
no	90	*545*
EXTRA TUITION BEFORE OR AFTER SCHOOL		
yes	12	*588*
no	88	*538*
GROUPS OTHER ARRANGEMENTS		
yes	59	*544*
no	42	*545*

A2.7 Schools' responses: *extent of enrichment activities for very able students*

ENRICHMENT ACTIVITIES	YEAR 9 (international eighth grade)	
	%	*Mean science score*
ENRICHMENT ACTIVITIES IN SCIENCE		
yes	43	*546*
no	57	*556*
If yes;		
GROUPS IN NORMAL CLASSES		
yes	42	*551*
no	58	*543*
GROUPS WITHDRAWN FROM CLASSES		
yes	6	*573*
no	94	*545*
EXTRA TUITION BEFORE OR AFTER SCHOOL		
yes	45	*542*
no	55	*550*
OTHER ARRANGEMENTS		
yes	42	*558*
no	58	*538*

Table A2.8 Schools' responses: *schools' own written curriculum guide in science*

CURRICICULUM GUIDE	YEAR 9 (international eighth grade)	
	%	*Mean science score*
SCHOOL HAS OWN WRITTEN CURRICULUM CONTENT GUIDE FOR SCIENCE		
yes	90	*555*
no	10	*531*

Table A3.1 Mathematics teachers: *use of textbooks/published schemes*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
yes	99	*477*	100	*515*
no	1	*479*	–	–

Table A3.2 Mathematics teachers: *proportion of teaching based on a textbook*

PROPORTION OF TEACHING BASED ON A TEXTBOOK	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
0–25%	6	*492*	6	*472*
26–50%	15	*479*	11	*507*
51–75%	45	*475*	45	*514*
76–100%	34	*480*	39	*524*

Table A3.3 Mathematics teachers: *proportion of class having access to calculators during mathematics lessons*

PROPORTION OF CLASS	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
almost all	64	*490*	80	*526*
about three quarters	12	*495*	7	*493*
about half	14	*452*	7	*463*
about one quarter	9	*420*	6	*450*
none	1	*465*	–	–

Table A3.4 Mathematics teachers: *how calculators are used*

FREQUENCY OF DIFFERENT USES	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
CHECKING ANSWERS				
almost every day	44	*495*	60	*531*
once or twice a week	30	*475*	26	*496*
once or twice a month	18	*445*	9	*483*
never, or hardly ever	8	*478*	5	*500*
TESTS AND EXAMS				
almost every day	21	*498*	35	*537*
once or twice a week	8	*502*	7	*492*
once or twice a month	53	*477*	54	*506*
never, or hardly ever	17	*447*	4	*474*
ROUTINE COMPUTATION				
almost every day	50	*505*	65	*529*
once or twice a week	30	*447*	31	*492*
once or twice a month	13	*463*	3	*480*
never, or hardly ever	7	*457*	1	*498*
COMPLEX PROBLEMS				
almost every day	31	*494*	45	*540*
once or twice a week	28	*486*	*27*	*511*
once or twice a month	22	*487*	15	*504*
never, or hardly ever	18	*437*	13	*445*
DEVELOPING NUMBER CONCEPTS				
almost every day	16	*492*	30	*534*
once or twice a week	33	*481*	25	*501*
once or twice a month	35	*479*	29	*514*
never, or hardly ever	1	*467*	15	*498*

Table A3.5 Mathematics teachers: *extent of individual, group and whole class teaching*

FREQUENCY OF DIFFERENT APPROACHES TO TEACHING AND LEARNING	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
WORK TOGETHER\TEACHER TEACHES WHOLE CLASS				
never or almost never	8	*453*	2	*511*
some lessons	58	*471*	51	*503*
most lessons	27	*497*	37	*523*
every lesson	7	*505*	10	*555*
WORK TOGETHER\STUDENTS INTERACT WITH EACH OTHER				
never or almost never	21	*473*	18	*530*
some lessons	67	*482*	63	*512*
most lessons	10	*464*	18	*518*
every lesson	2	*498*	1	*493*
INDIVIDUAL WORK\NO ASSISTANCE FROM TEACHER				
never or almost never	27	*469*	23	*504*
some lessons	43	*482*	53	*513*
most lessons	26	*478*	20	*530*
every lesson	5	*498*	5	*534*
INDIVIDUAL WORK\ASSISTANCE FROM TEACHER				
never or almost never	2	*453*	3	*540*
some lessons	41	*479*	40	*518*
most lessons	49	*478*	49	*512*
every lesson	8	*474*	9	*516*
WORK IN GROUPS\NO ASSISTANCE FROM THE TEACHER				
never or almost never	36	*491*	37	*523*
some lessons	56	*474*	55	*512*
most lessons	8	*445*	8	*503*
every lesson	1	*500*	0	–
WORK IN GROUPS\ASSISTANCE FROM THE TEACHER				
never or almost never	13	*504*	11	*542*
some lessons	75	*475*	75	*511*
most lessons	10	*480*	12	*520*
every lesson	2	*433*	2	*499*

Table A3.6 Mathematics teachers: *different approaches used with students*

FREQUENCY WITH WHICH DIFFERENT APPROACHES WERE USED	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
EXPLAIN REASONING BEHIND AN IDEA				
never or almost never	2	*418*	1	*527*
some lessons	41	*475*	34	*519*
most lessons	46	*486*	51	*510*
every lesson	11	*475*	14	*525*
REPRESENT AND ANALYSE RELATIONSHIPS				
never or almost never	2	*515*	2	*468*
some lessons	87	*479*	80	*518*
most lessons	11	*471*	17	*511*
every lesson	0	–	1	*495*
WORK ON PROBLEMS WITH NO OBVIOUS METHOD OF SOLUTION				
never or almost never	16	*458*	17	*501*
some lessons	75	*480*	78	*519*
most lessons	9	*507*	5	*518*
USE COMPUTERS TO SOLVE EXERCISES OR PROBLEMS				
never or almost never	51	*477*	53	*516*
some lessons	48	*482*	45	*514*
most lessons	1	*415*	1	*559*
every lesson	0	–	1	*500*
WRITE EQUATIONS TO REPRESENT RELATIONSHIPS				
never or almost never	7	*393*	6	*474*
some lessons	78	*475*	73	*506*
most lessons	15	*527*	21	*559*
every lesson	1	*526*	0	–
PRACTISE COMPUTATIONAL SKILLS				
never or almost never	6	*507*	7	*539*
some lessons	48	*480*	52	*515*
most lessons	38	*474*	34	*505*
every lesson	8	*472*	8	*539*

Table A3.7 Mathematics teachers: *frequency of setting homework*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
never	0	–	0	–
less than once a week	5	*420*	4	*430*
once or twice a week	93	*480*	91	*517*
3 or 4 times a week	3	*554*	5	*552*

Table A3.8 Mathematics teachers: *average time needed for homework*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
I do not assign homework	0	–	0	–
less than 15 minutes	1	*373*	1	*378*
15-30 minutes	68	*472*	49	*506*
31-60 minutes	31	*499*	50	*525*

Table A3.9 Mathematics teachers: *type of homework set*

FREQUENCY OF SETTING DIFFERENT TYPES OF HOMEWORK	YEAR 8 (International seventh grade)		YEAR 9 (International eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
WORKSHEETS OR WORKBOOKS				
never	4	*529*	2	*521*
rarely	9	*503*	20	*533*
sometimes	78	*477*	72	*511*
always	10	*451*	6	*488*
I do not assign homework	0	–	0	–
PROBLEMS/QUESTIONS SET IN TEXTBOOK				
never	11	*425*	5	*459*
rarely	17	*465*	6	*510*
sometimes	65	*488*	74	*510*
always	7	*511*	16	*551*
I do not assign homework	0	–	0	–
READING A TEXTBOOK				
never	49	*465*	36	*499*
rarely	34	*494*	44	*526*
sometimes	17	*488*	19	*518*
I do not assign homework	0	–	0	–
WRITING DEFINITIONS OR OTHER SHORT WRITING ASSIGNMENT				
never	43	*463*	44	*518*
rarely	45	*493*	43	*512*
sometimes	11	*480*	13	*514*
I do not assign homework	0	–	0	–
SMALL INVESTIGATIONS OR GATHERING DATA				
never	3	*465*	1	*510*
rarely	16	*477*	19	*523*
sometimes	81	*480*	79	*513*
always	0	–	1	*492*
I do not assign homework	0	–	0	–
WORKING INDIVIDUALLLY ON LONG-TERM PROJECTS OR EXPERIMENTS				
never	32	*457*	17	*496*
rarely	29	*478*	27	*532*
sometimes	38	*498*	56	*512*
always	1	*416*	0	–
I do not assign homework	0	–	0	–
WORKING IN SMALL GROUPS ON LONG-TERM PROJECTS OR EXPERIMENTS				
never	62	*471*	46	*512*
rarely	30	*494*	40	527
sometimes	8	*484*	15	*491*
I do not assign homework	0	–	0	–
FINDING ONE OR MORE USES FOR THE CONTENTS COVERED				
never	38	*471*	38	*530*
rarely	40	*487*	42	*513*
sometimes	22	*476*	20	*495*
always	0	–	1	*419*
I do not assign homework	0	–	0	–
PREPARING ORAL REPORTS				
never	65	*466*	52	*517*
rarely	30	*505*	37	*517*
sometimes	5	*485*	11	*495*
always	0	–	0	–
I do not assign homework	0	–	0	–
KEEPING A JOURNAL				
never	87	*476*	76	*522*
rarely	12	*502*	19	*499*
sometimes	0	–	3	*463*
always	1	*497*	1	*424*
I do not assign homework	0	–	0	–

Table A3.10 Mathematics teachers: *Following up mathematics homework*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
WRITTEN HOMEWORK/FEEDBACK TO CLASS				
never	2	*466*	0	–
rarely	3	*414*	3	*466*
sometimes	48	*469*	43	*505*
always	47	*493*	54	*526*
I do not assign homework	0	–	0	–
WRITTEN HOMEWORK/BASIS FOR DISCUSSION				
never	6	*424*	3	*469*
rarely	18	*468*	12	*497*
sometimes	72	*484*	77	*518*
always	4	*525*	8	*533*
I do not assign homework	0	–	0	–

Table A4.1 Students' reports: *different approaches/activities used in mathematics lessons*

FREQUENCY OF DIFFERENT APPROACH/ACTIVITY	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
THE TEACHER SHOWS US HOW TO DO MATHS PROBLEMS				
Almost always	44	*477*	50	*513*
Quite often	41	*479*	40	*505*
Once in while	13	477	10	*488*
Never	1	*454*	1	*437*
WE COPY NOTES FROM THE BOARD				
Almost always	21	*470*	25	*503*
Quite often	44	*479*	39	*508*
Once in while	30	*483*	31	*514*
Never	6	*467*	5	*485*
WE HAVE A TEST				
Almost always	9	*440*	10	*479*
Quite often	42	*478*	40	*511*
Once in while	46	*487*	49	*511*
Never	3	*452*	2	*503*
WE WORK FROM WORKCARDS OR TEXTBOOKS ON OUR OWN				
Almost always	57	*480*	57	*508*
Quite often	29	*478*	32	*514*
Once in while	10	*474*	8	*490*
Never	3	*454*	2	*472*
WE WORK ON MATHS PROJECTS				
Almost always	13	*442*	10	*470*
Quite often	26	*465*	28	*505*
Once in while	44	*495*	50	*519*
Never	17	*483*	13	*493*
WE USE CALCULATORS				
Almost always	26	*486*	45	*517*
Quite often	50	*485*	46	*507*
Once in while	21	*456*	9	*467*
Never	2	*421*	0	–
WE USE COMPUTERS				
Almost always	3	*389*	2	*445*
Quite often	10	*444*	8	*459*
Once in while	45	*487*	46	*514*
Never	43	*482*	45	*512*
WE WORK TOGETHER IN PAIRS OR SMALL GROUPS				
Almost always	9	*453*	8	*479*
Quite often	26	*471*	24	*500*
Once in while	47	*485*	47	*515*
Never	17	*480*	21	*511*
WE USE THINGS FROM EVERY DAY LIFE IN SOLVING MATHEMATICS PROBLEMS				
Almost always	14	*471*	12	*487*
Quite often	41	*473*	41	*512*
Once in while	34	*487*	36	*508*
Never	11	*482*	11	*509*

continued\

Table A4.1 Students' reports: *different approaches/activities used in mathematics lessons* (*CONTINUED*)

FREQUENCY OF DIFFERENT APPROACH/ACTIVITY	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
THE TEACHER GIVES US HOMEWORK				
Almost always	61	*488*	65	*519*
Quite often	33	*469*	29	*497*
Once in while	5	*414*	6	*445*
Never	1	396	1	*377*
WE ARE ALLOWED TO START OUR HOMEWORK IN CLASS				
Almost always	7	*459*	8	*510*
Quite often	18	*476*	21	*520*
Once in while	32	*491*	39	516
Never	43	*471*	32	*488*
THE TEACHER MARKS OUR HOMEWORK				
Almost always	65	*474*	65	*507*
Quite often	21	*477*	21	*509*
Once in while	10	*500*	11	*518*
Never	4	*497*	4	*487*
WE MARK EACH OTHER'S HOMEWORK				
Almost always	7	*486*	5	*502*
Quite often	15	*498*	16	*514*
Once in while	25	*490*	29	*523*
Never	53	*465*	50	*497*
WE DISCUSS OUR COMPLETED HOMEWORK IN CLASS				
Almost always	23	*493*	28	*524*
Quite often	30	*484*	33	*519*
Once in while	25	*480*	24	*500*
Never	22	*452*	15	*464*

Table A4.2 Students' reports: *how often different approaches/activities were used with a new topic in mathmatics*

WHEN WE START A NEW TOPIC:	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
THE TEACHER EXPLAINS THE RULES AND DEFINITIONS				
Almost always	69	*481*	73	*510*
Quite often	23	*472*	22	*504*
Once in a while	6	*463*	4	*474*
Never	2	*472*	1	*434*
WE DISCUSS PRACTICAL PROBLEMS RELATED TO EVERYDAY LIFE				
Almost always	21	*473*	19	*493*
Quite often	40	*472*	43	*505*
Once in a while	27	*492*	28	*524*
Never	12	*477*	10	*497*
WE WORK IN SMALL GROUPS				
Almost always	14	*458*	10	*464*
Quite often	28	*470*	25	*496*
Once in a while	40	*486*	42	*519*
Never	19	*488*	23	*517*
WE ASK WHAT OTHER STUDENTS KNOW				
Almost always	27	*474*	23	*503*
Quite often	42	*482*	43	*508*
Once in a while	21	*478*	24	*512*
Never	9	*469*	10	*504*
WE LOOK AT A TEXTBOOK WHILE THE TEACHER TALKS ABOUT IT				
Almost always	32	*462*	37	*500*
Quite often	37	*483*	38	*511*
Once in a while	19	*491*	18	*521*
Never	12	*485*	7	*489*
WE SOLVE RELATED EXAMPLE				
Almost always	41	*484*	46	*523*
Quite often	43	*474*	40	*499*
Once in a while	13	*473*	12	*487*
Never	4	*472*	3	*453*
WE READ A TEXTBOOK OR WORKSHEET				
Almost always	46	*469*	44	*501*
Quite often	35	*479*	36	*506*
Once in a while	14	*483*	16	*520*
Never	5	*473*	4	*510*

Table A4.3 Homework in maths (hours per week)

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
no time	4	*426*	4	*438*
less than 1 hour	55	*469*	44	*488*
1-2 hours	35	*501*	46	*530*
more than 2 hours	6	*492*	7	*544*

Table A4.4 Students' reports: *extra lessons in mathematics/hours per week*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
no time	85	*487*	90	*514*
less than 1 hour	10	*460*	6	*473*
1-2 hours	4	*438*	3	*484*
3-4 hours	1	*453*	1	*437*

Table A4.5 Students attitude to the use of computers in mathematics lessons

I like using computers in mathematics lessons	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
do not use computers	38	*484*	39	*514*
dislike a lot	1	*434*	1	*500*
dislike	4	*480*	5	*519*
like	28	*477*	31	*505*
like a lot	29	*470*	24	*495*

Table A5.1 Science teachers: *individual, group and whole class teaching*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
WORK TOGETHER/TEACHER TEACHES WHOLE CLASS				
never or almost never	2	*516*	3	*561*
some lessons	61	*525*	52	*569*
most lessons	33	*533*	35	*582*
every lesson	5	*532*	10	*568*
WORK TOGETHER/STUDENTS INTERACT				
never or almost never	23	*532*	22	*584*
some lessons	67	*532*	63	*570*
most lessons	11	*490*	13	*568*
every lesson	0	–	2	*599*
INDIVIDUAL WORK/NO ASSISTANCE FROM TEACHER				
never or almost never	16	*532*	24	*575*
some lessons	72	*521*	63	*572*
most lessons	13	*558*	11	*586*
every lesson	0	–	3	*547*
INDIVIDUAL WORK/ASSISTANCE FROM TEACHER				
never or almost never	1	*603*	7	*585*
some lessons	59	*525*	63	*577*
most lessons	36	*528*	26	*561*
every lesson	4	*530*	3	585
WORK IN GROUPS/NO ASSISTANCE FROM TEACHER				
never or almost never	19	*524*	22	*579*
some lessons	62	*533*	60	*572*
most lessons	18	*513*	17	*568*
every lesson	1	*555*	2	*595*
WORK IN GROUPS/ASSISTANCE FROM TEACHER				
never or almost never	3	*541*	3	*596*
some lessons	53	*523*	56	*570*
most lessons	41	*533*	36	*574*
every lesson	4	*524*	6	*599*

Table A5.2 Science teachers: *frequency with which they ask students to:*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
EXPLAIN THE REASONING BEHIND AN IDEA				
never or almost never	2	*463*	1	*611*
some lessons	34	*527*	27	*564*
most lessons	45	*514*	54	*569*
every lesson	20	*566*	19	*597*
REPRESENT AND ANALYSE RELATIONSHIPS				
never or almost never	1	*470*	1	*531*
some lessons	70	*528*	74	*571*
most lessons	29	*530*	23	*582*
every lesson	0	–	2	*595*
WORK ON PROBLEMS WITH NO OBVIOUS METHOD OF SOLUTION				
never or almost never	24	*523*	35	*573*
some lessons	71	*530*	59	*573*
most lessons	5	*517*	4	*570*
every lesson	0	–	1	*597*
USE COMPUTERS TO SOLVE EXERCISES OR PROBLEMS				
never or almost never	72	*524*	71	*577*
some lessons	28	*535*	29	*565*
most lessons	0	–	0	–
every lesson	0	–	0	–
WRITE EXPLANATIONS ABOUT WHAT AND WHY				
never or almost never	0	–	0	–
some lessons	22	*517*	28	*562*
most lessons	66	*531*	59	*576*
every lesson	12	*528*	13	*587*
PUT EVENTS OF OBJECTS IN ORDER AND GIVE REASONS FOR ORDER				
never or almost never	10	*541*	14	*600*
some lessons	70	*535*	66	*567*
most lessons	20	*502*	18	*572*
every lesson	1	*383*	3	*597*

Table A5.3 Science teachers: *use of textbooks*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
yes	98	*531*	96	*573*
no	2	*549*	4	*591*

Table A5.4 Science teachers: *proportion of teaching based on a textbook*

PROPORTION OF TEACHING	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
0–25%	48	*545*	48	*578*
26–50%	12	*510*	17	*570*
51–75%	19	*501*	15	*582*
76–100%	21	*526*	20	*557*

Table A5.5 Science teachers: *how calculators are used*

FREQUENCY OF DIFFERENT USES	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
CHECKING ANSWERS				
almost every day	4	*528*	7	*599*
once or twice a week	16	*558*	21	*589*
once or twice a month	35	*530*	38	*581*
never, or hardly ever	46	*514*	35	*552*
TESTS AND EXAMS				
almost every day	5	*553*	8	*565*
once or twice a week	5	*613*	4	*594*
once or twice a month	50	*533*	59	*581*
never, or hardly ever	41	*510*	28	*556*
ROUTINE COMPUTATION				
almost every day	6	*563*	10	*596*
once or twice a week	21	*537*	20	*578*
once or twice a month	44	*532*	42	*576*
never, or hardly ever	29	*505*	28	*558*
SOLVING COMPLEX PROBLEMS				
almost every day	4	*525*	6	*600*
once or twice a week	5	*614*	7	*580*
once or twice a month	23	*540*	20	*582*
never, or hardly ever	69	*518*	66	*567*
DEVELOPING NUMBER CONCEPTS				
almost every day	1	*528*	4	*596*
once or twice a week	2	*571*	5	*573*
once or twice a month	17	*550*	9	*568*
never, or hardly ever	80	*522*	82	*573*

Table A5.6 Science teachers: *frequency of setting homework*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
never	1	*485*	0	–
less than once a week	12	*481*	12	*525*
once or twice a week	87	*535*	86	*581*
3 or 4 times a week	0	–	1	*536*
every day	1	*562*	1	*629*

Table A5.7 Science teachers: *average time needed for homework*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
I do not assign homework	1	*485*	0	–
less than 15 minutes	2	*480*	2	*509*
15-30 minutes	80	*530*	64	*572*
31-60 minutes	17	*529*	35	*581*

Table A5.8 Science teachers: *type of homework set*

FREQUENCY OF SETTING DIFFERENT TYPES OF HOMEWORK	YEAR 8 (International seventh grade)		YEAR 9 (International eighth grade)	
	%	*Mean science score*	%	*Mean science score*
WORKSHEETS OR TEXTBOOKS				
never	4	*563*	3	*583*
rarely	15	*528*	16	*596*
sometimes	77	*528*	76	*573*
always	3	*482*	6	*530*
I do not assign homework	1	*485*	0	–
PROBLEMS/QUESTIONS SET IN TEXTBOOK				
never	28	*495*	24	*537*
rarely	23	*539*	21	*569*
sometimes	47	*543*	53	*590*
always	1	*524*	2	*637*
I do not assign homework	1	*485*	0	–
READING A TEXTBOOK				
never	25	*496*	22	*529*
rarely	40	*545*	29	*577*
sometimes	33	*534*	47	*589*
always	1	*524*	1	*551*
I do not assign homework	1	*485*	0	–
WRITING DEFINITIONS OR OTHER SHORT WRITING ASSIGNMENT				
never	6	*498*	12	*574*
rarely	34	*556*	29	*589*
sometimes	59	*517*	58	*565*
always	1	*527*	1	*583*
I do not assign homework	1	*485*	0	–
SMALL INVESTIGATIONS OR GATHERING DATA				
never	9	*566*	8	*563*
rarely	21	*533*	26	*592*
sometimes	68	*521*	66	*567*
always	1	*550*	0	–
I do not assign homework	1	*485*	0	–
WORKING INDIVIDUALLLY ON LONG-TERM PROJECTS OR EXPERIMENTS				
never	24	*543*	23	*572*
rarely	43	*523*	42	*571*
sometimes	32	*523*	35	*578*
always	0	–	0	–
I do not assign homework	1	*485*	0	*534*
WORKING IN SMALL GROUPS ON LONG-TERM PROJECTS OR EXPERIMENTS				
never	39	*525*	40	*575*
rarely	44	*526*	42	*577*
sometimes	16	*542*	18	*565*
I do not assign homework	1	*485*	0	*534*
FINDING ONE OR MORE USES FOR THE CONTENTS COVERED				
never	12	*535*	16	*577*
rarely	30	*550*	33	*573*
sometimes	57	*518*	50	*571*
always	0	*611*	1	*536*
I do not assign homework	1	*485*	0	–
PREPARING ORAL REPORTS				
never	35	*522*	32	*577*
rarely	40	*529*	41	*579*
sometimes	24	*535*	27	*561*
I do not assign homework	1	*485*	0	–
KEEPING A JOURNAL				
never	59	529	65	*579*
rarely	30	*529*	26	*566*
sometimes	9	*518*	8	*554*
always	1	*535*	1	*598*
I do not assign homework	1	*485*	0	–

Table A5.9 Science teachers: *Following up science homework*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
WRITTEN HOMEWORK/FEEDBACK TO CLASS				
never	0	–	1	*523*
rarely	5	*520*	3	*548*
sometimes	38	*529*	44	*561*
always	56	*528*	53	*587*
I do not assign homework	1	*485*	0	–
WRITTEN HOMEWORK/BASIS FOR DISCUSSION				
never	2	*542*	4	*553*
rarely	20	*548*	16	*550*
sometimes	72	*520*	76	*579*
always	5	*568*	4	*595*
I do not assign homework	1	*485*	0	–

Table A6.1 Students' reports: *different approaches/activities used in science lessons*

FREQUENCY OF DIFFERENT APPROACH/ACTIVITY	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
THE TEACHER SHOW HOW TO DO SCIENCE PROBLEMS				
almost always	43	*504*	41	*546*
pretty often	43	*518*	45	*559*
once in a while	12	*528*	12	*568*
never	2	*528*	2	*542*
WE COPY NOTES FROM THE BOARD				
almost always	48	*509*	47	*545*
pretty often	40	*515*	43	*562*
once in a while	11	*527*	9	*571*
never	1	*521*	1	*517*
WE HAVE A TEST				
almost always	12	*473*	11	*511*
pretty often	45	*519*	44	*556*
once in a while	41	*522*	45	*563*
never	1	*476*	1	*547*
WE WORK ON SCIENCE PROJECTS				
almost always	28	*495*	21	*525*
pretty often	36	*513*	35	*554*
once in a while	28	533	34	*571*
never	8	*513*	11	*558*
WE WORK FROM WORKCARDS OR TEXTBOOKS ON OUR OWN				
almost always	18	*494*	15	*523*
pretty often	29	*507*	33	*549*
once in a while	39	*531*	39	*572*
never	15	*505*	13	*551*
WE USE CALCULATORS				
almost always	2	*486*	3	*520*
pretty often	8	*514*	11	*579*
once in a while	33	*535*	45	*567*
never	57	*503*	42	*537*
WE USE COMPUTERS				
almost always	1	*470*	1	*479*
pretty often	6	*470*	4	*527*
once in a while	28	*521*	31	*566*
never	66	*515*	64	*552*
WE USE THINGS FROM EVERYDAY LIFE IN SOLVING SCIENCE PROBLEMS				
almost always	13	*498*	12	*528*
pretty often	38	*518*	39	*566*
once in a while	38	*515*	40	*553*
never	11	*517*	9	*545*
WE WORK TOGETHER IN PAIRS OR SMALL GROUPS				
almost always	41	*518*	36	*557*
pretty often	45	*516*	49	*554*
once in a while	13	*499*	12	*546*
never	2	*483*	3	*557*

continued\

Table A6.1 Students' reports: *different approaches/activities used in science lessons* (*CONTINUED*)

FREQUENCY OF DIFFERENT APPROACH/ACTIVITY	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
THE TEACHER GIVES HOMEWORK				
almost always	49	*525*	53	*561*
pretty often	39	*509*	38	*553*
once in a while	11	*488*	9	*525*
never	1	*446*	1	*477*
WE ARE ALLOWED TO START OUR HOMEWORK IN CLASS				
almost always	8	*515*	8	*554*
pretty often	19	*508*	24	*559*
once in a while	34	*532*	38	*564*
never	38	*501*	31	*539*
THE TEACHER MARKS OUR HOMEWORK				
almost always	69	*520*	70	*560*
pretty often	21	*503*	20	*542*
once in a while	8	*507*	7	*543*
never	2	*477*	2	*539*
WE MARK EACH OTHER'S HOMEWORK				
almost always	2	*483*	2	*480*
pretty often	7	*493*	7	*525*
once in a while	21	*530*	24	*566*
never	70	*512*	68	*555*
WE DISCUSS OUR COMPLETED HOMEWORK IN CLASS				
almost always	19	*525*	20	*562*
pretty often	27	*521*	30	*568*
once in a while	31	*517*	31	*556*
never	23	*491*	19	*523*
THE TEACHER DEMONSTRATES AN EXPERIMENT				
almost always	55	*514*	56	*548*
pretty often	35	*521*	35	*570*
once in a while	8	*502*	9	*543*
never	2	*458*	1	*502*
WE DO EXPERIMENTS OR PRACTICAL INVESTIGATIONS IN CLASS				
almost always	56	*516*	55	*552*
pretty often	33	*522*	37	*562*
once in a while	9	*488*	8	*543*
never	2	*420*	1	*486*

Table A6.2 Students' reports: *how often different approaches/activities were used with a new topic in science*

WHEN WE START A NEW TOPIC:	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
THE TEACHER EXPLAINS THE RULES AND DEFINITIONS				
almost always	63	*513*	61	*554*
pretty often	31	*516*	34	*556*
once in a while	5	*515*	5	*560*
never	1	*458*	1	*487*
WE DISCUSS A PRACTICAL PROBLEM RELATED TO EVERYDAY LIFE				
almost always	26	*502*	23	*540*
pretty often	46	*516*	47	*558*
once in a while	23	*526*	25	*561*
never	5	*511*	5	*551*
WE WORK IN SMALL GROUPS				
almost always	40	*516*	36	*544*
pretty often	39	*513*	41	*563*
once in a while	16	*515*	19	*555*
never	5	*490*	5	*555*
THE TEACHER ASK STUDENTS WHAT THEY KNOW ABOUT THE TOPIC				
almost always	35	*511*	31	*557*
pretty often	43	*519*	46	*556*
once in a while	17	*512*	18	*547*
never	5	*500*	5	*553*
WE LOOK AT A TEXTBOOK WHILE THE TEACHER TALKS ABOUT IT				
almost always	28	*495*	22	*526*
pretty often	32	*513*	34	*544*
once in a while	27	*530*	30	*581*
never	14	*528*	13	*571*
WE SOLVE A RELATED EXAMPLE				
almost always	29	*503*	27	*553*
pretty often	46	*517*	45	*549*
once in a while	20	527	23	*566*
never	5	*509*	5	*566*
WE READ A TEXTBOOK OR WORKSHEET				
almost always	29	*503*	28	*539*
pretty often	32	*516*	35	*555*
once in a while	25	*538*	28	*585*
never	10	*507*	7	*572*

Table A6.3 Homework in science (hours per week)

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
no time	4	*494*	5	*500*
less than 1 hour	56	*510*	46	*535*
1-2 hours	34	*528*	42	*577*
more than 2 hours	5	*522*	8	*587*

Table A6.4 Extra lessons in science/hours per week

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
no time	90	*523*	93	*560*
less than 1 hour	7	*475*	4	*493*
1-2 hours	3	*458*	2	*484*
more than 2 hours	0	_	1	*499*

Table A6.5 Students' attitude to the use of computers in science lessons

I like using computers in science lessons	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
don't use computers	53	*518*	50	*556*
dislike a lot	1	*461*	2	*563*
dislike	5	*498*	6	*543*
like	23	*510*	26	*558*
like a lot	18	*510*	17	*546*

Table A7.1 Mathematics teachers: *biographical details*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
AGE OF TEACHER				
under 25	6	*522*	5	*493*
25-29	10	*513*	12	*525*
30-39	27	*485*	23	*522*
40-49	44	*468*	43	*514*
50-59	13	*463*	16	*508*
60 or more	1	*390*	0	–
SEX OF TEACHER				
female	47	*482*	45	*509*
male	53	*476*	55	*520*
LEVEL OF EDUCATION COMPLETED				
3 or 4 year training	22	*452*	14	*513*
BA/BSc no training	8	*524*	9	*535*
BA/BSc training/BEd	58	*488*	66	*510*
Higher degree no training	6	*436*	6	*554*
Higher degree training	6	*484*	5	*507*
YEARS OF TEACHING EXPERIENCE				
0-5 years	17	*512*	19	*521*
6-10 years	13	*496*	11	*518*
11-20 years	37	*465*	39	*512*
> 20 years	33	*473*	31	*514*

Table A7.2 Mathematics teachers: *years to which mathematics was taught at time of testing*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
YEAR 7				
yes	77	*477*	64	*511*
no	23	*489*	36	*523*
YEAR 8				
yes	99	*481*	68	*512*
no	1	*371*	33	*522*
YEAR 9				
yes	63	*478*	100	*515*
no	37	*482*	0	–
YEAR 10				
yes	73	*480*	89	*517*
no	27	*480*	11	*501*
YEAR 11				
yes	67	*475*	88	*515*
no	33	*489*	12	*518*
YEAR 12				
yes	28	*508*	34	*537*
no	72	*469*	66	*504*
YEAR 13				
yes	21	*509*	24	*545*
no	80	*472*	76	*505*

Table A7.3 Mathematics teachers: *whether part- or full-time*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
part-time	11	*465*	10	*511*
full-time	89	*481*	90	*516*

Table A7.4 Mathematics teachers: *attitudes towards teaching as a career*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
WAS TEACHING FIRST CHOICE OF CAREER?				
yes	62	*468*	57	*507*
no	39	*496*	44	*526*
WOULD YOU LIKE TO CHANGE CAREER?				
yes	40	*467*	41	*511*
no	60	*487*	59	*519*
IS YOUR WORK APPRECIATED BY SOCIETY?				
yes	19	*500*	27	*519*
no	81	*475*	73	*514*
IS YOUR WORK APPRECIATED BY YOUR STUDENTS?				
yes	66	*487*	73	*518*
no	34	*463*	27	*507*

Table A7.5 Mathematics teachers: *to be good at mathematics how important do you think it is to:*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
REMEMBER FORMULAE AND PROCEDURES				
not important	3	*416*	6	*477*
somewhat important	66	*482*	54	*506*
very important	31	*478*	41	*533*
THINK IN A SEQUENTIAL AND PROCEDURAL MANNER				
not important	1	*390*	3	*454*
somewhat important	27	*489*	28	*518*
very important	73	*476*	70	*516*
UNDERSTAND MATHEMATICAL CONCEPTS, ETC.				
not important	0	–	1	*384*
somewhat important	17	*490*	16	*503*
very important	83	*476*	84	*518*
THINK CREATIVELY				
not important	10	*477*	10	*510*
somewhat important	60	*482*	58	*524*
very important	30	*475*	32	*500*
UNDERSTAND HOW MATHEMATICS IS USED IN THE REAL WORLD				
not important	8	*486*	6	*529*
somewhat important	51	*488*	53	*518*
very important	41	*466*	41	*510*
PROVIDE REASONS TO SUPPORT SOLUTIONS				
not important	0	*363*	0	–
somewhat important	34	*468*	31	*503*
very important	65	*485*	68	*522*

Table A7.6 Mathematics teachers: *views on mathematics*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
MATHEMATICS IS PRIMARILY AN ABSTRACT SUBJECT				
strongly disagree	12	*487*	14	*521*
disagree	56	*465*	59	*517*
agree	23	*513*	25	*511*
strongly agree	8	*470*	2	*486*
MATHEMATICS IS A FORMAL REPRESENTATION OF WORLD				
strongly disagree	3	*479*	1	*538*
disagree	29	*487*	35	*523*
agree	62	*476*	56	*516*
strongly agree	6	*487*	8	*484*
MATHEMATICS IS A PRACTICAL AND STRUCTURED GUIDE FOR ADDRESSING REAL SITUATIONS				
strongly disagree	2	*488*	2	*517*
disagree	18	*501*	18	*527*
agree	62	*472*	67	*514*
strongly agree	18	*481*	12	*509*
IF STUDENTS ARE HAVING DIFFICULTY, AN EFFECTIVE APPROACH IS TO GIVE THEM MORE PRACTICE				
strongly disagree	7	*447*	14	*517*
disagree	55	*489*	41	*523*
agree	36	*472*	42	*513*
strongly agree	2	*433*	4	*482*
SOME STUDENTS HAVE A NATURAL TALENT FOR MATHEMATICS				
strongly disagree	0	–	2	*547*
disagree	7	*409*	8	*495*
agree	54	*488*	55	*514*
strongly agree	40	*479*	36	*520*
MORE THAN ONE REPRESENTATION SHOULD BE USED IN TEACHING A MATHEMATICS TOPIC				
strongly disagree	0	–	1	*577*
disagree	6	*458*	4	*569*
agree	53	485	59	*520*
strongly agree	41	475	36	*499*
MATHEMATICS SHOULD BE LEARNED AS A SET OF ALGORITHMS OR RULES				
strongly disagree	20	*469*	22	*510*
disagree	60	*483*	60	*510*
agree	19	*481*	16	*547*
strongly agree	1	*411*	2	*468*
BASIC COMPUTATIONAL SKILLS ARE SUFFICIENT FOR TEACHING PRIMARY MATHEMATICS				
strongly disagree	40	*475*	41	*531*
disagree	50	*482*	42	*505*
agree	8	*499*	14	*507*
strongly agree	2	*450*	4	*485*

Table A7.7 Science teachers: *biographical details*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
AGE OF TEACHER				
under 25	2	*570*	2	*580*
25-29	6	*517*	13	*581*
30-39	28	*503*	26	*574*
40-49	47	*537*	39	*569*
50-59	16	*543*	19	*582*
60 or more	0	–	1	*559*
SEX OF TEACHER				
female	39	*530*	39	*570*
male	61	*527*	61	*577*
LEVEL OF EDUCATION COMPLETED				
3 or 4 year training	16	*523*	8	*548*
BA/BSc no training	5	*529*	8	*593*
BA/BSc training/BEd	64	*521*	67	*573*
Higher degree no training	7	*591*	6	*599*
Higher degree training	7	*548*	10	*574*
YEARS OF TEACHING EXPERIENCE				
0-5 years	25	*507*	20	*562*
6-10 years	10	*521*	13	*571*
11-20 years	40	*540*	34	*580*
> 20 years	25	*532*	33	*576*

Table A7.8 Science teachers: *years to which science was taught at time of testing*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
YEAR 7				
yes	71	*526*	57	*568*
no	29	*532*	43	*580*
YEAR 8				
yes	99	*527*	61	*568*
no	1	*594*	39	*581*
YEAR 9				
yes	59	*514*	100	*573*
no	41	*549*	0	*550*
YEAR 10				
yes	73	*516*	91	*572*
no	27	*559*	9	*585*
YEAR 11				
yes	69	*514*	90	*572*
no	31	*560*	10	*580*
YEAR 12				
yes	26	*536*	38	*591*
no	74	*525*	62	*562*
YEAR 13				
yes	22	*540*	34	*598*
no	78	*525*	66	*560*

Table A7.9 Science teachers: *whether full- or part-time*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
part-time	8	*528*	7	*577*
full-time	92	*528*	93	*573*

Table A7.10 Science teachers: attitudes towards teaching as a career

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
WAS TEACHING FIRST CHOICE OF CAREER?				
yes	47	*536*	42	*581*
no	53	*521*	58	*569*
WOULD YOU LIKE TO CHANGE CAREER?				
yes	49	*519*	46	*563*
no	51	*535*	55	*583*
IS YOUR WORK APPRECIATED BY SOCIETY?				
yes	18	*522*	24	*606*
no	82	*531*	76	*564*
IS YOUR WORK APPRECIATED BY YOUR STUDENTS?				
yes	65	*536*	68	*584*
no	35	*519*	32	*557*

Table A7.11 Science teachers: *to be good at science how important do you think it is to:*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
REMEMBER FORMULAE AND PROCEDURES				
not important	6	*457*	9	*591*
somewhat important	68	*526*	65	*568*
very important	27	*550*	26	*580*
THINK IN A SEQUENTIAL AND PROCEDURAL MANNER				
not important	1	*365*	0	–
somewhat important	25	*530*	27	*575*
very important	75	*532*	72	*573*
UNDERSTAND SCIENTIFIC CONCEPTS, ETC.				
somewhat important	23	*507*	10	*541*
very important	77	*536*	90	*577*
BE ABLE TO THINK CREATIVELY				
not important	6	*500*	5	*571*
somewhat important	60	*525*	62	*572*
very important	33	*541*	33	*576*
UNDERSTAND HOW SCIENCE IS USED IN REAL WORLD				
not important	4	*572*	4	*565*
somewhat important	39	*534*	39	577
very important	57	*523*	57	572
BE ABLE TO PROVIDE REASONS TO SUPPORT SOLUTIONS				
not important	1	*636*	0	–
somewhat important	20	*513*	15	*569*
very important	79	*532*	85	*574*

Table A7.12 Science teachers: *views on science*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
SCIENCE IS PRIMARILY AN ABSTRACT SUBJECT				
strongly disagree	29	*546*	23	*577*
disagree	58	*523*	63	*568*
agree	10	*509*	12	*588*
strongly agree	3	*510*	1	*560*
SCIENCE IS PRIMARILY A FORMAL REPRESENTATION OF WORLD				
strongly disagree	2	*507*	2	*538*
disagree	19	*544*	20	*576*
agree	68	*524*	69	*571*
strongly agree	12	*546*	10	*587*
SCIENCE IS PRIMARILY A PRACTICAL AND STRUCTURED GUIDE FOR ADDRESSING REAL SITUATIONS				
strongly disagree	2	*519*	1	*587*
disagree	12	*525*	15	*575*
agree	72	*533*	71	*569*
strongly agree	14	*502*	13	*586*
IT IS IMPORTANT FOR TEACHERS TO GIVE STUDENTS PRESCRIPTIVE AND SEQUENTIAL DIRECTIONS FOR DOING SCIENCE EXPERIMENTS				
strongly disagree	3	*540*	6	*598*
disagree	36	*522*	42	*565*
agree	51	529	43	*579*
strongly agree	10	*553*	9	*558*
FOCUSING ON RULES IS A BAD IDEA				
strongly disagree	2	*484*	5	*579*
disagree	48	*524*	47	*566*
agree	47	*532*	45	*577*
strongly agree	4	*561*	4	*564*
DEBATES IN CLASS HARM LEARNING				
strongly disagree	56	*537*	51	*574*
disagree	42	*518*	44	*575*
agree	2	*542*	1	*592*
strongly agree	0	–	4	*539*
STUDENTS SEE A SCIENCE TASK AS THE SAME TASK WHEN IT IS REPRESENTED IN TWO DIFFERENT WAYS				
strongly disagree	5	*503*	6	*578*
disagree	57	*527*	65	*568*
agree	38	*532*	28	*577*
strongly agree	0	–	1	*529*

Table A8.1 Students' reports: *student and home background*

	YEAR 8 (international seventh grade)			YEAR 9 (international eighth grade)		
	%	Mean science score	Mean mathematics score	%	Mean science score	Mean mathematics score
STUDENT'S SEX						
girl	46	*500*	*468*	48	*542*	*504*
boy	54	*523*	*485*	52	*563*	*509*
WERE YOU BORN IN ENGLAND?						
yes	95	*514*	*478*	95	*554*	*507*
no	5	*479*	*452*	5	*534*	*500*
HOW OFTEN DO YOU SPEAK ENGLISH AT HOME?						
always or almost always	95	*516*	*481*	96	*556*	*510*
sometimes	4	*472*	*437*	3	*522*	486
never	1	*502*	*483*	0	*406*	*441*
WAS YOUR MOTHER BORN IN THE UK?						
yes	87	*515*	*479*	88	*554*	*507*
no	13	*503*	*476*	12	*560*	*513*
WAS YOUR FATHER BORN IN THE UK?						
yes	87	*517*	*480*	87	*556*	*508*
no	13	*497*	*470*	14	*544*	*506*
DID YOUR MOTHER GO TO COLLEGE/UNIVERSITY?						
yes	35	*540*	*496*	35	*589*	*526*
no	26	*504*	*461*	31	*549*	*505*
not sure	39	*503*	*464*	34	*540*	*489*
DID YOUR FATHER GO TO COLLEGE/UNIVERSITY?						
yes	37	*543*	*499*	36	*592*	*535*
no	26	*506*	*464*	26	*545*	*494*
not sure	40	*497*	*458*	38	*539*	*488*
STUDENT LIVES WITH MOTHER						
yes	96	*513*	*478*	96	*554*	*508*
no	4	*503*	*466*	4	*531*	*478*
STUDENT LIVES WITH FATHER						
yes	77	*516*	*481*	77	*557*	*510*
no	23	*500*	*463*	23	*539*	*495*
STUDENT LIVES WITH BROTHER(S)						
yes	60	*508*	*473*	57	*547*	*503*
no	41	*520*	*483*	43	*560*	*511*
STUDENT LIVES WITH SISTER(S)						
yes	56	*507*	*473*	55	*546*	*502*
no	44	*520*	*483*	45	*562*	*512*
STUDENT LIVES WITH STEPMOTHER						
yes	2	*474*	*452*	2	*522*	*480*
no	98	*513*	*478*	98	*554*	*507*
STUDENT LIVES WITH STEPFATHER						
yes	9	*490*	*452*	8	*529*	*496*
no	91	*515*	*480*	92	*555*	*508*
STUDENT LIVES WITH GRANDPARENTS						
yes	5	*459*	*420*	5	*525*	*476*
no	95	*516*	*480*	96	*554*	*508*
STUDENT LIVES WITH OTHER RELATIVE(S)						
yes	4	*451*	*416*	3	*488*	*439*
no	96	*515*	*480*	98	*555*	*508*
STUDENT LIVES WITH OTHER(S)						
yes	5	*497*	*458*	5	*536*	*489*
no	95	*513*	*478*	95	*554*	*508*

Table A8.1 Students' reports: *student and home background* (CONTINUED)

	YEAR 8 (international seventh grade)			YEAR 9 (international eighth grade)		
	%	*Mean science score*	*Mean mathematics score*	%	*Mean science score*	*Mean mathematics score*
NO. OF PEOPLE LIVING IN HOME						
3 or less	17	*520*	*484*	17	*556*	*509*
4	40	*518*	*481*	45	*565*	*517*
5	25	*520*	*479*	23	*548*	*506*
6	12	*495*	*474*	10	*533*	*484*
7 or more	7	*466*	*436*	5	*514*	*466*
NO. OF BOOKS IN STUDENT'S HOME						
0-10 books	6	*428*	*407*	6	*472*	*431*
11-25 books	13	*463*	*426*	13	*502*	*463*
26-100 books	27	*496*	*467*	27	*536*	*495*
101-200 books	23	*526*	*487*	23	*564*	*518*
more than 200 books	32	*553*	*512*	32	*596*	*540*
CALCULATOR AT HOME						
yes	98	*514*	*478*	99	*554*	*508*
no	2	*415*	*412*	1	*494*	*425*
COMPUTER AT HOME						
yes	90	*513*	*477*	89	*553*	*506*
no	10	*510*	*477*	11	*558*	*512*
STUDY DESK AT HOME						
yes	90	*517*	*481*	90	*558*	*512*
no	10	*469*	*442*	10	*512*	*463*
DICTIONARY AT HOME						
yes	97	*515*	*480*	98	*555*	*509*
no	3	*430*	*399*	2	*462*	*428*

Table A8.2 Students' reports: *out-of-school activities*

	YEAR 8 (international seventh grade)			YEAR 9 (international eighth grade)		
	%	Mean science score	Mean mathematics score	%	Mean science score	Mean mathematics score
HOMEWORK IN ALL SUBJECTS (HOURS PER DAY)						
no time	1	*472*	*424*	1	*475*	*430*
less than 1 hour	32	*493*	*458*	29	*521*	*472*
1 –2 hours	55	*528*	*491*	55	*566*	*521*
more than 2 hours	12	*522*	*501*	15	*584*	*538*
EXTRA LESSONS IN MATHS (HOURS PER WEEK)						
no time	85	–	*487*	90	–	*514*
less than 1 hour	10	–	*460*	6	–	*473*
1 –2 hours	4	–	*438*	3	–	*484*
more than 2 hours	1	–	*443*	1		*437*
EXTRA LESSONS IN SCIENCE (HOURS PER WEEK)						
no time	90	*523*	–	93	*560*	–
less than 1 hour	7	*475*	–	4	*493*	–
1 –2 hours	2	*458*	–	2	*484*	–
more than 2 hours	–	–	–	1	*499*	–
PARTICIPATION IN MATHS/SCIENCE CLUBS (HOURS PER WEEK)						
no time	92	*520*	*485*	95	*557*	*512*
less than 1 hour	5	477	454	2	*532*	*484*
1 –2 hours	2	*498*	*465*	2	*505*	*474*
more than 2 hours	0	–	–	1	*512*	*426*
WORKING AT A PAID JOB (HOURS PER WEEK)						
no time	75	*520*	*485*	62	*560*	*513*
less than 1 hour	9	508	460	8	*543*	*502*
1 –2 hours	8	*513*	*485*	13	*555*	*507*
3 –5 hours	5	*499*	*471*	11	*551*	*511*
more than 5 hours	3	*495*	*484*	7	*540*	*500*
WATCHING TV OR VIDEOS (HOURS PER DAY)						
no time	4	*505*	*487*	3	*506*	*472*
less than 1 hour	19	*512*	*477*	18	*551*	*504*
1 –2 hours	34	*524*	*489*	37	*565*	*515*
3 –5 hours	31	*519*	*483*	31	*558*	*516*
more than 5 hours	12	*488*	*455*	11	*530*	*481*
PLAYING COMPUTER GAMES (HOURS PER DAY)						
no time	29	*525*	*491*	36	*560*	*516*
less than 1 hour	38	*521*	*483*	34	*560*	*516*
1 –2 hours	24	*509*	*474*	21	*548*	*501*
3 –5 hours	6	*473*	*445*	5	*544*	*474*
more than 5 hours	3	*490*	*448*	3	*496*	*450*
SOCIALISING WITH FRIENDS (HOURS PER DAY)						
no time	16	*546*	*508*	12	*590*	*541*
less than 1 hour	18	*526*	*496*	18	*573*	*531*
1 –2 hours	31	*515*	*482*	30	*561*	*516*
3 –5 hours	24	*504*	*466*	26	*542*	*495*
more than 5 hours	12	*481*	*437*	*14*	*506*	*460*
DOING JOBS AT HOME (HOURS PER DAY)						
no time	16	*516*	*484*	16	*553*	*504*
less than 1 hour	60	*519*	*483*	58	*561*	*518*
1 –2 hours	20	*518*	*480*	23	*548*	*499*
3 –5 hours	3	*465*	*441*	3	*536*	*474*
more than 5 hours	1	*436*	*380*	1	*486*	*434*
PLAYING SPORTS (HOURS PER DAY)						
no time	16	*516*	*473*	20	*550*	*500*
less than 1 hour	28	*522*	*484*	29	*549*	*511*
1 –2 hours	36	*522*	*486*	34	*572*	*522*
3 –5 hours	14	*505*	*477*	13	*544*	*497*
more than 5 hours	6	*478*	*452*	6	*526*	*478*
READING A BOOK FOR PLEASURE (HOURS PER DAY)						
no time	28	*500*	*462*	34	*528*	*489*
less than 1 hour	48	*515*	*485*	45	*565*	*518*
1 –2 hours	18	*542*	*500*	16	*582*	*521*
3 –5 hours	5	*534*	*489*	3	*566*	*521*
more than 5 hours	1	*542*	*488*	1	*590*	*522*

Table A8.3 Students' reports: *Educational aspirations*

	YEAR 8 (international seventh grade)			YEAR 9 (international eighth grade)		
	%	*Mean science score*	*Mean mathematics score*	%	*Mean science score*	*Mean mathematics score*
WHAT STUDENTS EXPECT TO DO AFTER YEAR 11						
Sixth form	35	*544*	*512*	37	*585*	*537*
College	32	*512*	*473*	37	*550*	*504*
Get a job	10	*449*	*419*	9	*487*	*438*
Not sure	21	*495*	*459*	16	*534*	*490*
WHAT STUDENTS EXPECT TO DO AFTER SIXTH FORM/COLLEGE						
University	54	*541*	*505*	57	*581*	*533*
Job	23	*474*	*442*	25	*522*	*471*
Not sure	22	*493*	*458*	18	*533*	*498*

Table A9.1 Students' attitudes towards mathematics

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
I LIKE MATHS				
dislike a lot	6	*446*	5	*473*
dislike	15	*466*	15	*499*
like	53	*477*	56	*507*
like a lot	26	*491*	24	*518*
I ENJOY LEARNING MATHS				
strongly agree	26	*478*	22	*510*
agree	55	*482*	59	*511*
disagree	16	*477*	17	*502*
strongly disagree	3	*445*	3	*478*
MATHS IS BORING				
strongly agree	9	*449*	7	*470*
agree	21	473	20	*502*
disagree	47	*485*	51	*513*
strongly disagree	23	*484*	21	*521*
MATHS IS AN EASY SUBJECT				
strongly agree	6	*465*	3	*459*
agree	24	*481*	20	*521*
disagree	55	*481*	56	507
strongly disagree	15	*480*	20	*514*
MATHS IS IMPORTANT IN EVERYONE'S LIFE				
strongly agree	53	*474*	55	*504*
agree	38	*487*	39	*514*
disagree	7	*479*	5	*516*
strongly disagree	2	*429*	1	470
I WOULD LIKE A JOB INVOLVING MATHS				
strongly agree	13	*486*	12	*515*
agree	36	*498*	38	*518*
disagree	36	*471*	36	*509*
strongly disagree	16	*455*	15	*484*

Table A9.2 Students' perceived ability in mathematics

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
I USUALLY DO WELL IN MATHS				
strongly agree	29	*501*	24	*538*
agree	64	*471*	69	*500*
disagree	6	*439*	6	*475*
strongly disagree	1	*432*	1	*431*

Table A9.3 Students' responses: *qualities required to do well in mathematics*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
NATURAL TALENT				
strongly agree	13	*445*	9	*484*
agree	38	*473*	36	*511*
disagree	44	492	48	*514*
strongly disagree	6	*506*	7	*505*
GOOD LUCK				
strongly agree	8	*413*	5	*437*
agree	21	*441*	18	*470*
disagree	49	*491*	51	*516*
strongly disagree	23	*511*	26	*537*
HARD WORK				
strongly agree	51	*472*	49	*501*
agree	41	*486*	44	*510*
disagree	7	*481*	7	*531*
strongly disagree	1	*461*	0	–
MEMORISING NOTES				
strongly agree	16	*442*	13	466
agree	33	*470*	35	*502*
disagree	40	*494*	40	*524*
strongly disagree	11	*511*	11	*532*

Table A9.4 Students' responses: *the importance of doing well in mathematics*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
MY MOTHER THINKS IT IS IMPORTANT TO DO WELL IN MATHS				
strongly agree	61	*483*	61	*511*
agree	37	*473*	38	*504*
disagree	2	*430*	1	*448*
MY FRIENDS THINK IT IS IMPORTANT TO DO WELL IN MATHS				
strongly agree	26	*473*	27	*501*
agree	59	*484*	61	*516*
disagree	13	*471*	11	*494*
strongly disagree	2	*449*	2	*453*
I THINK IT IS IMPORTANT TO DO WELL IN MATHS				
strongly agree	68	*481*	67	*511*
agree	30	*474*	32	*501*
disagree	2	*418*	1	*472*

Table A9.5 Students' responses: *reasons for doing well in mathematics*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
TO GET THE JOB I WANT				
strongly agree	40	*471*	37	*497*
agree	40	*483*	43	*511*
disagree	18	*488*	17	*524*
strongly disagree	3	*468*	3	*497*
TO PLEASE MY PARENTS				
strongly agree	28	*465*	20	*490*
agree	43	*483*	43	*513*
disagree	24	*491*	29	*518*
strongly disagree	4	*476*	7	*493*
TO GET INTO THE UNIVERSITY/COLLEGE I WANT				
strongly agree	45	*485*	41	*513*
agree	41	*479*	45	*514*
disagree	11	*468*	11	*485*
strongly disagree	3	*448*	3	*447*
TO PLEASE MYSELF				
strongly agree	45	*479*	47	*509*
agree	46	*482*	46	*509*
disagree	7	*467*	5	*502*
strongly disagree	2	*457*	2	*478*

Table A9.6 Students' responses: *perceived behaviour of students in mathematics lessons*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean mathematics score*	%	*Mean mathematics score*
STUDENTS NEGLECT SCHOOL WORK				
strongly agree	11	*425*	8	*454*
agree	30	*460*	28	*483*
disagree	46	*495*	49	*523*
strongly disagree	13	*515*	14	*541*
STUDENTS ARE ORDERLY AND QUIET				
strongly agree	8	*457*	8	*501*
agree	58	*489*	58	*523*
disagree	29	*470*	29	*490*
strongly disagree	6	*457*	4	*493*
STUDENTS DO EXACTLY AS TOLD				
strongly agree	17	*473*	14	*517*
agree	62	*489*	65	*516*
disagree	18	*456*	17	*489*
strongly disagree	4	*461*	4	*458*

Table A9.7 Students' attitudes towards science

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
I LIKE SCIENCE				
dislike a lot	6	*474*	6	*501*
dislike	17	*490*	16	*540*
like	49	*515*	52	*550*
like a lot	29	*530*	27	*580*
I ENJOY LEARNING SCIENCE				
strongly agree	30	*523*	27	*576*
agree	52	*517*	55	*553*
disagree	14	*488*	14	*539*
strongly disagree	4	*495*	4	*492*
SCIENCE IS BORING				
strongly agree	7	*474*	6	*508*
agree	18	*502*	18	*536*
disagree	49	*521*	52	*559*
strongly disagree	26	*520*	24	*572*
SCIENCE IS AN EASY SUBJECT				
strongly agree	5	*458*	3	*531*
agree	22	*506*	20	*557*
disagree	60	*521*	58	*557*
strongly disagree	13	*515*	20	*550*
SCIENCE IS IMPORTANT IN EVERYONE'S LIFE				
strongly agree	26	*514*	29	*561*
agree	50	*516*	52	*558*
disagree	20	*512*	17	*545*
strongly disagree	3	*508*	3	*485*
I WOULD LIKE JOB INVOLVING SCIENCE				
strongly agree	18	*538*	16	*586*
agree	24	*527*	31	*573*
disagree	39	*506*	37	*542*
strongly disagree	19	*493*	17	*517*

Table A9.8 Students' perceived ability in science

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
I USUALLY DO WELL IN SCIENCE				
strongly agree	24	*538*	21	*595*
agree	65	*510*	67	*548*
disagree	10	*482*	10	*514*
strongly disagree	1	*488*	2	*511*

Table A9.9 Students' responses: *qualities required to do well in science*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
NATURAL TALENT				
strongly agree	16	*479*	11	*516*
agree	38	*507*	36	*558*
disagree	40	*531*	46	*566*
strongly disagree	7	*542*	8	*546*
GOOD LUCK				
strongly agree	8	*440*	6	*483*
agree	22	*474*	19	*522*
disagree	48	*529*	50	*564*
strongly disagree	22	*550*	25	*582*
HARD WORK				
strongly agree	50	*508*	51	*547*
agree	42	*519*	43	*561*
disagree	7	*527*	6	*559*
strongly disagree	1	*487*	1	*554*
MEMORISING NOTES				
strongly agree	20	*477*	18	*530*
agree	33	*504*	38	*552*
disagree	37	*534*	34	*569*
strongly disagree	10	*551*	10	*569*

Table A9.10 Students' responses: *the importance of doing well in science*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
MY MOTHER THINKS IT IS IMPORTANT TO DO WELL IN SCIENCE				
strongly agree	41	*523*	42	*562*
agree	55	*511*	54	*553*
disagree	4	*478*	4	*506*
MY FRIENDS THINK IT IS IMPORTANT TO DO WELL IN SCIENCE				
strongly agree	17	*508*	18	*550*
agree	57	*517*	62	*561*
disagree	23	*511*	18	*545*
strongly disagree	3	*510*	2	*521*
I THINK IT IS IMPORTANT TO DO WELL IN SCIENCE				
strongly agree	53	*519*	55	*562*
agree	42	*510*	41	*548*
disagree	5	*492*	3	*509*
strongly disagree	1	*470*	0	–

Table A9.11 Students' responses: *reasons for doing well in science*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
TO GET THE JOB I WANT				
strongly agree	27	*518*	28	*563*
agree	31	*515*	34	*563*
disagree	34	*513*	31	*546*
strongly disagree	8	*501*	8	*522*
TO PLEASE MY PARENTS				
strongly agree	26	*507*	18	*536*
agree	44	*517*	45	*562*
disagree	24	*519*	28	*556*
strongly disagree	6	*511*	9	*550*
TO GET INTO THE UNIVERSITY/COLLEGE I WANT				
strongly agree	35	*526*	32	*570*
agree	39	*512*	43	*556*
disagree	21	*506*	19	*541*
strongly disagree	6	*488*	6	*505*
TO PLEASE MYSELF				
strongly agree	39	*519*	40	*565*
agree	46	*515*	47	*552*
disagree	11	*503*	10	*532*
strongly disagree	4	*478*	3	*524*

Table A9.12 Students' responses: *preferred science subject for a career in science*

	YEAR 8 (international seventh grade)		YEAR 9 (international eighth grade)	
	%	*Mean science score*	%	*Mean science score*
PREFERRED SUBJECT FOR A CAREER IN SCIENCE				
biology	26	*529*	35	*562*
chemistry	35	*506*	27	*547*
earth science	24	*505*	23	*554*
physics	15	*525*	15	*555*

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THIRD INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

First National Report Part 2

Part 1 of this report compared the mathematics and science performance of 13-year old students in England with that of their counterparts in other countries. The main finding was that students in England performed relatively well in science but relatively badly in mathematics.

Part 2 of the report extends the findings of the first part of the report by comparing the responses of students and their teachers to the TIMSS questionnaires. Issues covered include:

- Time allocated to mathematics and science lessons
- Class size
- Classroom organisation (whole class, group and individual teaching)
- Homework
- Use of calculators and computers
- Teachers' and students' attitudes
- Teachers' school-related activities out of school hours
- Students' out of school activities.

This report is based on a national survey of nearly 3,700 students in 127 schools, which was part of a world-wide sample of nearly 300,000 students in approximately 6,000 schools in over 40 countries. It is essential reading for all those concerned with the teaching of mathematics and science in secondary schools: teachers, governors, LEA advisory teams, policy makers and researchers.

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