TIMSS 2011:
mathematics and science achievement in England

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Chapter 1 Attainment in TIMSS 2011

Chapter outline

This chapter summarises pupils' attainment in mathematics and science in Year 5 (Y5, ages 9–10) and Year 9 (Y9, ages 13–14) in 2011 and over time. Findings for mathematics are presented first, followed by findings for science. Outcomes for England are compared with those of other countries.

Key findings

- England's Y5 and Y9 pupils have maintained the levels of performance seen in mathematics in the last cycle of TIMSS in 2007. They are above average at Y5 and among the average group of countries at Y9.
- England's Y5 and Y9 pupils continue to achieve above the international average in science, despite a drop in science attainment at Y5 since 2007.
- Countries performing similarly to England in 2011 show a range of trends in attainment, some having improved on their performance in previous cycles of TIMSS, while others have declined or maintained their previous level of attainment.
- Countries performing better than England in TIMSS 2011 also show a range of trends over time, with some maintaining their high level of performance and others improving. In some cases, even among some of the highest performing countries, performance over time has been relatively volatile, showing both improvement and decreases in attainment at different points in time.
- Cohort analysis across TIMSS 2007 and 2011 suggests that secondary schools in many countries, including England, may not capitalise effectively on the earlier mathematics and science achievement of their pupils at primary school. For many participants, the scores of the secondary school cohort were lower (relative to the mean) than the scores of the same cohort at primary school.
- For only a handful of participants (varying for each subject), the scores of the secondary school cohort were higher (relative to the mean) than the scores of the same cohort at primary school. These countries may succeed in 'adding value' to pupils' primary school achievement in mathematics and science.
- The cohort analysis suggests that the science attainment of England's secondary pupils may have declined relative to the rate of primary–to–secondary progress that might have been expected four years ago.

1.1 Mathematics attainment: Year 5

The TIMSS 2011 score for Year 5 (Y5) pupils in England was 542, well above the centre point of the international scale (500) and ranking ninth among participating nations.[1] Table 1.1 summarises England's performance internationally, taking account of the significance of any apparent differences in attainment, while Table 1.2 shows the rankings for mathematics at ages 9–10 (international 'grade 4').

As was the case for TIMSS 2007, the highest performing countries were those in the Asian Pacific Rim (four such countries for TIMSS 2007 and five in 2011). In Europe, only Northern Ireland significantly[2] outscored England in mathematics at this age in 2011 (Northern Ireland did not participate in TIMSS 2007, when no other European nation performed better than England).

Interpreting the data, Performance groups

The TIMSS achievement scale has a centre point of 500 and a standard deviation of 100. It is scaled to remain constant from assessment to assessment, allowing comparison over time.

Countries participating in TIMSS follow guidelines and strict sampling targets to provide samples that are nationally representative. 'Benchmarking participants' are regional entities which follow the same guidelines and targets to provide samples that are representative at regional level. Benchmarking participants are included in Table 1.1 in square brackets.

1 Rankings should be treated with caution as some apparent differences in attainment may not be significant. See 'Interpreting the data: international rankings' for more information.

2 Throughout this report, findings listed as 'significant' are statistically significant.

Table 1.1 TIMSS 2011 performance groups: mathematics at ages 9–10

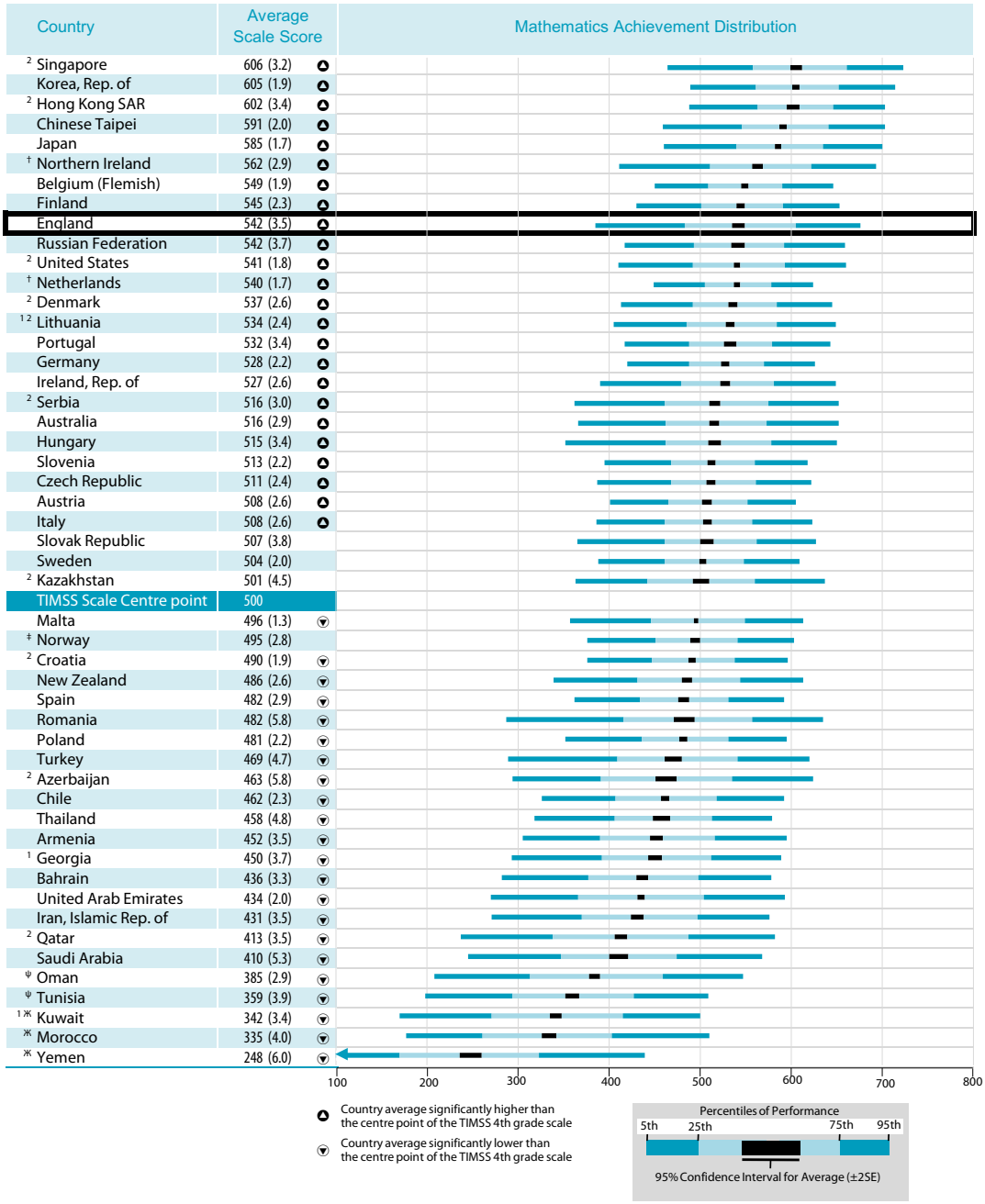
HIGHER performance compared with England Participants performing at a significantly higher level than England		**SIMILAR performance compared with England** Participants performing at a similar level to England (not statistically significantly different)		**LOWER performance compared with England** Participants performing at a significantly lower level than England	
6 countries [and 1 benchmarking participant] (with their scale scores)		**6 other countries [and 1 benchmarking participant]** (with their scale scores)		**37 countries [and 5 benchmarking participants]** *including…* (with their scale scores)	
Singapore	606	Belgium (Flemish)	549	[Quebec, Canada]	533
Korea	605	Finland	545	Portugal	532
Hong Kong	602	[Florida, US]	[545]	Germany	528
Chinese Taipei	591	**England**	**542**	Ireland, Rep of	527
Japan	585	Russian Federation	542	[Ontario, Canada]	[518]
Northern Ireland	562	United States	541	Australia	516
[North Carolina, US]	[554]	Netherlands	540	Austria	508
		Denmark	537	Italy	508
				[Alberta, Canada]	[507]
				Sweden	504
				Kazakhstan	501
				Norway	495
				New Zealand	486
				Spain	482

Source: Exhibit 1.3 international mathematics report.

Interpreting the data: international rankings

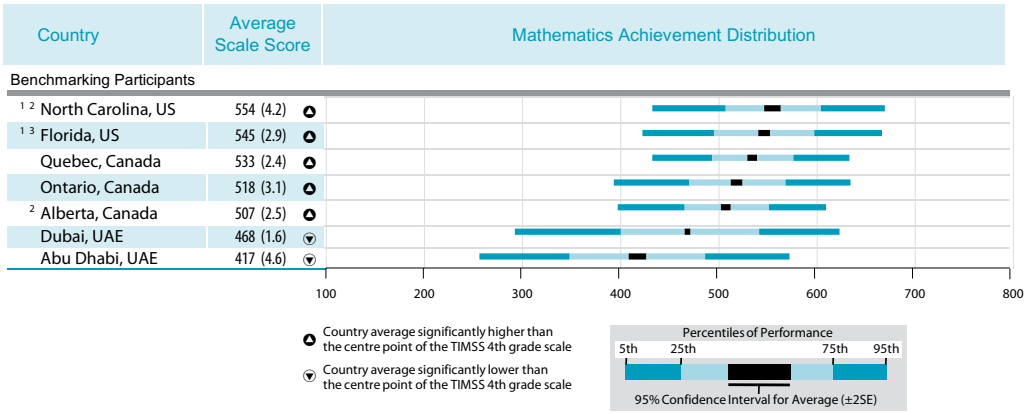
The mean scores on the TIMSS achievement scale (with 95 per cent confidence intervals) are shown graphically as the darkened areas on the achievement distributions, and listed (together with their standard errors) in the 'Average Scale Score' column of the table. Arrows beside the scores indicate whether the average achievement in that country is significantly higher (upward arrow) or lower (downward arrow) than the scale centre point of 500. The standard error refers to uncertainty in estimates resulting from random fluctuations in samples. The smaller the standard error, the better the score is as an estimate of the population's score. The distribution of scores is discussed in chapter 2.

Table 1.2 Mean scores and distribution of Y5 mathematics achievement, TIMSS 2011[3]



( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

3 This table, and others like it throughout the report, are taken from the international reports. They therefore contain some international terminology, such as 'students' in place of 'pupils'.



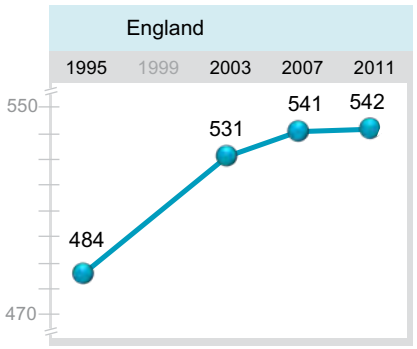
Source: Exhibit 1.1, international mathematics report

Rankings can be volatile, varying according to the mix of countries participating in any given cycle. However, measurement of trends can indicate progress in a more stable fashion, since the outcomes from successive cycles of TIMSS are analysed on comparable scales. Trend analysis shows that England's attainment in Y5 mathematics has remained stable since the last TIMSS cycle in 2007. England's score then was 541, not significantly different from its 2011 score of 542. Four TIMSS cycles have involved pupils aged 9–10 and England's mathematics scores in each of these cycles are shown in Figure 1.1 below. The score increased dramatically between 1995 and 2003.[4] The difference from 2003 to 2007 was smaller but also a significant increase. The high performance at this age then stabilised from 2007 to 2011.

Interpreting the data: England's Y5 mathematics trends

The diagram shows England's mean scale score in each cycle from 1995 onwards (the 1999 cycle of TIMSS included only older pupils, not the 9–10 year olds). Only the differences between 1995–2003 and 2003–2007 are statistically significant.

Figure 1.1: Trends in Y5 mathematics achievement in England



Source: Exhibit 1.7, international mathematics report

Source of statistical significance information: Exhibit 1.5 in the same report

4 Exhibit 1.5 in the international mathematics report identifies this difference as statistically significant.

Among the six countries and one benchmarking participant performing similarly to England in TIMSS 2011 mathematics at ages 9–10, two had not previously participated at this age range: Finland and Florida. Table B.1 in Appendix B summarises the performance trends of the other countries in the same achievement band as England in TIMSS 2011. It shows a variety of trends, and only the United States and Denmark have made improvements over time to reach the level of England's attainment at this age range. Two further countries which performed similarly to England in 2007 were Kazakhstan and Latvia. Kazakhstan performed less well than England in TIMSS 2011, while Latvia did not participate.

Table B.2 in Appendix B shows parallel trend information for those participants performing better than England in Y5 mathematics in TIMSS 2011. It is notable that these higher–performing participants have all shown an improvement in at least one TIMSS cycle, with Chinese Taipei showing an increase in every participating cycle. Hong Kong's trend follows a similar pattern to England's (although Hong Kong started from a higher score threshold).

1.2 Mathematics attainment: Year 9

The TIMSS 2011 score for Year 9 (Y9) pupils in England was 507, not significantly different from the centre point of the international scale (500) and ranking tenth among participating nations.[5] Once again, the highest performing countries were those in the Asian Pacific Rim (five countries), and no other European nation performed significantly better than England. Table 1.3 summarises England's performance internationally, taking account of the significance of any apparent differences in attainment, while Table 1.4 shows the rankings for mathematics at ages 13–14 (international 'grade 8').

5 Rankings should be treated with caution as some apparent differences in attainment may not be significant. See 'Interpreting the data: international rankings' for more information.

Interpreting the data: performance groups

See section 1.1 for a summary of how to interpret this table.

Table 1.3 TIMSS 2011 performance groups: mathematics at ages 13–14

HIGHER performance compared with England Participants performing at a significantly higher level than England		**SIMILAR performance compared with England** Participants performing at a similar level to England (not statistically significantly different)		**LOWER performance compared with England** Participants performing at a significantly lower level than England	
6 countries [and 4 benchmarking participants] (with their scale scores)		**8 other countries [and 7 benchmarking participants]** (with their scale scores)		**27 countries [and 3 benchmarking participants]** *including…* (with their scale scores)	
Korea	613	[Indiana, US]	[522]	New Zealand	488
Singapore	611	[Colorado, US]	[518]	Kazakhstan	487
Chinese Taipei	609	[Connecticut, US]	[518]	Sweden	484
Hong Kong	586	Israel	516	Norway	475
Japan	570	Finland	514	[Alabama, US]	[466]
[Massachusetts, US]	[561]	[Florida, US]	[513]		
[Minnesota, US]	[545]	[Ontario, Canada]	[512]		
Russian Federation	539	United States	509		
[North Carolina, US]	[537]	**England**	**507**		
[Quebec, Canada]	[532]	[Alberta, Canada]	[505]		
		Hungary	505		
		Australia	505		
		Slovenia	505		
		Lithuania	502		
		Italy	498		
		[California, US]	[493]		

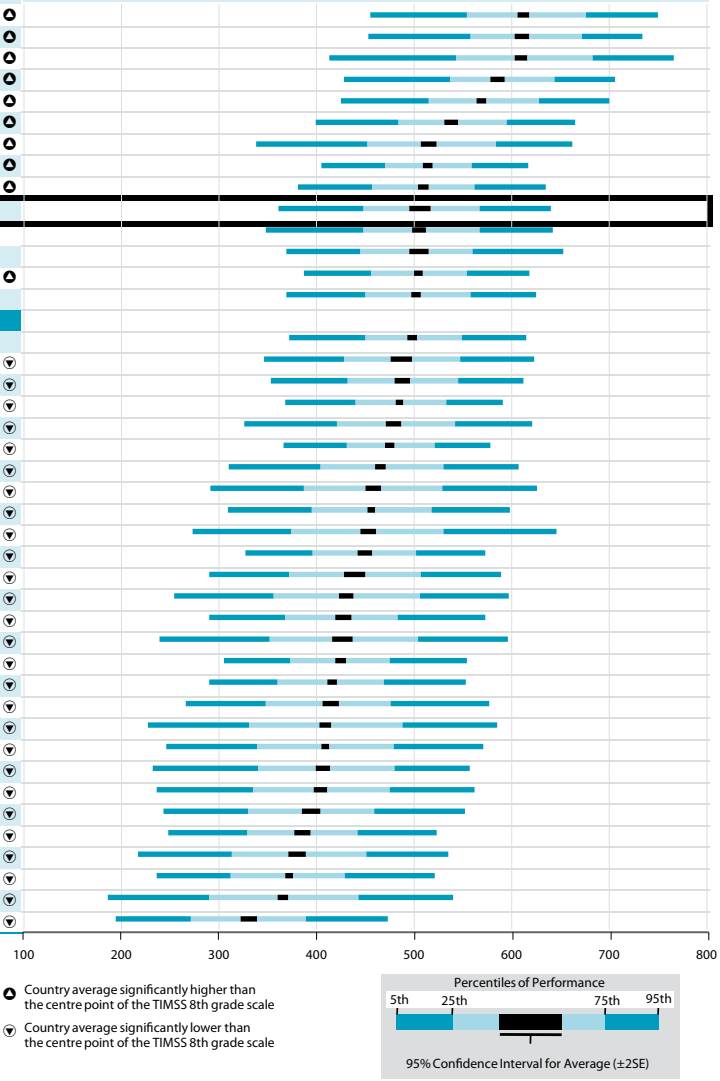
Source: Exhibit 1.4, international mathematics report

Interpreting the data: international rankings

See section 1.1 for a summary of how to interpret this table. The distribution of scores is discussed in chapter 2.

Table 1.4 Mean scores and distribution of Y9 mathematics achievement, TIMSS 2011

Country	Average Scale Score	
Korea, Rep. of	613 (2.9)	▲
[2] Singapore	611 (3.8)	▲
Chinese Taipei	609 (3.2)	▲
Hong Kong SAR	586 (3.8)	▲
Japan	570 (2.6)	▲
[2] Russian Federation	539 (3.6)	▲
[3] Israel	516 (4.1)	▲
Finland	514 (2.5)	▲
[2] United States	509 (2.6)	▲
‡ England	507 (5.5)	
Hungary	505 (3.5)	
Australia	505 (5.1)	
Slovenia	505 (2.2)	▲
[1] Lithuania	502 (2.5)	
TIMSS Scale Centre point	500	
Italy	498 (2.4)	
New Zealand	488 (5.5)	▼
Kazakhstan	487 (4.0)	▼
Sweden	484 (1.9)	▼
Ukraine	479 (3.9)	▼
Norway	475 (2.4)	▼
Armenia	467 (2.7)	▼
Romania	458 (4.0)	▼
United Arab Emirates	456 (2.1)	▼
Turkey	452 (3.9)	▼
Lebanon	449 (3.7)	▼
Malaysia	440 (5.4)	▼
[1] Georgia	431 (3.8)	▼
Thailand	427 (4.3)	▼
Ψ Macedonia, Rep. of	426 (5.2)	▼
Tunisia	425 (2.8)	▼
Chile	416 (2.6)	▼
Ψ Iran, Islamic Rep. of	415 (4.3)	▼
Ψ Qatar	410 (3.1)	▼
Ψ Bahrain	409 (2.0)	▼
Ψ Jordan	406 (3.7)	▼
Ψ Palestinian Nat'l Auth.	404 (3.5)	▼
Ψ Saudi Arabia	394 (4.6)	▼
Ψ Indonesia	386 (4.3)	▼
Ψ Syrian Arab Republic	380 (4.5)	▼
Ж Morocco	371 (2.0)	▼
Ψ Oman	366 (2.8)	▼
Ж Ghana	331 (4.3)	▼

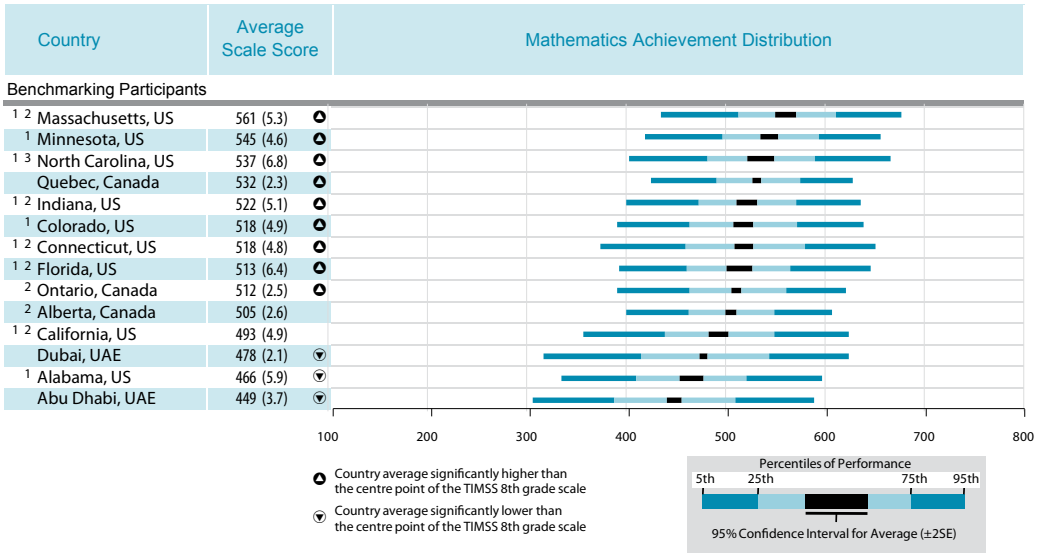


Ж Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

Ψ Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation does not exceed 25% but exceeds 15%.

See Appendix C.3 in the international report for target population coverage notes 1, 2, and 3. See Appendix C.9 for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



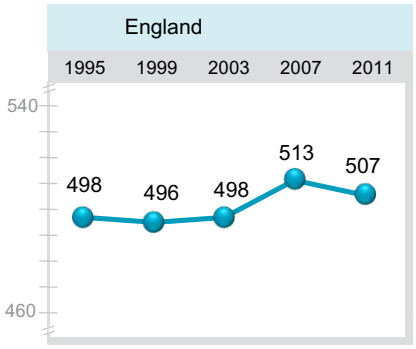
Source: Exhibit 1.2, international mathematics report

As noted in section 1.1, rankings can be volatile, varying according to the blend of countries participating in any given cycle. However, measurement of trends can indicate progress in a more stable fashion, since the outcomes from successive cycles of TIMSS are analysed on comparable scales. Five TIMSS cycles have involved pupils aged 13–14 and trend analysis shows that England's mathematics scores have remained relatively stable across that time span. England's trends are shown in Figure 1.2 below. There was a significant increase in 2007, compared with the scores of the previous three cycles.[6] The 2011 score of 507 is not significantly different from the 2007 score of 513.

Interpreting the data: England's Y9 mathematics trends

The diagram shows England's mean scale score in each cycle from 1995 onwards. Only the difference between 2003 and 2007 is statistically significant. The 2011 score is not significantly different from that of any other year.

Figure 1.2 Trends in Y9 mathematics achievement in England



Source: Exhibit 1.8, international mathematics report

Source of statistical significance information: Exhibit 1.6 in the same report

6 See Exhibit 1.6 in the international mathematics report.

Among the eight countries and seven benchmarking participants performing similarly to England in TIMSS 2011 mathematics at ages 13–14, three had not previously participated (the three benchmarking states of Colorado, Florida and California). Table B.3 in Appendix B summarises the performance trends of the other countries in the same achievement band as England in TIMSS 2011. It shows a mixed picture, generally of stability (e.g. Indiana and Connecticut) and/or decline (e.g. Alberta and Finland[7]), with only a few participants improving at some point (e.g. Italy in 2011, and United States, Slovenia and Lithuania, like England, making some improvement in earlier cycles). Two further participants which performed similarly to England in 2007 were the Russian Federation (now outperforming England in this age group) and the Czech Republic (which did not participate at this age group in 2011).

Table B.4 in Appendix B shows parallel trend information for those participants performing better than England in Y9 mathematics in TIMSS 2011. The findings are more mixed than for Y5, although once again the higher–performing Pacific Rim countries display a tendency to show an increase in at least one cycle. However, whereas at ages 9–10, this improvement in the Pacific Rim countries was sometimes interspersed with periods of stability, at ages 13–14 some periods of decline are seen (Singapore and Hong Kong). For the other higher–performing regions or nations which have participated in more than two cycles, progress is similarly variable for this age group: a mix of stability, decline and/or improvement over time is seen.

Because TIMSS is a four–yearly survey and involves pupils four years apart in their schooling, the Y9 cohort taking the current cycle of TIMSS will also have been involved in the previous cycle as a Y5 cohort. As a result, it is possible to compare directly the result of four more years of schooling. Table 1.5 shows the mathematics outcomes for participants in both the 2011 and 2007 cycles. In these cases, their TIMSS 2007 Y5 cohort was also their TIMSS 2011 Y9 cohort.[8]

Interpreting the data: relative achievement

Although the cohort of pupils in each half of the table is the same, the pupils comprising the samples within that cohort will have differed. They will also have taken a different assessment, corresponding to a slightly different assessment framework (setting out the curriculum content to be assessed). However, since the results are nationally representative and based on parallel scales, it is possible to calculate the difference from the centre point of the scale for the cohort at each time point and, from that, to evaluate how well the same cohort of pupils has performed, relatively, at each time point.

7 In 1999, Finland participated in TIMSS at 7th grade (pupils a year younger than the 8th grade (Y9) pupils tested in TIMSS 2011); in 2011, Finland tested both 7th and 8th graders (Y8 and Y9 equivalents). The trend data identified here is, therefore, for 7th graders only.

8 Note that the term ‘cohort’ refers to the whole year group from which the participating TIMSS pupils were sampled. While the Y9 cohort from which the 2011 sample was drawn was the same as the Y5 cohort in TIMSS 2007, different pupils from the cohort would have been sampled each time (i.e. a nationally representative sample each time, but not identical groups of pupils in each sample).

Table 1.5 Relative mathematics achievement of 2007 Y5 cohort as Y9 cohort in 2011[9]

2007 - Fourth Grade			2011 - Eighth Grade		
Country	Achievement Difference from TIMSS Scale Centre point (500)		Country	Achievement Difference from TIMSS Scale Centre point (500)	
Hong Kong SAR	107 (3.6)	▲	Singapore	111 (3.8)	▲
Singapore	99 (3.7)	▲	Chinese Taipei	109 (3.2)	▲
Chinese Taipei	76 (1.7)	▲	Hong Kong SAR	86 (3.8)	▲
Japan	68 (2.1)	▲	Japan	70 (2.6)	▲
Russian Federation	44 (4.9)	▲	Russian Federation	39 (3.6)	▲
England	41 (2.9)	▲	United States	9 (2.6)	▲
Lithuania	30 (2.4)	▲	England	7 (5.5)	
United States	29 (2.4)	▲	Hungary	5 (3.5)	
Australia	16 (3.5)	▲	Australia	5 (5.1)	
Hungary	10 (3.5)	▲	Slovenia	5 (2.2)	▲
Italy	7 (3.1)	▲	Lithuania	2 (2.5)	
Sweden	3 (2.5)		Italy	-2 (2.4)	
Slovenia	2 (1.8)		Sweden	-16 (1.9)	▼
Norway	-27 (2.5)	▼	Norway	-25 (2.4)	▼
Georgia	-62 (4.2)	▼	Georgia	-69 (3.8)	▼
Iran, Islamic Rep. of	-98 (4.1)	▼	Tunisia	-75 (2.8)	▼
Tunisia	-173 (4.5)	▼	Iran, Islamic Rep. of	-85 (4.3)	▼
Benchmarking Participants			Benchmarking Participants		
Quebec, Canada	19 (3.0)	▲	Quebec, Canada	32 (2.3)	▲
Ontario, Canada	12 (3.1)	▲	Ontario, Canada	12 (2.5)	▲
Dubai, UAE	-56 (2.1)	▼	Dubai, UAE	-22 (2.1)	▼

▲ Country average significantly higher than the centre point of the TIMSS scale
▼ Country average significantly lower than the centre point of the TIMSS scale

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.9, international mathematics report

For many participants, their 2011 mathematics scores at Y9 were closer to the mid–point of the scale, compared with those at for Y5 in 2007. This implies that the relative level of mathematics attainment demonstrated by their pupils at primary school did not continue into secondary school. Participants where this applied included England, Hong Kong, United States, Australia, Italy and Sweden. These generally showed a similar trend in the earlier 2003–to–2007 cohort comparison.[10] Among this group, only Hong Kong showed relative stability across the two time points in the 2003–to–2007 comparison, while all others (apart from Sweden, which did not participate in 2003) showed a decline from primary to secondary relative attainment in that earlier comparison as well as in the current comparison. This suggests that secondary schools in these countries may not be able to capitalise effectively on the earlier mathematics achievement of their pupils at primary school.

Only three of the participants improved noticeably in their distance from the mid–point of the scale across the two time points: Singapore, Chinese Taipei and Quebec. This implies that, in these countries and benchmarking region, pupils who were doing reasonably well at primary school did even better at secondary school. For Chinese Taipei and Quebec, the trend was the same for the 2003–to–2007 cohort, suggesting that their secondary schools may consistently add 'value' to their pupils' experience of mathematics at primary school. However, Singapore had similar relative attainment across the 2003–to–2007 time points, perhaps indicating that their schools might have previously maintained the level of progress across the two sectors and is now

9 This table is taken from the international report. 'Fourth grade' refers to pupils aged 9–10 years (Y5 in England) and 'Eighth grade' refers to 13–14 year olds (Y9 in England).

10 See Mullis *et al* (2008)

improving it. Further trend data in subsequent cycles would be needed in order to confirm or refine this hypothesis.

For many participants, the relative attainment of this cohort four years apart remained at a similar level, implying that their primary and secondary schools were supporting pupils' mathematics progress to a similar extent. Participants where this applied include Japan, Russian Federation, Slovenia, Norway and Ontario. The 2003–to–2007 comparative analysis for this group of participants was more volatile, with some showing stable relative attainment across the earlier cycles, some relative improvement and others relative decline.

1.3 Science attainment: Year 5

The TIMSS 2011 score for Year 5 (Y5) pupils in England was 529, significantly above the centre point of the international scale (500) and ranking 15th among participating nations.[11] As was the case for TIMSS 2007, the highest performing countries were Asian Pacific Rim countries (excluding Hong Kong, in this case). However, unlike mathematics in 2011, England was outperformed by other European countries in science at this age range: Finland and the Czech Republic both scored more highly. Table 1.6 summarises England's performance internationally, taking account of the significance of any apparent differences in attainment, while Table 1.7 shows the rankings for science at ages 9–10 (international 'grade 4').

Interpreting the data: performance groups

See section 1.1 for a summary of how to interpret this table.

11 Rankings should be treated with caution as some apparent differences in attainment may not be significant. See 'Interpreting the data: international rankings' for more information.

Table 1.6 TIMSS 2011 performance groups: science at ages 9–10

HIGHER performance compared with England Participants performing at a significantly higher level than England		**SIMILAR performance compared with England** Participants performing at a similar level to England (not statistically significantly different)		**LOWER performance compared with England** Participants performing at a significantly lower level than England	
8 countries [and 2 benchmarking participants] (with their scale scores)		**10 other countries [and 2 benchmarking participants]** (with their scale scores)		**31 countries [and 3 benchmarking participants]** *including…* (with their scale scores)	
Korea	587	[North Carolina, US]	[538]	Slovenia	520
Singapore	583	Hong Kong	535	Northern Ireland	517
Finland	570	Hungary	534	Ireland, Rep of	516
Japan	559	Sweden	533	[Quebec, Canada]	[516]
Russian Federation	552	Slovak Republic	532	Australia	516
Chinese Taipei	552	Austria	532	Belgium (Flemish)	509
[Florida, US]	[545]	Netherlands	531	Spain	505
United States	544	**England**	**529**	New Zealand	497
[Alberta, Canada]	[541]	Denmark	528	Kazakhstan	495
Czech Republic[12]	536	Germany	528	Norway	494
		[Ontario, Canada]	[528]		
		Italy	524		
		Portugal	522		

Source: Exhibit 1.3, international science report

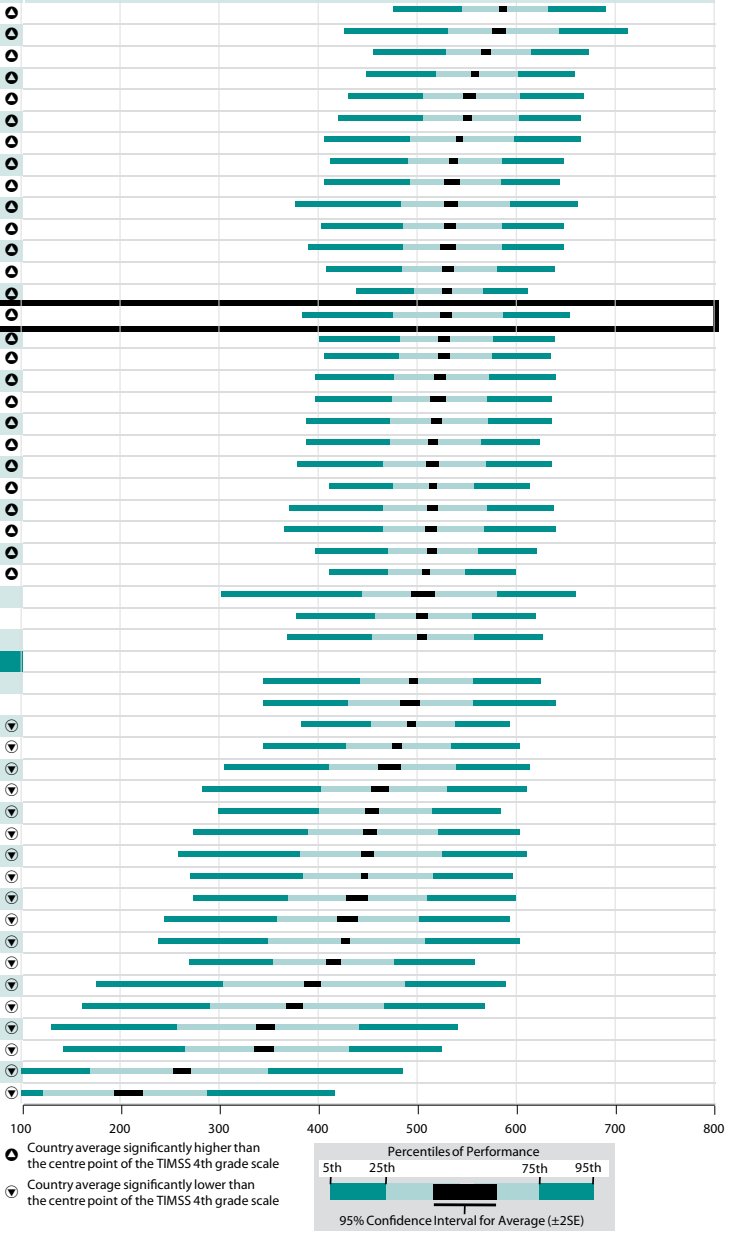
12 Taking account of the size of standard errors, this score is significantly higher than the mean score for England, despite being lower than the mean score for North Carolina (which has a larger standard error).

Interpreting the data: international rankings

See section 1.1 for a summary of how to interpret this table. The distribution of scores is discussed in chapter 2.

Table 1.7 Mean scores and distribution of Y5 science achievement, TIMSS 2011

Country	Average Scale Score	Science Achievement Distribution
Korea, Rep. of	587 (2.0)	▲
[2] Singapore	583 (3.4)	▲
Finland	570 (2.6)	▲
Japan	559 (1.9)	▲
Russian Federation	552 (3.5)	▲
Chinese Taipei	552 (2.2)	▲
[2] United States	544 (2.1)	▲
Czech Republic	536 (2.5)	▲
[2] Hong Kong SAR	535 (3.8)	▲
Hungary	534 (3.7)	▲
Sweden	533 (2.7)	▲
Slovak Republic	532 (3.8)	▲
Austria	532 (2.8)	▲
[†] Netherlands	531 (2.2)	▲
England	529 (2.9)	▲
[2] Denmark	528 (2.8)	▲
Germany	528 (2.9)	▲
Italy	524 (2.7)	▲
Portugal	522 (3.9)	▲
Slovenia	520 (2.7)	▲
[†] Northern Ireland	517 (2.6)	▲
Ireland, Rep. of	516 (3.4)	▲
[2] Croatia	516 (2.1)	▲
Australia	516 (2.8)	▲
[2] Serbia	516 (3.1)	▲
[1 2] Lithuania	515 (2.4)	▲
Belgium (Flemish)	509 (2.0)	▲
Romania	505 (5.9)	
Spain	505 (3.0)	
Poland	505 (2.6)	
TIMSS Scale Centre point	500	
New Zealand	497 (2.3)	
[2] Kazakhstan	495 (5.1)	
[‡] Norway	494 (2.3)	▼
Chile	480 (2.4)	▼
Thailand	472 (5.6)	▼
Turkey	463 (4.5)	▼
[1] Georgia	455 (3.8)	▼
Iran, Islamic Rep. of	453 (3.7)	▼
Bahrain	449 (3.5)	▼
Malta	446 (1.9)	▼
[2] Azerbaijan	438 (5.6)	▼
Saudi Arabia	429 (5.4)	▼
United Arab Emirates	428 (2.5)	▼
Armenia	416 (3.8)	▼
[2] Qatar	394 (4.3)	▼
Oman	377 (4.3)	▼
[1 Ψ] Kuwait	347 (4.7)	▼
[Ψ] Tunisia	346 (5.3)	▼
[Ж] Morocco	264 (4.5)	▼
[Ж] Yemen	209 (7.3)	▼

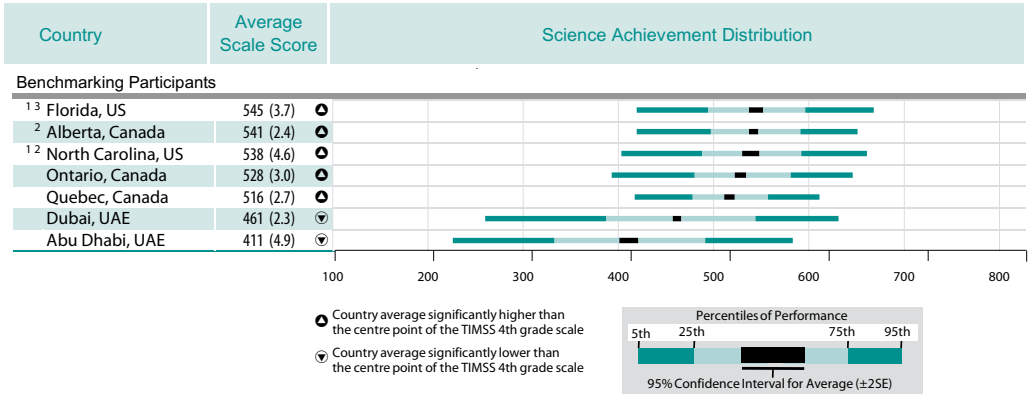


Ж Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

Ψ Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation does not exceed 25% but exceeds 15%.

See Appendix C.2 in international report for target population coverage notes 1, 2, and 3. See Appendix C.8 for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



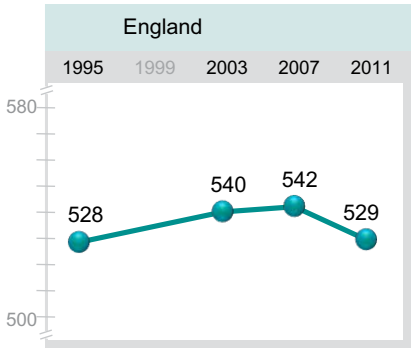
Source: Exhibit 1.1, international science report

As noted earlier, rankings can be volatile, varying according to the mix of countries participating in any given cycle. However, measurement of trends can indicate progress in a more stable fashion, since the outcomes from successive cycles of TIMSS are analysed on comparable scales. Trend analysis shows that England's attainment in Y5 science, although still relatively high, has nevertheless declined since the last TIMSS cycle in 2007. England's score then was 542, significantly higher than its 2011 score of 529. Prior to 2011, science attainment had risen between 1995 and 2003, and remained stable between 2003 and 2007. These trends in England's science scores are summarised in Figure 1.3 below. The significant decline between 2007 and 2011 coincides with the ending of the mandatory key stage 2 tests in science (in 2009) and the introduction in 2010 of science monitoring tests for a sample of key stage 2 pupils.

Interpreting the data: England's Y5 science trends

The diagram shows England's mean scale score in each cycle from 1995 onwards (the 1999 cycle of TIMSS included only the older pupils, not the 9–10 year olds). The differences between 1995–2003 and 2007–2011 are statistically significant.

Figure 1.3 Trends in Y5 science achievement in England



Source: Exhibit 1.7, international science report

Source of statistical significance information: Exhibit 1.5 in the same report

Among the 10 countries and two benchmarking participants performing similarly to England in TIMSS 2011 science at ages 9–10, only one had not previously participated: North Carolina. Table B.5 in Appendix B summarises the performance trends of the other participants in the same achievement band as England in TIMSS 2011. Notably, most of the participants that performed similarly to England in TIMSS 2011 Y5 science performed at a lower level than England in 2007. In some cases, these participants have increased their score to match that of England in 2011. However, in other cases, those participants have remained stable or their score has declined, indicating that it is the drop in England's score that has contributed to the similar performance in 2011.

Five further countries which performed similarly to England in 2007 were Japan, Russian Federation, Latvia, United States and Kazakhstan. Latvia did not participate in TIMSS 2011, while Kazakhstan did less well than England in 2011. However, Japan, Russian Federation and the United States all did better than England in 2011, Japan by increasing its score and the remaining two countries by remaining stable in their scores.

Table B.6 in Appendix B shows parallel trend information for those participants outperforming England in Y5 science in TIMSS 2011. Whereas, for mathematics, the higher–performing participants tended to show an increase in one or more of the TIMSS cycles, for science, there is no such clear pattern. Table B.6 shows a mixed picture of increases, declines and stability and this is true for the typically higher–performing Pacific Rim countries as well as for the other higher scoring participants.

1.4 Science attainment: Year 9

The TIMSS 2011 score for Year 9 (Y9) pupils in England was 533, above the centre point of the international scale (500) and ranking ninth among participating nations.[13] The five countries performing significantly better than England were four of the Asian Pacific Rim countries and Finland. Table 1.8 summarises England's performance internationally, taking account of the significance of any apparent differences in attainment, while Table 1.9 shows the rankings for science at ages 13–14.

13 Rankings should be treated with caution as some apparent differences in attainment may not be significant. See 'Interpreting the data: international rankings' in section 1.1 for more information.

Interpreting the data: performance groups

See section 1.1 for a summary of how to interpret this table.

Table 1.8 TIMSS 2011 performance groups: science at ages 13–14

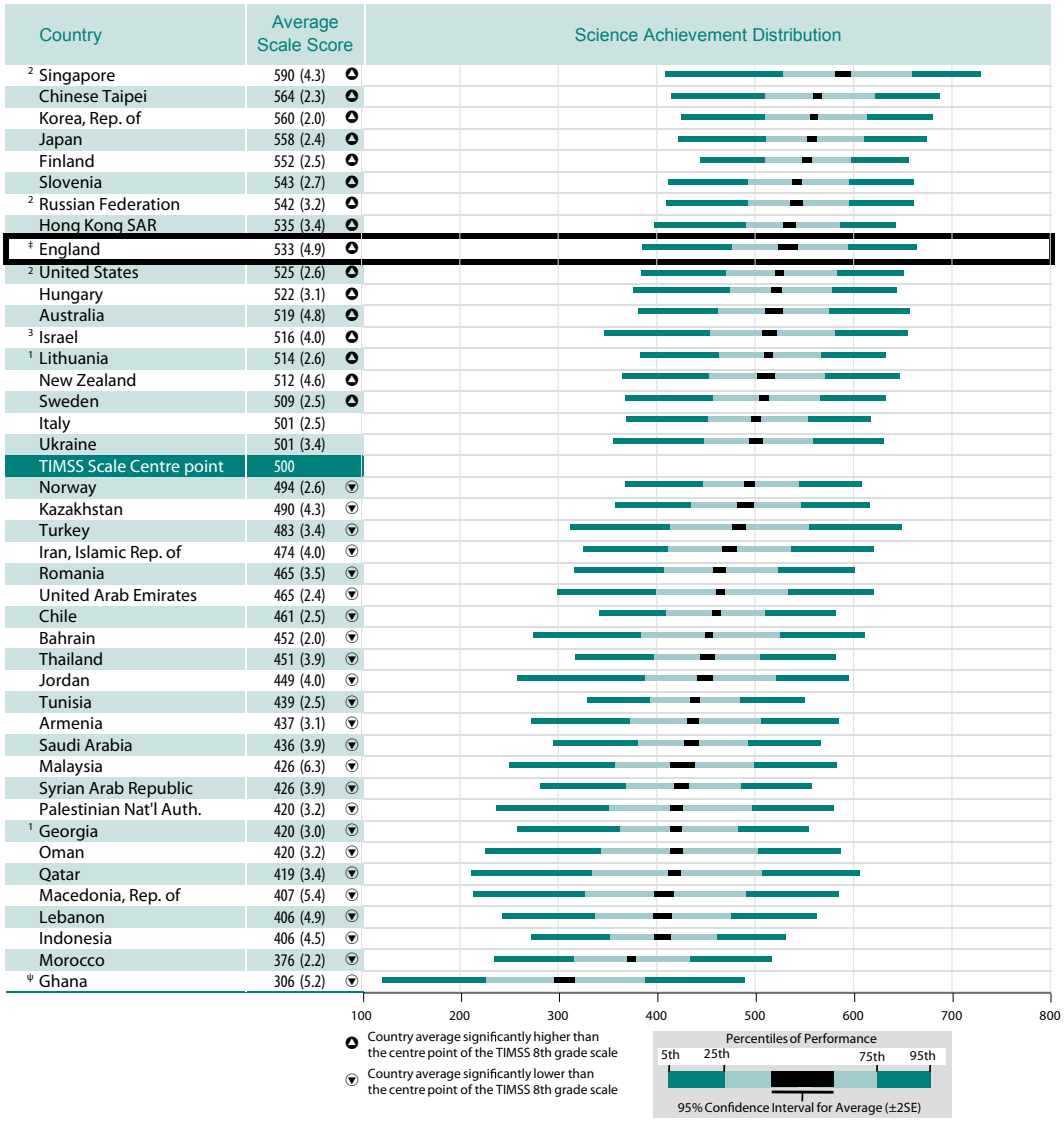
HIGHER performance compared with England Participants performing at a significantly higher level than England		**SIMILAR performance compared with England** Participants performing at a similar level to England (not statistically significantly different)		**LOWER performance compared with England** Participants performing at a significantly lower level than England	
5 countries [and 3 benchmarking participants] (with their scale scores)		**5 other countries [and 5 benchmarking participants]** (with their scale scores)		**31 countries [and 6 benchmarking participants]** *including…* (with their scale scores)	
Singapore	590	Slovenia	543	[Ontario, Canada]	[521]
[Massachusetts, US]	[567]	Russian Federation	542	[Quebec, Canada]	[520]
Chinese Taipei	564	[Colorado, US]	[542]	Australia	519
Korea	560	Hong Kong	535	Israel	516
Japan	558	[Indiana, US]	[533]	Lithuania	514
[Minnesota, US]	[553]	**England**	**533**	New Zealand	512
Finland	552	[Connecticut, US]	[532]	Sweden	509
[Alberta, Canada]	[546]	[North Carolina, US]	[532]	Italy	501
		[Florida, US]	[530]	Norway	494
		United States	525	Kazakhstan	490
		Hungary	522	[California, US]	[490]
				[Alabama, US]	[485]

Source: Exhibit 1.4, international science report

Interpreting the data: international rankings

See section 1.1 for a summary of how to interpret this table. The distribution of scores is discussed in chapter 2.

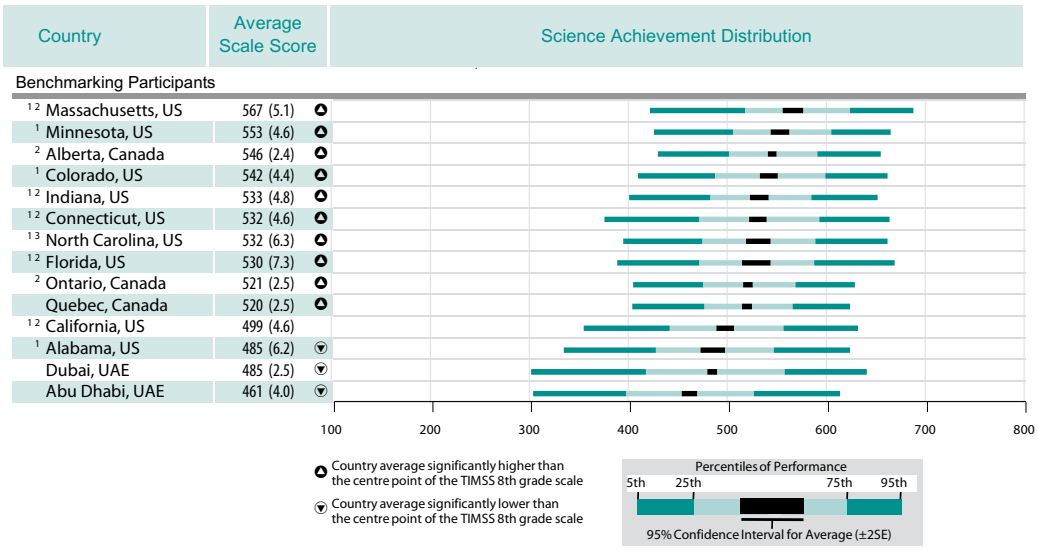
Table 1.9 Mean scores and distribution of Y9 science achievement, TIMSS 2011



Ψ Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation does not exceed 25% but exceeds 15%.

See Appendix C.3 in the international report for target population coverage notes 1, 2, and 3. See Appendix C.9 for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



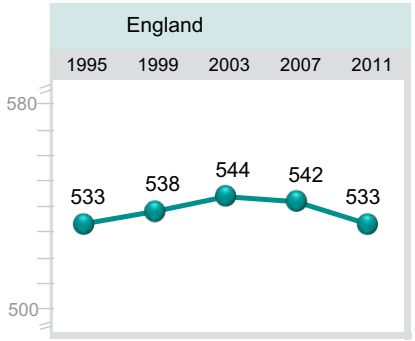
Source: Exhibit 1.2, international science report

As noted earlier, rankings can be volatile, varying according to the blend of countries participating in any given cycle. However, measurement of trends indicates progress in a more stable fashion, since the outcomes from successive cycles of TIMSS are analysed on comparable scales. Five TIMSS cycles have involved pupils aged 13–14 and trend analysis shows that England's Y9 science scores have remained stable across that time span, with no significant differences in attainment, as shown in Figure 1.4 below.

Interpreting the data: England's Y9 science trends

The diagram shows England's mean scale score in each cycle from 1995 onwards. None of the differences are statistically significant.

Figure 1.4 Trends in Y9 science achievement in England



Source: Exhibit 1.8, international science report

Source of statistical significance information: Exhibit 1.6 in the same report

Among the five countries and five benchmarking participants performing similarly to England in TIMSS 2011 science at ages 13–14, two had not previously participated (the benchmarking states of Colorado and Florida). Table B.7 in Appendix B summarises the performance trends of the other participants in the same achievement band as England in TIMSS 2011. A handful of these participants improved their scores in 2011 but others, like England, maintained their previous level of achievement. The Czech Republic also performed similarly to England in TIMSS 2007, but did not take part at this age range in TIMSS 2011.

Table B.8 in Appendix B shows parallel trend information for those participants performing better than England in TIMSS 2011. Once again, there are no patterns in terms of the progress of these higher–performing participants. While some of them (e.g. Singapore and Japan) show some increases over time despite their high baseline, the table overall shows a mixture of increases, stability and decline, even among the highest performers.

As noted in section 1.2, because TIMSS is a four–yearly survey and involves pupils four years apart in their schooling, the Y9 cohort taking the latest cycle of TIMSS will also have been involved in the previous cycle as a Y5 cohort. As a result, it is possible to compare directly the result of four more years of schooling. Table 1.10 shows the science outcomes for participants in both the 2011 and 2007 cycles. In these cases, their TIMSS 2007 Y5 cohort was also their TIMSS 2011 Y9 cohort.[14]

Interpreting the data: relative achievement

Although the cohort of pupils in each half of the table is the same, the pupils comprising the samples within that cohort will have differed. They will also have taken a different assessment, corresponding to a slightly different assessment framework (setting out the curriculum content to be assessed). However, since the results are nationally representative and based on parallel scales, it is possible to calculate the difference from the centre point of the scale for the cohort at each time point and, from that, to evaluate how well the same cohort of pupils has performed, relatively, at each time point.

14 Note that the term ‘cohort’ refers to the whole year group from which the participating TIMSS pupils were sampled. While the Y9 cohort from which the 2011 sample was drawn was the same as the Y5 cohort in TIMSS 2007, different pupils from the cohort would have been sampled each time (i.e. a nationally representative sample each time, but not identical groups of pupils in each sample).

Table 1.10 Relative science achievement of 2007 Y5 cohort as Y9 cohort in 2011[15]

2007 - Fourth Grade			2011 - Eighth Grade		
Country	Achievement Difference from TIMSS Scale Centre point (500)		Country	Achievement Difference from TIMSS Scale Centre point (500)	
Singapore	87 (4.1)	▲	Singapore	90 (4.3)	▲
Chinese Taipei	57 (2.0)	▲	Chinese Taipei	64 (2.3)	▲
Hong Kong SAR	54 (3.5)	▲	Japan	58 (2.4)	▲
Japan	48 (2.1)	▲	Slovenia	43 (2.7)	▲
Russian Federation	46 (4.8)	▲	Russian Federation	42 (3.2)	▲
England	42 (2.9)	▲	Hong Kong SAR	35 (3.4)	▲
United States	39 (2.7)	▲	England	33 (4.9)	▲
Hungary	36 (3.3)	▲	United States	25 (2.6)	▲
Italy	35 (3.2)	▲	Hungary	22 (3.1)	▲
Australia	27 (3.3)	▲	Australia	19 (4.8)	▲
Sweden	25 (2.9)	▲	Lithuania	14 (2.6)	▲
Slovenia	18 (1.9)	▲	Sweden	9 (2.5)	▲
Lithuania	14 (2.4)	▲	Italy	1 (2.5)	
Norway	-23 (3.5)	▼	Norway	-6 (2.6)	▼
Iran, Islamic Rep. of	-64 (4.3)	▼	Iran, Islamic Rep. of	-26 (4.0)	▼
Georgia	-82 (4.6)	▼	Tunisia	-61 (2.5)	▼
Tunisia	-182 (5.9)	▼	Georgia	-80 (3.0)	▼
Benchmarking Participants			Benchmarking Participants		
Ontario, Canada	36 (3.7)	▲	Ontario, Canada	21 (2.5)	▲
Quebec, Canada	17 (2.7)	▲	Quebec, Canada	20 (2.5)	▲
Dubai, UAE	-40 (2.8)	▼	Dubai, UAE	-15 (2.5)	▼

▲ Country average significantly higher than the centre point of the TIMSS scale
▼ Country average significantly lower than the centre point of the TIMSS scale

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.9, international science report

Participants for whom 2011 scores at Y9 were lower (relative to their mean score) compared with those at 2007 Y5 included England, Hong Kong, United States, Hungary and Italy. This implies that the level of relative attainment demonstrated at primary school did not continue into secondary school. While Hong Kong, United States and Italy showed a similarly declining pattern for the earlier 2003–to–2007 cohort comparison,[16] Hungary showed a relative increase from primary to secondary school. England showed a similar level of relative attainment in each sector in the 2003–to–2007 comparison. This suggests that the science attainment of England's secondary pupils may have declined relative to the rate of primary–to–secondary progress that might have been expected four years ago.

Only four of the participants made large improvements in their distance from the mid–point of the scale across the two time points: Slovenia, Norway, Iran and Tunisia. This implies that, in these countries, pupils who scored at a particular level in science in primary school did much better at secondary school. These countries had experienced a similar journey for their 2003–to–2007 cohort, suggesting that the relative increase in attainment between primary and secondary education is a relatively consistent feature of their system.

For some 2011 participants, including Singapore and Chinese Taipei, the attainment of this cohort four years apart remained at a broadly similar level, implying that their primary and secondary schools were supporting pupils' progress to a similar degree. This was also the case for Singapore for the 2003–2007 cohort, although Chinese Taipei had a 10–point primary–to–secondary relative increase in that cycle (compared with a seven point increase in the 2007–2011 comparison).

15 This table is taken from the international report. 'Fourth grade' refers to pupils aged 9–10 years (Y5 in England) and 'Eighth grade' refers to 13–14 year olds (Y9 in England).

16 See Martin *et al* (2008)

Chapter 2 Distribution of attainment in TIMSS 2011

Chapter outline

This chapter outlines the distribution of attainment in mathematics and science in England in Year 5 (Y5, ages 9 –10) and Year 9 (Y9, ages 13 –14) in 2011 and over time. It describes the TIMSS 'benchmarks' of achievement and the proportions reaching each benchmark. It is accompanied by an appendix containing sample test items illustrating questions at each benchmark level.

Key findings

- For mathematics and science at Y5 and Y9 in England, the difference in attainment between the highest and lowest performing pupils was just under 300 TIMSS scale points.
- The highest performing countries tended to have narrower or similar ranges of attainment compared with England, although there were exceptions (e.g. Chinese Taipei had a wider range of attainment for Y9 mathematics, and Singapore had a wider range of attainment in science for both age groups).
- For both subjects at both ages, the distributions of attainment tended to show a wider range of attainment for pupils below a country's average score than for those above it.
- For Y5 mathematics and science and for Y9 science, England had between 40 and 50 per cent of pupils at the top two international benchmarks. For Y9 mathematics, the figure was lower at 32 per cent. The comparable figures for the highest performing Pacific Rim countries in each case were between about 60 and 80 per cent.
- At Y5, England's proportions of pupils at the top two benchmarks were similar for mathematics and science. In contrast, the countries performing significantly[17] better than England typically had more pupils in the top two benchmarks for mathematics than for science.
- At Y9, England had more pupils at the top two benchmarks for science than for mathematics. Some of those performing significantly better than England had a similar pattern, while the other highest performers again had more high attaining pupils in mathematics than science.
- In England, 7 per cent failed to reach the Low benchmark for either subject at Y5 and for science at Y9. A larger proportion of 12 per cent failed to reach the Low benchmark for mathematics at Y9. The equivalent figures for the highest performing participants were typically at or lower than 4 per cent for each subject at each age range.
- England's proportions of Y9 pupils at the top two benchmarks for mathematics and science have not changed significantly since 2007. There was also no significant change for Y5 mathematics. The proportions at the top two benchmarks for Y5 science in England decreased significantly since TIMSS 2007.

17 Throughout this report, findings listed as 'significant' are statistically significant.

- Participants performing better than England tended to have increased their percentages at the top two benchmarks for mathematics. Most of the highest performing participants also improved their percentages at the top two benchmarks in science at both ages. Chinese Taipei and Hong Kong, like England, had fewer pupils at the top benchmarks for Y5 science in 2011 compared with 2007.

2.1 Distribution of mathematics attainment: Year 5

England's mean score at Y5 mathematics was 542, but there was relatively wide variation between the highest and lowest scoring pupils in England: a range of just under 300 TIMSS scale points (see Table 2.1). Northern Ireland had a similarly wide range of attainment but the range in the other countries performing significantly better than England was narrower: approximately 30 to 100 scale points narrower than the range in England (see Table 1.2 in Chapter 1). For most countries and benchmarking participants, the distribution of attainment shows a wider range of attainment for scores below the Y5 mathematics average than above it.

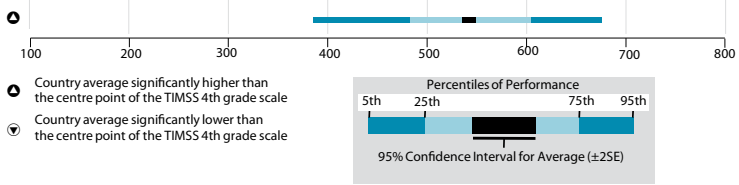
Interpreting the data: England's mean score and distribution

The TIMSS achievement scale summarises pupil performance on a scale with a centre point of 500 and a standard deviation of 100. The shaded line represents the range of scores achieved by 90 per cent of pupils in England. The scores of the top 5 per cent and bottom 5 per cent in each country are excluded from the international table as they represent outliers.

The dark bar towards the centre of the distribution for each country indicates the country's average score with 95 per cent confidence interval. The 5th and 95th percentiles indicate the range of performance for the majority of pupils in a country (i.e. the 5th percentile indicates that 5 per cent of the scores for that country will be less than or equal to the score at that point of the range, and the 95th percentile indicates that 95 per cent of the scores will be less than or equal to the score at that point of the range). The lighter shading on either side of the country average indicates the range of scores achieved by the middle 50 per cent of pupils.

Table 2.1 England's mean score and distribution, Y5 mathematics achievement

Country	Average Scale Score	Mathematics Achievement Distribution
England	542 (3.5)	



( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.1, international mathematics report

The distribution of achievement can be explored further by looking at the percentages of the sample achieving each of the TIMSS benchmarks (see the 'Interpreting the data' box below for more information about benchmarks). Table 2.2 summarises the benchmarks for Y5 mathematics.

Interpreting the data: Y5 mathematics international benchmarks

TIMSS reports achievement at four points along the achievement scale as 'international benchmarks'. The Advanced International Benchmark is set at a scale score of 625, the High International Benchmark at 550, the Intermediate International Benchmark at 475, and the Low International Benchmark at 400. The benchmark descriptions summarise what pupils scoring at each TIMSS International Benchmark typically know and can do in the target subject.

Table 2.2 Y5 summary of mathematics international benchmarks

625	Advanced international benchmark	●
	Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning. They can solve a variety of multi-step word problems involving whole numbers including proportions. Students at this level show an increasing understanding of fractions and decimals. Students can apply geometric knowledge of a range of two- and three-dimensional shapes in a variety of situations. They can draw a conclusion from data in a table and justify their	
550	High international benchmark	○
	Students can apply their knowledge and understanding to solve problems. Students can solve word problems involving operations with whole numbers. They can use division in a variety of problem situations. They can use their understanding of place value to solve problems. Students can extend patterns to find a later specified term. Students demonstrate understanding of line symmetry and geometric properties. Students can interpret and use data in tables and graphs to solve problems. They can use information in pictographs and tally charts to complete bar graphs.	
475	Intermediate international benchmark	●
	Students can apply basic mathematical knowledge in straightforward situations. Students at this level demonstrate an understanding of whole numbers and some understanding of fractions. Students can visualize three-dimensional shapes from two-dimensional representations. They can interpret bar graphs, pictographs, and tables to solve simple problems.	
400	Low international benchmark	○
	Students have some basic mathematical knowledge. Students can add and subtract whole numbers. They have some recognition of parallel and perpendicular lines, familiar geometric shapes, and coordinate maps. They can read and complete simple bar graphs and tables.	

Source: Exhibit 2.1, international mathematics report

In England, 49 per cent of Y5 pupils reached at least the High benchmark in mathematics (18 per cent of Y5 pupils reaching the Advanced international benchmark, with a further 31 per cent reaching the High benchmark). This compared with 59 per cent in Northern Ireland and 70 to 80 per cent reaching at least the High benchmark in the highest scoring Pacific Rim countries (see Table 2.3). In the highest scoring country, Singapore, 43 per cent of pupils reached the Advanced international benchmark in Y5 mathematics.[18] Generally, the highest scoring participants had a higher proportion of pupils at the Advanced benchmark.

In England, 93 per cent of pupils reached at least the Low international benchmark for Y5 mathematics. This indicates that 7 per cent achieved below this level. In the higher performing countries, the comparable figures varied from 4 per cent (Northern Ireland) to none (Korea).

Table 2.3 shows that, for Y5 mathematics, England forms the tail of a group of participants with generally higher percentages at the Advanced benchmark. All countries below England on the table have fewer than 15 per cent of their pupils at the Advanced benchmark. However, it is also noticeable from the table that England has fewer pupils reaching at least the High benchmark, compared with the highest achieving countries in Y5 mathematics. At the High benchmark, England's performance is more similar to the group of countries listed immediately below it in the table.

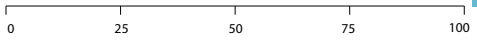
Interpreting the data: performance at the international benchmarks

The table indicates the percentage of pupils reaching each of the four benchmarks and this information is summarised in the series of dots on the chart. Percentages are cumulative (reading the chart from left to right). Thus, for each country the black dot shows the percentage reaching at least the Advanced benchmark. The clear dot then shows the percentage reaching at least the High benchmark and this figure includes those who reached the Advanced benchmark. The darker shaded dot indicates the percentage reaching at least the Intermediate benchmark, and this includes those in the two previous categories. The lighter shaded dot shows cumulatively how many reached at least the Low benchmark. The position of that dot also indicates the percentage that did not reach any of the listed benchmarks.

18 In the context of Singapore excluding a combined total of 6.3 per cent of 9 –10 year old pupils (5.9 per cent at school level and 0.4 per cent within-school exclusions); Hong Kong also had high exclusions at this age range (9.1 per cent at school level and 2.7 per cent within-school exclusions, making a total of 11.8 per cent), and Singapore excluded a similar proportion at school level at Y9. The comparable exclusion figures for England were 1.7 per cent and 0.4 per cent respectively (making a total, when rounding is taken into account, of 2.0 per cent; well within the international target limit of 5 per cent exclusions). See Appendix C of the international mathematics report for more information.

Table 2.3 Performance at the international benchmarks, Y5 mathematics

Country	Percentages of Students Reaching International Benchmarks (Advanced, High, Intermediate, Low)	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
[2] Singapore		43 (2.0)	78 (1.4)	94 (0.7)	99 (0.2)
Korea, Rep. of		39 (1.3)	80 (0.8)	97 (0.4)	100 (0.1)
[2] Hong Kong SAR		37 (1.8)	80 (1.6)	96 (1.0)	99 (0.5)
Chinese Taipei		34 (1.2)	74 (1.1)	93 (0.6)	99 (0.2)
Japan		30 (1.0)	70 (1.0)	93 (0.5)	99 (0.2)
† Northern Ireland		24 (1.3)	59 (1.4)	85 (1.2)	96 (0.5)
England		18 (1.3)	49 (1.7)	78 (1.4)	93 (0.7)
Russian Federation		13 (1.4)	47 (2.0)	82 (1.4)	97 (0.6)
[2] United States		13 (0.8)	47 (1.1)	81 (0.8)	96 (0.3)
Finland		12 (0.8)	49 (1.3)	85 (1.2)	98 (0.4)
[1 2] Lithuania		10 (0.8)	43 (1.5)	79 (1.2)	96 (0.6)
Belgium (Flemish)		10 (0.8)	50 (1.3)	89 (0.8)	99 (0.2)
Australia		10 (0.9)	35 (1.4)	70 (1.4)	90 (1.0)
[2] Denmark		10 (1.0)	44 (1.5)	82 (1.1)	97 (0.6)
Hungary		10 (0.8)	37 (1.4)	70 (1.5)	90 (1.0)
[2] Serbia		9 (0.8)	36 (1.5)	70 (1.4)	90 (1.0)
Ireland, Rep. of		9 (0.9)	41 (1.6)	77 (1.4)	94 (0.6)
Portugal		8 (1.2)	40 (1.9)	80 (1.7)	97 (0.6)
[2] Kazakhstan		7 (1.0)	29 (2.0)	62 (2.4)	88 (1.2)
Romania		7 (0.6)	28 (1.7)	57 (2.2)	79 (1.9)
Slovak Republic		5 (0.7)	30 (1.7)	69 (1.6)	90 (1.2)
Germany		5 (0.5)	37 (1.4)	81 (1.3)	97 (0.6)
[2] Azerbaijan		5 (1.0)	21 (2.3)	46 (2.3)	72 (1.9)
Italy		5 (0.6)	28 (1.4)	69 (1.3)	93 (0.8)
† Netherlands		5 (0.6)	44 (1.5)	88 (0.8)	99 (0.2)
Czech Republic		4 (0.5)	30 (1.5)	72 (1.3)	93 (0.8)
Turkey		4 (0.5)	21 (1.4)	51 (1.7)	77 (1.5)
Slovenia		4 (0.5)	31 (1.4)	72 (1.4)	94 (0.6)
New Zealand		4 (0.5)	23 (1.1)	58 (1.3)	85 (0.8)
Malta		4 (0.3)	25 (0.9)	63 (0.8)	88 (0.6)
Sweden		3 (0.4)	25 (1.2)	69 (1.4)	93 (0.7)
Austria		2 (0.3)	26 (1.5)	70 (1.9)	95 (0.8)
‡ Norway		2 (0.4)	21 (1.6)	63 (1.8)	91 (1.0)
United Arab Emirates		2 (0.2)	12 (0.5)	35 (0.8)	64 (1.0)
Armenia		2 (0.4)	14 (1.0)	41 (1.7)	72 (1.4)
[2] Qatar		2 (0.4)	10 (0.9)	29 (1.4)	55 (1.6)
[1] Georgia		2 (0.5)	12 (1.0)	41 (1.7)	72 (1.7)
Chile		2 (0.3)	14 (0.7)	44 (1.1)	77 (1.2)
Saudi Arabia		2 (0.7)	7 (1.3)	24 (1.9)	55 (1.8)
Poland		2 (0.3)	17 (1.1)	56 (1.3)	87 (0.9)
[2] Croatia		2 (0.3)	19 (1.0)	60 (1.2)	90 (0.9)
Bahrain		1 (0.3)	10 (0.9)	34 (1.4)	67 (1.4)
Spain		1 (0.3)	17 (1.1)	56 (1.9)	87 (1.3)
Thailand		1 (0.3)	12 (1.4)	43 (2.3)	77 (2.1)
Iran, Islamic Rep. of		1 (0.2)	9 (0.8)	33 (1.4)	64 (1.5)
Ψ Oman		1 (0.1)	5 (0.3)	20 (0.8)	46 (1.2)
Ж Morocco		0 (0.2)	2 (0.7)	10 (1.2)	26 (1.5)
[1] Ж Kuwait		0 (0.1)	1 (0.3)	9 (0.7)	30 (1.3)
Ж Yemen		0 (0.0)	0 (0.2)	2 (0.5)	9 (1.0)
Ψ Tunisia		0 (0.0)	2 (0.3)	11 (1.0)	35 (1.8)
International Median		4	28	69	90



Ж Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.
Ψ Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation is less than 25% but exceeds 15%.

See Appendix C.2 in international report for target population coverage notes 1, 2, and 3. See Appendix C.8 for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Country	Percentages of Students Reaching International Benchmarks (Advanced, High, Intermediate, Low)	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
Benchmarking Participants					
[1 2] North Carolina, US		16 (1.8)	54 (2.6)	86 (1.7)	98 (0.6)
[1 3] Florida, US		14 (1.3)	47 (1.7)	83 (1.2)	97 (0.4)
Ontario, Canada		7 (0.8)	34 (1.7)	73 (1.6)	94 (0.7)
Quebec, Canada		6 (0.8)	40 (1.7)	83 (1.2)	99 (0.2)
Dubai, UAE		5 (0.5)	22 (0.8)	50 (0.8)	75 (0.9)
[2] Alberta, Canada		3 (0.5)	25 (1.6)	70 (1.4)	94 (0.9)
Abu Dhabi, UAE		1 (0.4)	8 (1.1)	29 (2.0)	58 (2.0)

Source: Exhibit 2.2, international mathematics report

Table 2.4 shows trends in the proportions achieving at each of the international benchmarks in England over time. It shows an improvement in the proportion at each of the Advanced and High benchmarks in 2011, compared with 2003 (although there was no significant change since 2007). The table also shows increases in the proportions reaching the Intermediate and Low benchmarks in 2011 compared with 1995 (although there were no significant increases in the intervening period).

Among the countries scoring more highly than England in Y5 mathematics, two (Japan and Chinese Taipei) have improved their percentage at the Advanced benchmark since TIMSS 2007. Singapore has remained stable across all years while Korea has improved since the 1995 cycle.[19]

Interpreting the data: trends in Y5 mathematics international benchmarks

The table shows the percentage reaching each benchmark in each of the TIMSS cycles at the target age range. The score threshold for each benchmark is given. The upward arrow indicates that the 2011 percentage is statistically significantly higher.

Table 2.4 Trends in Y5 mathematics international benchmarks

Country	Advanced International Benchmark (625) Per cent of Students				High International Benchmark (550) Per cent of Students			
	2011	2007	2003	1995	2011	2007	2003	1995
England	18	16	14 ▲	7 ▲	49	48	43 ▲	24 ▲

Country	Intermediate International Benchmark (475) Per cent of Students				Low International Benchmark (400) Per cent of Students			
	2011	2007	2003	1995	2011	2007	2003	1995
England	78	79	75	54 ▲	93	94	93	82 ▲

▲ 2011 per cent significantly higher

▼ 2011 per cent significantly lower

Source: Exhibit 2.3, international mathematics report

Examples A to D in Appendix C show Y5 mathematics test items exemplifying attainment at each of the benchmark levels. Further examples are available in the international mathematics report, along with a more detailed description of each benchmark.

19 See Exhibit 2.3 in the international mathematics report for more information.

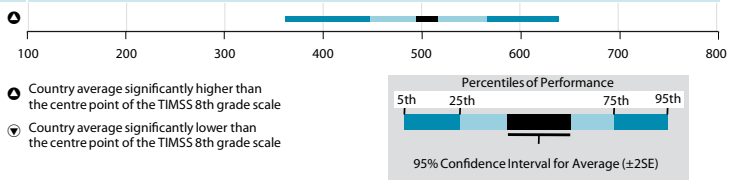
2.2 Distribution of mathematics attainment: Year 9

The mean score and distribution of TIMSS Y9 mathematics achievement in England is shown again in Table 2.5 below. England's mean score for Y9 mathematics was 507 and, as at Y5, there was relatively wide variation between the highest and lowest scoring pupils in England: again, a range of just under 300 TIMSS scale points.

> **Interpreting the data: England's mean score and distribution**
>
> See section 2.1 for a summary of how to interpret this table.

Table 2.5 England's mean score and distribution, Y9 mathematics achievement

Country	Average Scale Score	Mathematics Achievement Distribution
‡ England	507 (5.5)	



See Appendix C.9 for sampling guidelines and sampling participation notes ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.2, international mathematics report

England's range for Y9 mathematics is similar to the range for many participants, including some of the higher performing countries (see Table 1.4 in Chapter 1). This implies that, while the highest performers may succeed in minimising variation in mathematics attainment among their primary pupils, the gap between their higher and lower attainers widens at secondary school. The gap for Chinese Taipei is particularly wide, at just under 400 scale points. For most participants, the distribution of attainment shows a wider range of attainment for scores below the Y9 mathematics average than above it.

Table 2.6 summarises the benchmarks for Y9 mathematics.

> **Interpreting the data: Y9 mathematics international benchmarks**
>
> See section 2.1 for a summary of how to interpret this table.

Table 2.6 Y9 summary of mathematics international benchmarks

625	Advanced International Benchmark	●
	Students can reason with information, draw conclusions, make generalizations, and solve linear equations. Students can solve a variety of fraction, proportion, and percent problems and justify their conclusions. Students can express generalizations algebraically and model situations. They can solve a variety of problems involving equations, formulas, and functions. Students can reason with geometric figures to solve problems. Students can reason with data from several sources or unfamiliar representations to solve multi-step problems.	
550	High International Benchmark	○
	Students can apply their understanding and knowledge in a variety of relatively complex situations. Students can use information from several sources to solve problems involving different types of numbers and operations. Students can relate fractions, decimals, and percents to each other. Students at this level show basic procedural knowledge related to algebraic expressions. They can use properties of lines, angles, triangles, rectangles, and rectangular prisms to solve problems. They can analyze data in a variety of graphs.	
475	Intermediate International Benchmark	●
	Students can apply basic mathematical knowledge in a variety of situations. Students can solve problems involving decimals, fractions, proportions, and percentages. They understand simple algebraic relationships. Students can relate a two-dimensional drawing to a three-dimensional object. They can read, interpret, and construct graphs and tables. They recognize basic notions of likelihood.	
400	Low International Benchmark	○
	Students have some knowledge of whole numbers and decimals, operations, and basic graphs.	

Source: Exhibit 2.18, international mathematics report

In England, 32 per cent of Y9 pupils reached at least the High benchmark (8 per cent reaching the Advanced benchmark, fewer than at Y5, and a further 24 per cent reaching the High benchmark). This compared with 61 to 78 per cent reaching at least the High benchmark in the highest scoring Pacific Rim countries, despite their sometimes larger ranges of attainment for this age group. In the three highest scoring countries, Korea, Singapore and Chinese Taipei, 47, 48 and 49 per cent respectively reached the Advanced international benchmark (see Table 2.7).

In England, 88 per cent of pupils reached at least the Low international benchmark for Y9 mathematics, fewer than for the equivalent benchmark at Y5. This indicates that 12 per cent achieved below this level at Y9. Among the countries performing better than England in Y9 mathematics, the comparable figures varied from 5 per cent (Russian Federation) to 1 per cent (Korea and Singapore).

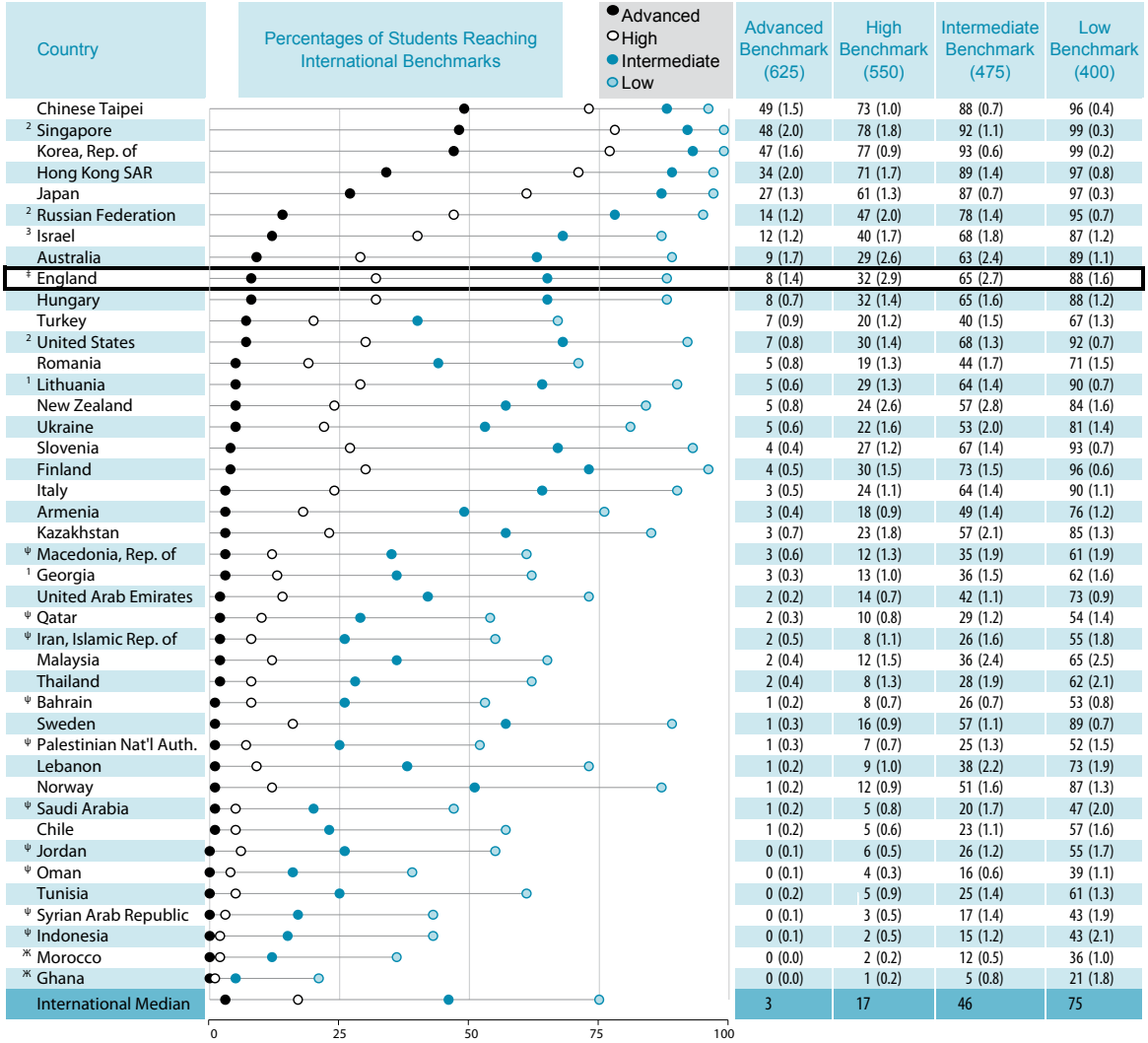
At Y9, the difference in profiles at the top of the performance table for mathematics is more stark than at Y5: England's percentage at the Advanced benchmark has more in common with the performance of the majority of countries than with the highest performing countries. England's percentage reaching at least the High benchmark is also noticeably lower than in the very highest achieving countries, and performance only begins to catch up at the Intermediate benchmark.

Interpreting the data: performance at the international benchmarks

See section 2.1 for a summary of how to interpret this table.

Table 2.7 Performance at the international benchmarks, Y9 mathematics

Country	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
Chinese Taipei	49 (1.5)	73 (1.0)	88 (0.7)	96 (0.4)
[2] Singapore	48 (2.0)	78 (1.8)	92 (1.1)	99 (0.3)
Korea, Rep. of	47 (1.6)	77 (0.9)	93 (0.6)	99 (0.2)
Hong Kong SAR	34 (2.0)	71 (1.7)	89 (1.4)	97 (0.8)
Japan	27 (1.3)	61 (1.3)	87 (0.7)	97 (0.3)
[2] Russian Federation	14 (1.2)	47 (2.0)	78 (1.4)	95 (0.7)
[3] Israel	12 (1.2)	40 (1.7)	68 (1.8)	87 (1.2)
Australia	9 (1.7)	29 (2.6)	63 (2.4)	89 (1.1)
[‡] England	8 (1.4)	32 (2.9)	65 (2.7)	88 (1.6)
Hungary	8 (0.7)	32 (1.4)	65 (1.6)	88 (1.2)
Turkey	7 (0.9)	20 (1.2)	40 (1.5)	67 (1.3)
[2] United States	7 (0.8)	30 (1.4)	68 (1.3)	92 (0.7)
Romania	5 (0.8)	19 (1.3)	44 (1.7)	71 (1.5)
[1] Lithuania	5 (0.6)	29 (1.3)	64 (1.4)	90 (0.7)
New Zealand	5 (0.8)	24 (2.6)	57 (2.8)	84 (1.6)
Ukraine	5 (0.6)	22 (1.6)	53 (2.0)	81 (1.4)
Slovenia	4 (0.4)	27 (1.2)	67 (1.4)	93 (0.7)
Finland	4 (0.5)	30 (1.5)	73 (1.5)	96 (0.6)
Italy	3 (0.5)	24 (1.1)	64 (1.4)	90 (1.1)
Armenia	3 (0.4)	18 (0.9)	49 (1.4)	76 (1.2)
Kazakhstan	3 (0.7)	23 (1.8)	57 (2.1)	85 (1.3)
[Ψ] Macedonia, Rep. of	3 (0.6)	12 (1.3)	35 (1.9)	61 (1.9)
[1] Georgia	3 (0.3)	13 (1.0)	36 (1.5)	62 (1.6)
United Arab Emirates	2 (0.2)	14 (0.7)	42 (1.1)	73 (0.9)
[Ψ] Qatar	2 (0.3)	10 (0.8)	29 (1.2)	54 (1.4)
[Ψ] Iran, Islamic Rep. of	2 (0.5)	8 (1.1)	26 (1.6)	55 (1.8)
Malaysia	2 (0.4)	12 (1.5)	36 (2.4)	65 (2.5)
Thailand	2 (0.4)	8 (1.3)	28 (1.9)	62 (2.1)
[Ψ] Bahrain	1 (0.2)	8 (0.7)	26 (0.7)	53 (0.8)
Sweden	1 (0.3)	16 (0.9)	57 (1.1)	89 (0.7)
[Ψ] Palestinian Nat'l Auth.	1 (0.3)	7 (0.7)	25 (1.3)	52 (1.5)
Lebanon	1 (0.2)	9 (1.0)	38 (2.2)	73 (1.9)
Norway	1 (0.2)	12 (0.9)	51 (1.6)	87 (1.3)
[Ψ] Saudi Arabia	1 (0.2)	5 (0.8)	20 (1.7)	47 (2.0)
Chile	1 (0.2)	5 (0.6)	23 (1.1)	57 (1.6)
[Ψ] Jordan	0 (0.1)	6 (0.5)	26 (1.2)	55 (1.7)
[Ψ] Oman	0 (0.1)	4 (0.3)	16 (0.6)	39 (1.1)
Tunisia	0 (0.2)	5 (0.9)	25 (1.4)	61 (1.3)
[Ψ] Syrian Arab Republic	0 (0.1)	3 (0.5)	17 (1.4)	43 (1.9)
[Ψ] Indonesia	0 (0.1)	2 (0.5)	15 (1.2)	43 (2.1)
[Ж] Morocco	0 (0.0)	2 (0.2)	12 (0.5)	36 (1.0)
[Ж] Ghana	0 (0.0)	1 (0.2)	5 (0.8)	21 (1.8)
International Median	3	17	46	75



[Ж] Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

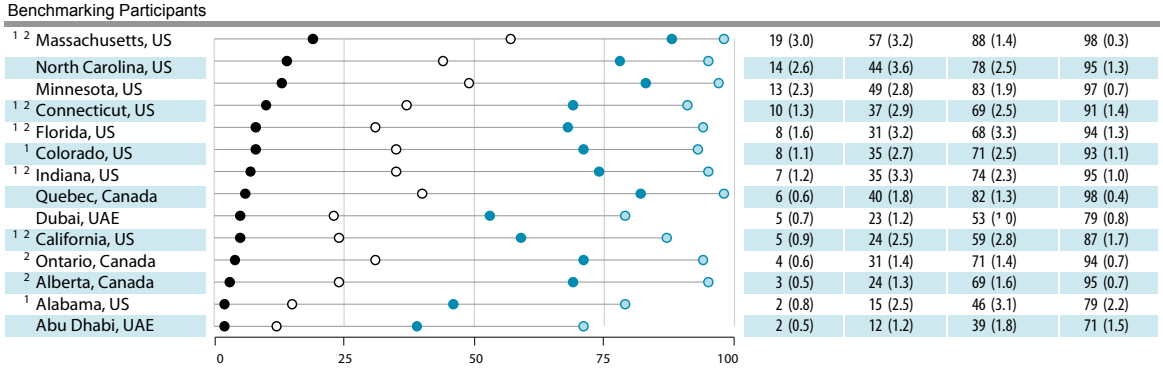
[Ψ] Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation is less than 25% but exceeds 15%.

See Appendix C.3 in international report for target population coverage notes 1, 2, and 3. See Appendix C.9 for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Benchmarking Participants

[1] [2] Massachusetts, US	19 (3.0)	57 (3.2)	88 (1.4)	98 (0.3)
North Carolina, US	14 (2.6)	44 (3.6)	78 (2.5)	95 (1.3)
Minnesota, US	13 (2.3)	49 (2.8)	83 (1.9)	97 (0.7)
[1] [2] Connecticut, US	10 (1.3)	37 (2.9)	69 (2.5)	91 (1.4)
[1] [2] Florida, US	8 (1.6)	31 (3.2)	68 (3.3)	94 (1.3)
[1] Colorado, US	8 (1.1)	35 (2.7)	71 (2.5)	93 (1.1)
[1] [2] Indiana, US	7 (1.2)	35 (3.3)	74 (2.3)	95 (1.0)
Quebec, Canada	6 (0.6)	40 (1.8)	82 (1.3)	98 (0.4)
Dubai, UAE	5 (0.7)	23 (1.2)	53 (* 0)	79 (0.8)
[1] [2] California, US	5 (0.9)	24 (2.5)	59 (2.8)	87 (1.7)
[2] Ontario, Canada	4 (0.6)	31 (1.4)	71 (1.4)	94 (0.7)
[2] Alberta, Canada	3 (0.5)	24 (1.3)	69 (1.6)	95 (0.7)
[1] Alabama, US	2 (0.8)	15 (2.5)	46 (3.1)	79 (2.2)
Abu Dhabi, UAE	2 (0.5)	12 (1.2)	39 (1.8)	71 (1.5)



Source: Exhibit 2.19, international mathematics report

Table 2.8 shows trends over time in England. It shows that there has been no significant change in the percentages at each of the benchmarks over time. This is in contrast to many other participants, such as the countries performing better than England, which have generally increased the percentages of pupils at the higher two benchmarks over time. In contrast, other participants have declined at these benchmarks over time, including Hungary and the Canadian provinces of Alberta and Quebec.[20]

Interpreting the data: trends in Y9 mathematics international benchmarks

See section 2.1 for a summary of how to interpret this table.

Table 2.8 Trends in Y9 mathematics international benchmarks

Country	Advanced International Benchmark (625) Per cent of Students					High International Benchmark (550) Per cent of Students				
	2011	2007	2003	1999	1995	2011	2007	2003	1999	1995
England	8	8	5	6	6	32	35	26	25	27

Country	Intermediate International Benchmark (475) Per cent of Students					Low International Benchmark (400) Per cent of Students				
	2011	2007	2003	1999	1995	2011	2007	2003	1999	1995
England	65	69	61	60	61	88	90	90	88	87

▲ 2011 per cent significantly higher

▼ 2011 per cent significantly lower

Source: Exhibit 2.20, international mathematics report

Examples E to H in Appendix C show Y9 mathematics test items exemplifying attainment at each of the benchmark levels. Further examples are available in the international mathematics report, along with a more detailed description of each benchmark.

2.3 Distribution of science attainment: Year 5

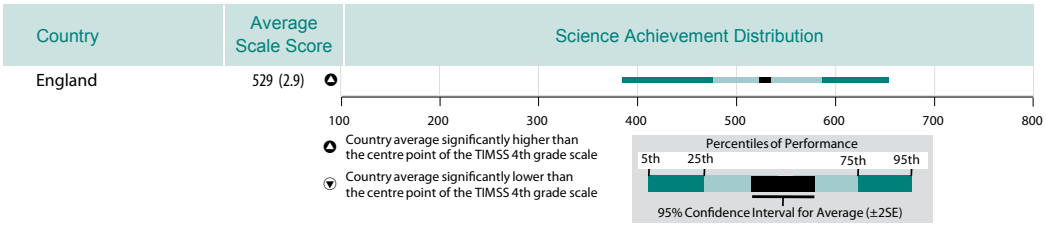
England's mean score at Y5 science was 529, and England's achievement band was just under 300 scale points wide (see Table 2.9), similar to the variation in attainment seen for mathematics at Y5. Again, this attainment band was similar in width to that of many other participants, but was a little narrower than the range for Singapore and a little wider than the range for the other high scoring countries (see Table 1.7 in Chapter 1). For most participants, the distribution of attainment shows a wider range of attainment below the Y5 science average than above it.

20 See Exhibit 2.20 in the international mathematics report for more information.

Interpreting the data: England's mean score and distribution

See section 2.1 for a summary of how to interpret this table.

Table 2.9 England's mean score and distribution, Y5 science achievement



( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.1, international science report

The TIMSS benchmarks give more information about this range of attainment. Table 2.10 summarises the benchmarks for Y5 science.

Interpreting the data: Y5 science international benchmarks

See section 2.1 for a summary of how to interpret this table.

Table 2.10 Y5 summary of science international benchmarks

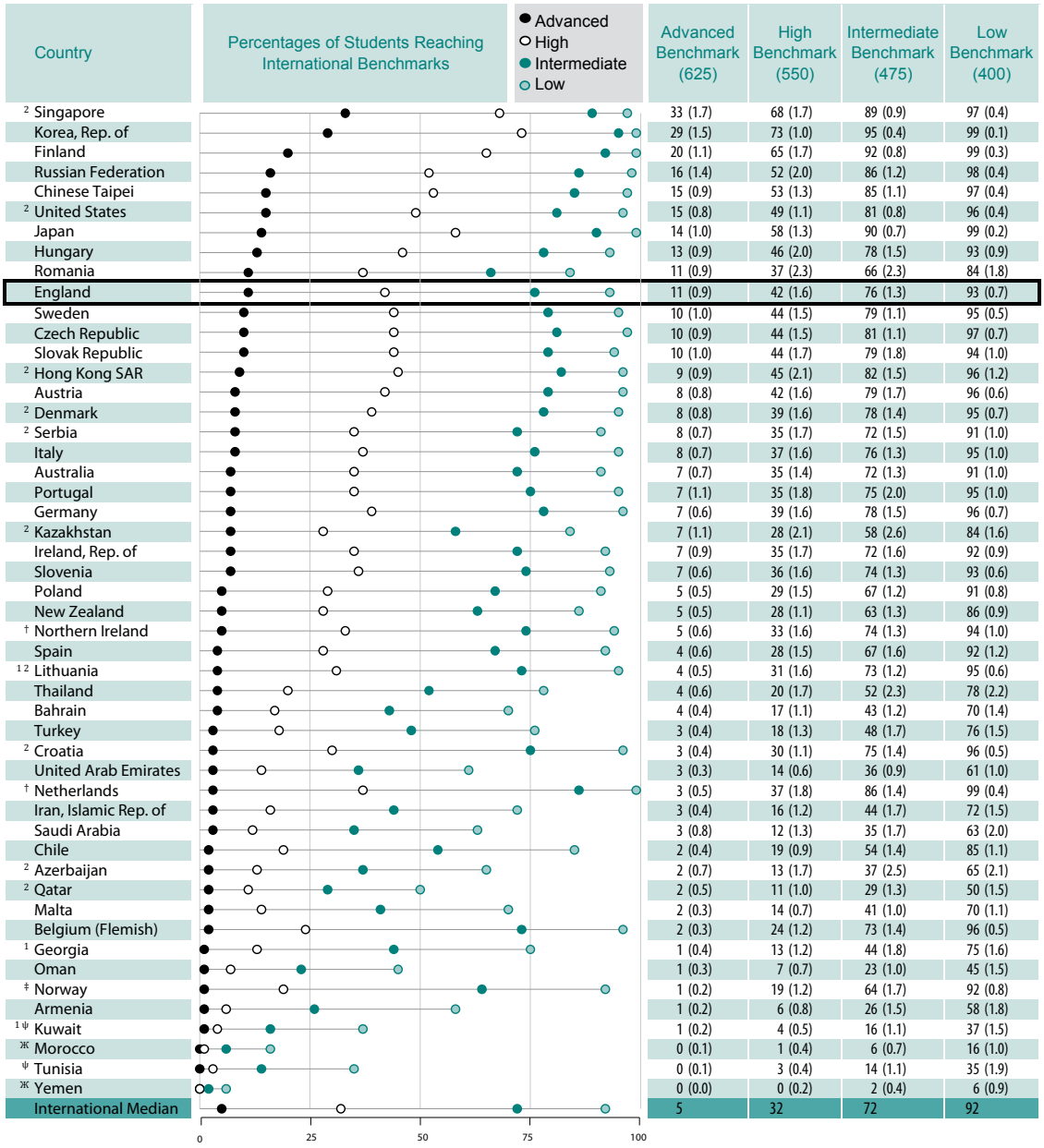
625	Advanced International Benchmark
	Students apply knowledge and understanding of scientific processes and relationships and show some knowledge of the process of scientific inquiry. Students communicate their understanding of characteristics and life processes of organisms, reproduction and development, ecosystems and organisms' interactions with the environment, and factors relating to human health. They demonstrate understanding of properties of light and relationships among physical properties of materials, apply and communicate their understanding of electricity and energy in practical contexts, and demonstrate an understanding of magnetic and gravitational forces and motion. Students communicate their understanding of the solar system and of Earth's structure, physical characteristics, resources, processes, cycles, and history. They have a beginning ability to interpret results in the context of a simple experiment, reason and draw conclusions from descriptions and diagrams, and evaluate and support an argument.
550	High International Benchmark
	Students apply their knowledge and understanding of the sciences to explain phenomena in everyday and abstract contexts. Students demonstrate some understanding of plant and animal structure, life processes, life cycles, and reproduction. They also demonstrate some understanding of ecosystems and organisms' interactions with their environment, including understanding of human responses to outside conditions and activities. Students demonstrate understanding of some properties of matter, electricity and energy, and magnetic and gravitational forces and motion. They show some knowledge of the solar system, and of Earth's physical characteristics, processes, and resources. Students demonstrate elementary knowledge and skills related to scientific inquiry. They compare, contrast, and make simple inferences, and provide brief descriptive responses combining knowledge of science concepts with information from both everyday and abstract contexts.
475	Intermediate International Benchmark
	Students have basic knowledge and understanding of practical situations in the sciences. Students recognize some basic information related to characteristics of living things, their reproduction and life cycles, and their interactions with the environment, and show some understanding of human biology and health. They also show some knowledge of properties of matter and light, electricity and energy, and forces and motion. Students know some basic facts about the solar system and show an initial understanding of Earth's physical characteristics and resources. They demonstrate ability to interpret information in pictorial diagrams and apply factual knowledge to practical situations.
400	Low International Benchmark
	Students show some elementary knowledge of life, physical, and earth sciences. Students demonstrate knowledge of some simple facts related to human health, ecosystems, and the behavioral and physical characteristics of animals. They also demonstrate some basic knowledge of energy and the physical properties of matter. Students interpret simple diagrams, complete simple tables, and provide short written responses to questions requiring factual information.

Source: Exhibit 2.1, international science report

Table 2.11 summarises international performance at the benchmarks for Y5 science. Again, it shows clearly the difference between England's profile and those of the highest scoring countries. England is in a group of countries with relatively low proportions of pupils at the Advanced benchmark in Y5 science and fewer than 50 per cent reaching at least the High benchmark.

England has 42 per cent of its pupils at the two highest benchmarks (11 per cent at the Advanced benchmark and 31 per cent at the High benchmark). This is only a little lower than the proportions for Y5 mathematics (18 and 31 per cent respectively, totalling 49 per cent).

Table 2.11 Performance at the international benchmarks, Y5 science



Country	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
[2] Singapore	33 (1.7)	68 (1.7)	89 (0.9)	97 (0.4)
Korea, Rep. of	29 (1.5)	73 (1.0)	95 (0.4)	99 (0.1)
Finland	20 (1.1)	65 (1.7)	92 (0.8)	99 (0.3)
Russian Federation	16 (1.4)	52 (2.0)	86 (1.2)	98 (0.4)
Chinese Taipei	15 (0.9)	53 (1.3)	85 (1.1)	97 (0.4)
[2] United States	15 (0.8)	49 (1.1)	81 (0.8)	96 (0.4)
Japan	14 (1.0)	58 (1.3)	90 (0.7)	99 (0.2)
Hungary	13 (0.9)	46 (2.0)	78 (1.5)	93 (0.9)
Romania	11 (0.9)	37 (2.3)	66 (2.3)	84 (1.8)
England	11 (0.9)	42 (1.6)	76 (1.3)	93 (0.7)
Sweden	10 (1.0)	44 (1.5)	79 (1.1)	95 (0.5)
Czech Republic	10 (0.9)	44 (1.5)	81 (1.1)	97 (0.7)
Slovak Republic	10 (1.0)	44 (1.7)	79 (1.8)	94 (1.0)
[2] Hong Kong SAR	9 (0.9)	45 (2.1)	82 (1.5)	96 (1.2)
Austria	8 (0.8)	42 (1.6)	79 (1.7)	96 (0.6)
[2] Denmark	8 (0.8)	39 (1.6)	78 (1.4)	95 (0.7)
[2] Serbia	8 (0.7)	35 (1.7)	72 (1.5)	91 (1.0)
Italy	8 (0.7)	37 (1.6)	76 (1.3)	95 (1.0)
Australia	7 (0.7)	35 (1.4)	72 (1.3)	91 (1.0)
Portugal	7 (1.1)	35 (1.8)	75 (2.0)	95 (1.0)
Germany	7 (0.6)	39 (1.6)	78 (1.5)	96 (0.7)
[2] Kazakhstan	7 (1.1)	28 (2.1)	58 (2.6)	84 (1.6)
Ireland, Rep. of	7 (0.9)	35 (1.7)	72 (1.6)	92 (0.9)
Slovenia	7 (0.6)	36 (1.6)	74 (1.3)	93 (0.6)
Poland	5 (0.5)	29 (1.5)	67 (1.2)	91 (0.8)
New Zealand	5 (0.5)	28 (1.1)	63 (1.3)	86 (0.9)
† Northern Ireland	5 (0.6)	33 (1.6)	74 (1.3)	94 (1.0)
Spain	4 (0.6)	28 (1.5)	67 (1.6)	92 (1.2)
[1 2] Lithuania	4 (0.5)	31 (1.6)	73 (1.2)	95 (0.6)
Thailand	4 (0.6)	20 (1.7)	52 (2.3)	78 (2.2)
Bahrain	4 (0.4)	17 (1.1)	43 (1.2)	70 (1.4)
Turkey	3 (0.4)	18 (1.3)	48 (1.7)	76 (1.5)
[2] Croatia	3 (0.4)	30 (1.1)	75 (1.4)	96 (0.5)
United Arab Emirates	3 (0.3)	14 (0.6)	36 (0.9)	61 (1.0)
† Netherlands	3 (0.5)	37 (1.8)	86 (1.4)	99 (0.4)
Iran, Islamic Rep. of	3 (0.4)	16 (1.2)	44 (1.7)	72 (1.5)
Saudi Arabia	3 (0.8)	12 (1.3)	35 (1.7)	63 (2.0)
Chile	2 (0.4)	19 (0.9)	54 (1.4)	85 (1.1)
[2] Azerbaijan	2 (0.7)	13 (1.7)	37 (2.5)	65 (2.1)
[2] Qatar	2 (0.5)	11 (1.0)	29 (1.3)	50 (1.5)
Malta	2 (0.3)	14 (0.7)	41 (1.0)	70 (1.1)
Belgium (Flemish)	2 (0.3)	24 (1.2)	73 (1.4)	96 (0.5)
[1] Georgia	1 (0.4)	13 (1.2)	44 (1.8)	75 (1.6)
Oman	1 (0.3)	7 (0.7)	23 (1.0)	45 (1.5)
‡ Norway	1 (0.2)	19 (1.2)	64 (1.7)	92 (0.8)
Armenia	1 (0.2)	6 (0.8)	26 (1.5)	58 (1.8)
[1 Ψ] Kuwait	1 (0.2)	4 (0.5)	16 (1.1)	37 (1.5)
※ Morocco	0 (0.1)	1 (0.4)	6 (0.7)	16 (1.0)
Ψ Tunisia	0 (0.1)	3 (0.4)	14 (1.1)	35 (1.9)
※ Yemen	0 (0.0)	0 (0.2)	2 (0.4)	6 (0.9)
International Median	5	32	72	92

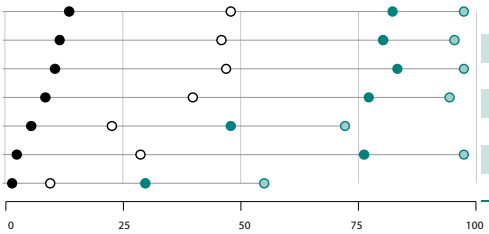
※ Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

Ψ Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation does not exceed 25% but exceeds 15%.

See Appendix C.2 in the international report for target population coverage notes 1, 2, and 3. See Appendix C.8 for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Benchmarking Participants



[1 3] Florida, US	14 (1.5)	48 (2.3)	82 (1.3)	97 (0.5)
[1 2] North Carolina, US	12 (1.5)	46 (2.6)	80 (1.9)	95 (0.9)
[2] Alberta, Canada	11 (0.9)	47 (1.6)	83 (1.2)	97 (0.5)
Ontario, Canada	9 (0.9)	40 (1.6)	77 (1.6)	94 (0.6)
Dubai, UAE	6 (0.7)	23 (0.9)	48 (0.9)	72 (1.1)
Quebec, Canada	3 (0.5)	29 (1.5)	76 (1.6)	97 (0.4)
Abu Dhabi, UAE	2 (0.3)	10 (0.9)	30 (1.9)	55 (2.1)

Source: Exhibit 2.2, international science report

In contrast, the proportions at the top benchmarks for the highest performing countries for both subjects are, in some cases, considerably lower for science than mathematics. Table 2.12 summarises the differences. It shows that the highest performing countries have differences between 10 and 19 percentage points at the Advanced benchmark across the two subjects, compared with England's difference of 7 percentage points.

In England, 93 per cent of pupils reached at least the Low international benchmark for Y5 science (the same percentage as for Y5 mathematics). This indicates that 7 per cent achieved below this level. Among the higher performing countries in science at this age, the comparable figures varied from 4 per cent (United States) to 1 per cent (Japan, Korea and Finland).

Interpreting the data: performance at the international benchmarks

See section 2.1 for a summary of how to interpret this table.

Table 2.12 Percentages reaching the top benchmarks for participants performing significantly better than England in both subjects at Y5

Country	Percentage reaching at least Advanced benchmark, mathematics	Percentage reaching at least High benchmark, mathematics	Percentage reaching at least Advanced benchmark, science	Percentage reaching at least High benchmark, science
England	18	49	11	42
Singapore	43	78	33	68
Korea	39	80	29	73
Chinese Taipei	34	74	15	53
Japan	30	70	14	58

Source: derived from Exhibit 2.2, international mathematics and science reports

Table 2.13 shows trends in the proportions achieving at each of the international Y5 science benchmarks in England over time. Although it is positive that the percentages at the Advanced benchmark are reasonably similar for mathematics and science, it is notable that there have been significant decreases in the percentages across the Y5 science Advanced, High and Intermediate benchmarks (whereas, for mathematics, they have improved since 2003 and remained stable since 2007). Only the percentage at the Low benchmark for Y5 science has increased significantly: there are now 93 per cent reaching the Low benchmark in Y5 science, in place of 90 per cent in 1995 (although 95 per cent reached it in 2007). This indicates that, whereas 10 per cent failed to reach the Low benchmark in 1995, only 5 per cent did so in 2007 but that has now risen again to 7 per cent failing to reach the Low benchmark in 2011.

Interpreting the data: trends in Y5 science international benchmarks

See section 2.1 for a summary of how to interpret this table.

Table 2.13 Trends in Y5 science international benchmarks

Country	Advanced International Benchmark (625) Per cent of Students				High International Benchmark (550) Per cent of Students			
	2011	2007	2003	1995	2011	2007	2003	1995
England	11	14 ▼	15 ▼	15 ▼	42	48 ▼	47 ▼	42

Country	Intermediate International Benchmark (475) Per cent of Students				Low International Benchmark (400) Per cent of Students			
	2011	2007	2003	1995	2011	2007	2003	1995
England	76	81 ▼	79	72	93	95 ▼	94	90 ▲

▲ 2011 per cent significantly higher

▼ 2011 per cent significantly lower

Source: Exhibit 2.3, international science report

Many other countries maintained their 2007 levels of performance against the benchmarks in 2011. England was one of only a few which showed decreases at the top benchmarks in that period, including Chinese Taipei and Hong Kong. Those which have increased their percentages at the top benchmarks since 2007 included the Czech Republic, Japan, Sweden and Denmark.[21]

Examples I to L in Appendix C show Y5 science test items exemplifying attainment at each of the benchmark levels. Further examples are available in the international science report, along with a more detailed description of each benchmark.

2.4 Distribution of science attainment: Year 9

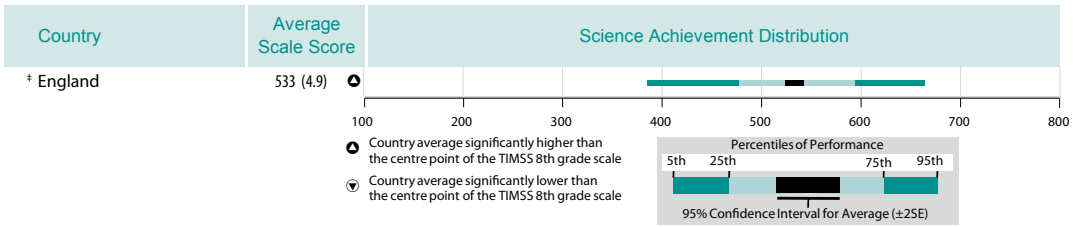
England's mean score at Y9 science was 533, and the science performance of most Y9 pupils in England remained, as at Y5, within a band just under 300 scale points wide (see Table 2.14).

21 See Exhibit 2.3 in the international science report for more information.

Interpreting the data: England's mean score and distribution

See section 2.1 for a summary of how to interpret this table.

Table 2.14 England's mean score and distribution, Y9 science achievement



See Appendix C.9 in international report for sampling guidelines and sampling participation notes † and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.2, international science report

Although England's range is, again, relatively wide, it is similar to the range for many participants at the 13 –14 year old age band, including some of the higher performing countries such as Chinese Taipei. It is a little larger than the range for Massachusetts, Minnesota and Alberta, and noticeably larger than the range for Finland. However, as was the case for Y5 science, it is smaller than the range for Singapore (see Table 1.9 in Chapter 1). For most participants, the distribution of attainment shows a wider range of attainment for scores below the Y9 science average than above it.

The benchmarks give more information about the range of performance within participating countries. Table 2.15 summarises the benchmarks for Y9 science.

Interpreting the data: Y9 science international benchmarks

See section 2.1 for a summary of how to interpret this table.

Table 2.15 Y9 summary of science international benchmarks

625	Advanced International Benchmark
	Students communicate an understanding of complex and abstract concepts in biology, chemistry, physics, and earth science. Students demonstrate some conceptual knowledge about cells and the characteristics, classification, and life processes of organisms. They communicate an understanding of the complexity of ecosystems and adaptations of organisms, and apply an understanding of life cycles and heredity. Students also communicate an understanding of the structure of matter and physical and chemical properties and changes and apply knowledge of forces, pressure, motion, sound, and light. They reason about electrical circuits and properties of magnets. Students apply knowledge and communicate understanding of the solar system and Earth's processes, structures, and physical features. They understand basic features of scientific investigation. They also combine information from several sources to solve problems and draw conclusions, and they provide written explanations to communicate scientific knowledge.
550	High International Benchmark
	Students demonstrate understanding of concepts related to science cycles, systems, and principles. They demonstrate understanding of aspects of human biology, and of the characteristics, classification, and life processes of organisms. Students communicate understanding of processes and relationships in ecosystems. They show an understanding of the classification and compositions of matter and chemical and physical properties and changes. They apply knowledge to situations related to light and sound and demonstrate basic knowledge of heat and temperature, forces and motion, and electrical circuits and magnets. Students demonstrate an understanding of the solar system and of Earth's processes, physical features, and resources. They demonstrate some scientific inquiry skills. They also combine and interpret information from various types of diagrams, contour maps, graphs, and tables; select relevant information, analyze, and draw conclusions; and provide short explanations conveying scientific knowledge.
475	Intermediate International Benchmark
	Students recognize and apply their understanding of basic scientific knowledge in various contexts. Students apply knowledge and communicate an understanding of human health, life cycles, adaptation, and heredity, and analyze information about ecosystems. They have some knowledge of chemistry in everyday life and elementary knowledge of properties of solutions and the concept of concentration. They are acquainted with some aspects of force, motion, and energy. They demonstrate an understanding of Earth's processes and physical features, including the water cycle and atmosphere. Students interpret information from tables, graphs, and pictorial diagrams and draw conclusions. They apply knowledge to practical situations and communicate their understanding through brief descriptive responses.
400	Low International Benchmark
	Students can recognize some basic facts from the life and physical sciences. They have some knowledge of biology, and demonstrate some familiarity with physical phenomena. Students interpret simple pictorial diagrams, complete simple tables, and apply basic knowledge to practical situations.

Source: Exhibit 2.17, international science report

Table 2.16 summarises international performance at the benchmarks for Y9 science. For Y9 science, England has 44 per cent of its pupils reaching at least the two highest benchmarks (14 per cent at the Advanced benchmark and 30 per cent at the High benchmark). This is very similar to the proportions for Y5 science (11 per cent and 31 per cent respectively, totalling 42 per cent).

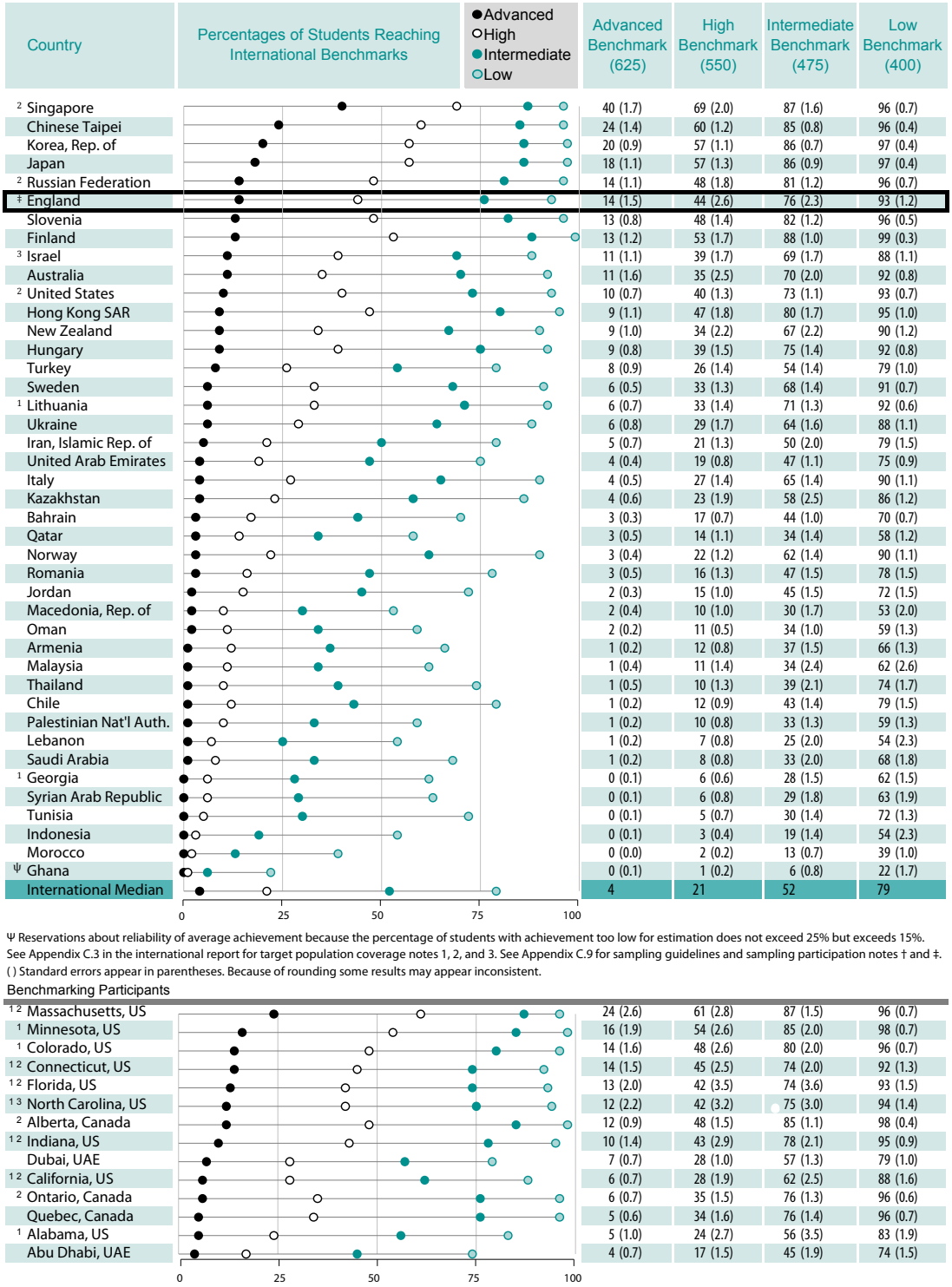
Again, the profile for England differs from those of the highest scoring countries. England is in a group of countries with percentages between 10 and 15 per cent at the Advanced benchmark and generally fewer than 50 per cent reaching at least the High benchmark. Once again, England only begins to catch up with the highest performers (see Table 2.16) at the level of the Intermediate benchmark.

Interpreting the data: performance at the international benchmarks

See section 2.1 for a summary of how to interpret this table.

Table 2.16 Performance at the international benchmarks, Y9 science

Exhibit 2.18: Performance at the International Benchmarks of Science Achievement



Country	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
[2] Singapore	40 (1.7)	69 (2.0)	87 (1.6)	96 (0.7)
Chinese Taipei	24 (1.4)	60 (1.2)	85 (0.8)	96 (0.4)
Korea, Rep. of	20 (0.9)	57 (1.1)	86 (0.7)	97 (0.4)
Japan	18 (1.1)	57 (1.3)	86 (0.9)	97 (0.4)
[2] Russian Federation	14 (1.1)	48 (1.8)	81 (1.2)	96 (0.7)
‡ England	14 (1.5)	44 (2.6)	76 (2.3)	93 (1.2)
Slovenia	13 (0.8)	48 (1.4)	82 (1.2)	96 (0.5)
Finland	13 (1.2)	53 (1.7)	88 (1.0)	99 (0.3)
[3] Israel	11 (1.1)	39 (1.7)	69 (1.7)	88 (1.1)
Australia	11 (1.6)	35 (2.5)	70 (2.0)	92 (0.8)
[2] United States	10 (0.7)	40 (1.3)	73 (1.1)	93 (0.7)
Hong Kong SAR	9 (1.1)	47 (1.8)	80 (1.7)	95 (1.0)
New Zealand	9 (1.0)	34 (2.2)	67 (2.2)	90 (1.2)
Hungary	9 (0.8)	39 (1.5)	75 (1.4)	92 (0.8)
Turkey	8 (0.9)	26 (1.4)	54 (1.4)	79 (1.0)
Sweden	6 (0.5)	33 (1.3)	68 (1.4)	91 (0.7)
[1] Lithuania	6 (0.7)	33 (1.4)	71 (1.3)	92 (0.6)
Ukraine	6 (0.8)	29 (1.7)	64 (1.6)	88 (1.1)
Iran, Islamic Rep. of	5 (0.7)	21 (1.3)	50 (2.0)	79 (1.5)
United Arab Emirates	4 (0.4)	19 (0.8)	47 (1.1)	75 (0.9)
Italy	4 (0.5)	27 (1.4)	65 (1.4)	90 (1.1)
Kazakhstan	4 (0.6)	23 (1.9)	58 (2.5)	86 (1.2)
Bahrain	3 (0.3)	17 (0.7)	44 (1.0)	70 (0.7)
Qatar	3 (0.5)	14 (1.1)	34 (1.4)	58 (1.2)
Norway	3 (0.4)	22 (1.2)	62 (1.4)	90 (1.1)
Romania	3 (0.5)	16 (1.3)	47 (1.5)	78 (1.5)
Jordan	2 (0.3)	15 (1.0)	45 (1.5)	72 (1.5)
Macedonia, Rep. of	2 (0.4)	10 (1.0)	30 (1.7)	53 (2.0)
Oman	2 (0.2)	11 (0.5)	34 (1.0)	59 (1.3)
Armenia	1 (0.2)	12 (0.8)	37 (1.5)	66 (1.3)
Malaysia	1 (0.4)	11 (1.4)	34 (2.4)	62 (2.6)
Thailand	1 (0.5)	10 (1.3)	39 (2.1)	74 (1.7)
Chile	1 (0.2)	12 (0.9)	43 (1.4)	79 (1.5)
Palestinian Nat'l Auth.	1 (0.2)	10 (0.8)	33 (1.3)	59 (1.3)
Lebanon	1 (0.2)	7 (0.8)	25 (2.0)	54 (2.3)
Saudi Arabia	1 (0.2)	8 (0.8)	33 (2.0)	68 (1.8)
[1] Georgia	0 (0.1)	6 (0.6)	28 (1.5)	62 (1.5)
Syrian Arab Republic	0 (0.1)	6 (0.8)	29 (1.8)	63 (1.9)
Tunisia	0 (0.1)	5 (0.7)	30 (1.4)	72 (1.3)
Indonesia	0 (0.1)	3 (0.4)	19 (1.4)	54 (2.3)
Morocco	0 (0.0)	2 (0.2)	13 (0.7)	39 (1.0)
Ψ Ghana	0 (0.1)	1 (0.2)	6 (0.8)	22 (1.7)
International Median	4	21	52	79

Ψ Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation does not exceed 25% but exceeds 15%.
See Appendix C.3 in the international report for target population coverage notes 1, 2, and 3. See Appendix C.9 for sampling guidelines and sampling participation notes † and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Benchmarking Participants

[1 2] Massachusetts, US	24 (2.6)	61 (2.8)	87 (1.5)	96 (0.7)
[1] Minnesota, US	16 (1.9)	54 (2.6)	85 (2.0)	98 (0.7)
[1] Colorado, US	14 (1.6)	48 (2.6)	80 (2.0)	96 (0.7)
[1 2] Connecticut, US	14 (1.5)	45 (2.5)	74 (2.0)	92 (1.3)
[1 2] Florida, US	13 (2.0)	42 (3.5)	74 (3.6)	93 (1.5)
[1 3] North Carolina, US	12 (2.2)	42 (3.2)	75 (3.0)	94 (1.4)
[2] Alberta, Canada	12 (0.9)	48 (1.5)	85 (1.1)	98 (0.4)
[1 2] Indiana, US	10 (1.4)	43 (2.9)	78 (2.1)	95 (0.9)
Dubai, UAE	7 (0.7)	28 (1.0)	57 (1.3)	79 (1.0)
[1 2] California, US	6 (0.7)	28 (1.9)	62 (2.5)	88 (1.6)
[2] Ontario, Canada	6 (0.7)	35 (1.5)	76 (1.3)	96 (0.6)
Quebec, Canada	5 (0.6)	34 (1.6)	76 (1.4)	96 (0.7)
[1] Alabama, US	5 (1.0)	24 (2.7)	56 (3.5)	83 (1.9)
Abu Dhabi, UAE	4 (0.7)	17 (1.5)	45 (1.9)	74 (1.5)

Source: Exhibit 2.18, international science report

The benchmark pattern across subjects at Y9 is more mixed than the pattern across Y5. Table 2.17 summarises the differences for England and compares them with the differences for the participants who performed significantly better than England at Y9 for both subjects. For most of these participants, the percentage reaching the Advanced benchmark is higher for mathematics than science. However, England has more at the Advanced benchmark in science than mathematics (a six percentage point difference, favouring science), and that is similar to the size of the difference seen for Singapore and Japan (favouring mathematics). However, there is a much larger difference for Korea and Chinese Taipei (27 and 25 percentage points different respectively, favouring mathematics). Like England, the two US benchmarking states of Massachusetts and Minnesota have a greater percentage at the Advanced benchmarks for science than mathematics.

Table 2.17 Percentages reaching the top benchmarks for participants performing significantly better than England in both subjects at Y9

Country	Percentage reaching at least Advanced benchmark, mathematics	Percentage reaching at least High benchmark, mathematics	Percentage reaching at least Advanced benchmark, science	Percentage reaching at least High benchmark, science
England	8	32	14	44
Singapore	48	78	40	69
Korea	47	77	20	57
Chinese Taipei	49	73	24	60
Japan	27	61	18	57
[Massachusetts, US]	[19]	[57]	[24]	[61]
[Minnesota, US]	[13]	[49]	[16]	[54]

Data for benchmarking participants are given in square brackets.

Source: derived from Exhibit 2.19 international mathematics report and Exhibit 2.18 international science report.

Table 2.18 shows the data for England. It shows that there has been only one change over time in the profile for Y9 science in England: there were fewer pupils at the Low benchmark in 2011 than there were in 2003. However, the percentage at the Low benchmark has returned to the levels seen in the first TIMSS survey in 1995, with 7 per cent failing to reach the Low benchmark. This trend is very similar to the position for Y9 mathematics (see section 2.2), where there were no significant changes at all over time. In contrast, the position for both subjects at Y5 was more changeable, with some increases in benchmark categories over time for Y5 mathematics and some decreases for Y5 science.

As was the case for Y9 mathematics, England's general stability in the profile of attainment differed from that of many other TIMSS participants. Among the highest performers in Y9 science, the profile in Chinese Taipei over time was very similar to that for England, but both Singapore and Korea had more pupils reaching the Advanced benchmark in 2011 compared with 2007.[22]

22 See Exhibit 2.19 in the international science report for more information.

Interpreting the data: trends in Y9 science international benchmarks

See section 2.1 for a summary of how to interpret this table.

Table 2.18 Trends in Y9 science international benchmarks

Country	Advanced International Benchmark (625) Per cent of Students				High International Benchmark (550) Per cent of Students			
	2011	2007	2003	1995	2011	2007	2003	1995
England	11	14 ▼	15 ▼	15 ▼	42	48 ▼	47 ▼	42

Country	Intermediate International Benchmark (475) Per cent of Students				Low International Benchmark (400) Per cent of Students			
	2011	2007	2003	1995	2011	2007	2003	1995
England	76	81 ▼	79	72	93	95 ▼	94	90 ▲

▲ 2011 per cent significantly higher

▼ 2011 per cent significantly lower

Source: Exhibit 2.19, international science report

Examples M to P in Appendix C show Y9 science test items exemplifying attainment at each of the benchmark levels. Further examples are available in the international science report, along with a more detailed description of each benchmark.

Chapter 3 Attainment by gender and language context

Chapter outline

This chapter summarises pupils' attainment by gender, in mathematics and science in Year 5 (Y5, ages 9 –10) and Year 9 (Y9, ages 13 –14) in 2011 and over time. Findings for mathematics are presented first, followed by findings for science. Outcomes for England are compared with international outcomes. Contextual information about the frequency with which pupils speak English (the language in which the TIMSS test is administered) is also outlined.

Key findings

- In England, there were no significant[23] gender differences for either subject (mathematics and science) at either grade (Y5 and Y9).
- Gender differences in science at Y9 persisted up to TIMSS 2003 but have since been eradicated. No significant gender difference existed at any point for Y5 science.
- There have been no gender differences in mathematics for either age group in England in the three most recent TIMSS cycles.
- Fewer pupils than in 2007 speak English as their first language.
- The more frequently that pupils reported speaking English at home, the better they appeared to do at mathematics and science in Y5 and at science in Y9.

3.1 Mathematics attainment by gender: Year 5

The TIMSS 2011 mathematics score for Year 5 (Y5) pupils in England was 542, above the centre point of the international scale. The scale score for girls was 541 and for boys, 544. This small difference was not significant. Table 3.1 overleaf shows the international rankings for gender difference. Of the 50 participating countries and seven benchmarking participants, just over half have a gender difference, mostly in favour of boys, but favouring girls in some countries. England is one of 27 participants (26 countries and one benchmarking participant) showing no overall gender difference for mathematics at this age.

23 Throughout this report, findings listed as 'significant' are statistically significant.

Interpreting the data: England's gender differences, Y5 mathematics

The TIMSS achievement scale has a centre point of 500 and a standard deviation of 100. It is scaled to remain constant from assessment to assessment, allowing comparison over time. The graphic shows the direction and size of any difference for each country. Statistically significant differences are shown in colour while non-significant differences are shown greyed out.

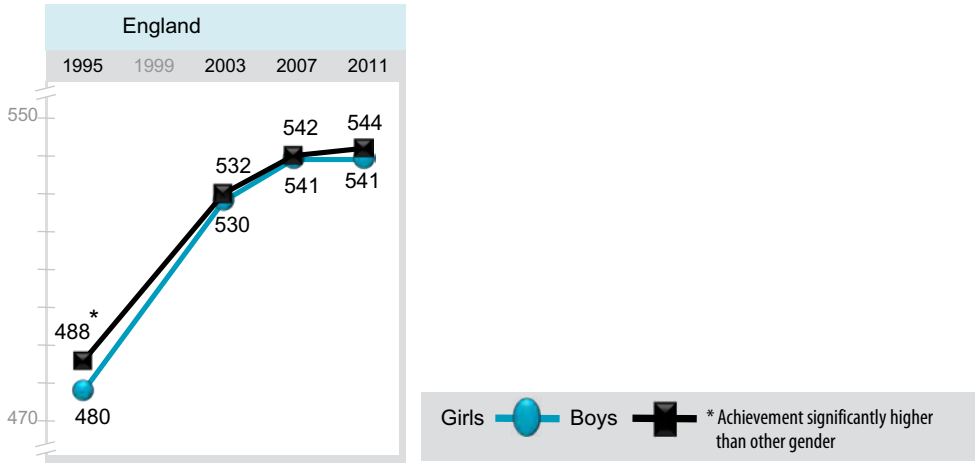
Countries participating in TIMSS follow guidelines and strict sampling targets to provide samples that are nationally representative. 'Benchmarking participants' are regional entities which follow the same guidelines and targets to provide samples that are representative at regional level.

Figure 3.1 shows the TIMSS gender trends over time for Y5 mathematics. It shows that the mathematics scores of girls and boys have mirrored each other across the four cycles of TIMSS in which pupils of this age have participated. The only significant difference seen at this grade occurred in TIMSS 1995, when boys performed eight score points higher than girls. Both genders improved their performance to a comparable level in 2003 and their levels of attainment in TIMSS have been parallel since then.

Interpreting the data: England's Y5 gender trends in mathematics

The diagram shows England's mean scale score for boys (indicated by a square) and girls (indicated by a circle) in each cycle from 1995 onwards (the 1999 cycle of TIMSS included only older pupils, not the 9 –10 year olds). Only the difference in 1995 was statistically significant.

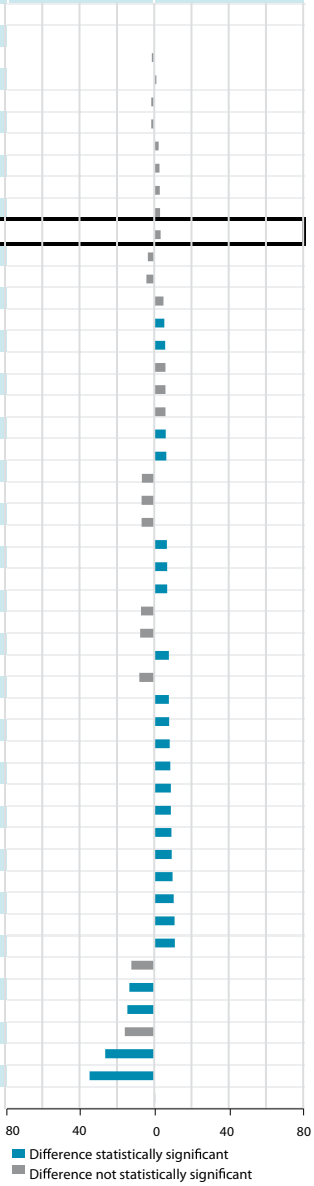
Figure 3.1: Gender trends in Y5 mathematics achievement in England



Source: Exhibit 1.12, international mathematics report

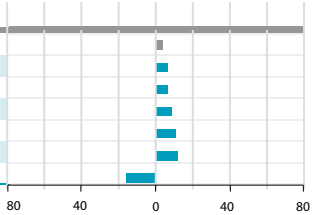
Table 3.1 TIMSS 2011 gender differences, mathematics at ages 9 –10

Country	Girls		Boys		Difference (Absolute Value)	Gender difference
	Per cent of Students	Average Scale Score	Per cent of Students	Average Scale Score		Girls scored higher / Boys scored higher
Iran, Islamic Rep. of	49 (2.9)	431 (5.2)	51 (2.9)	431 (5.4)	0 (8.0)	
New Zealand	49 (0.8)	486 (3.3)	51 (0.8)	486 (2.8)	0 (3.1)	
† Northern Ireland	49 (1.3)	562 (3.3)	51 (1.3)	563 (3.6)	0 (3.8)	
Russian Federation	49 (1.0)	543 (3.7)	51 (1.0)	542 (4.1)	1 (2.4)	
1 2 Lithuania	48 (0.8)	533 (2.6)	52 (0.8)	534 (2.9)	1 (2.6)	
Chinese Taipei	47 (0.6)	592 (2.5)	53 (0.6)	590 (2.4)	2 (2.8)	
Turkey	48 (0.6)	470 (5.2)	52 (0.6)	469 (4.8)	2 (3.8)	
Hungary	49 (1.0)	514 (3.6)	51 (1.0)	517 (3.9)	2 (3.2)	
Romania	48 (0.9)	481 (6.7)	52 (0.9)	484 (5.9)	3 (4.5)	
Japan	49 (0.5)	584 (2.0)	51 (0.5)	587 (2.5)	3 (3.0)	
England	48 (1.0)	541 (4.2)	52 (1.0)	544 (3.5)	3 (3.4)	
Ireland, Rep. of	49 (2.3)	526 (3.7)	51 (2.3)	529 (3.3)	3 (4.6)	
Armenia	47 (0.8)	454 (4.1)	53 (0.8)	451 (3.6)	3 (3.0)	
2 Singapore	49 (0.6)	608 (3.6)	51 (0.6)	604 (3.5)	4 (3.0)	
Sweden	49 (1.0)	501 (2.5)	51 (1.0)	506 (2.4)	5 (2.7)	
2 Kazakhstan	48 (0.8)	498 (4.4)	52 (0.8)	504 (4.8)	5 (2.6)	
2 Denmark	51 (0.7)	534 (2.9)	49 (0.7)	540 (2.9)	6 (2.8)	
Australia	49 (1.0)	513 (3.3)	51 (1.0)	519 (3.6)	6 (3.8)	
Portugal	49 (1.1)	529 (4.1)	51 (1.1)	535 (3.4)	6 (3.2)	
2 Serbia	48 (0.9)	513 (3.8)	52 (0.9)	519 (3.5)	6 (4.1)	
2 Hong Kong SAR	46 (1.2)	598 (3.2)	54 (1.2)	604 (3.9)	6 (2.3)	
Korea, Rep. of	48 (0.4)	601 (2.1)	52 (0.4)	608 (2.2)	7 (2.0)	
2 Azerbaijan	47 (0.8)	466 (6.4)	53 (0.8)	460 (5.9)	7 (3.9)	
⁂ Morocco	48 (0.8)	338 (4.6)	52 (0.8)	331 (4.3)	7 (3.9)	
Ψ Tunisia	47 (0.8)	363 (4.5)	53 (0.8)	356 (4.4)	7 (4.4)	
Malta	49 (0.5)	492 (1.6)	51 (0.5)	499 (2.1)	7 (2.5)	
‡ Norway	51 (1.1)	492 (2.8)	49 (1.1)	499 (3.5)	7 (2.8)	
Finland	49 (0.8)	542 (2.5)	51 (0.8)	549 (2.9)	7 (2.8)	
1 Georgia	48 (0.9)	454 (3.2)	52 (0.9)	447 (4.9)	7 (3.9)	
Bahrain	50 (1.6)	440 (4.5)	50 (1.6)	432 (4.0)	7 (5.5)	
† Netherlands	52 (1.0)	536 (2.1)	48 (1.0)	544 (2.1)	8 (2.4)	
United Arab Emirates	50 (1.6)	438 (2.8)	50 (1.6)	430 (3.5)	8 (5.0)	
Belgium (Flemish)	50 (0.9)	545 (2.2)	50 (0.9)	553 (2.4)	8 (2.5)	
Slovak Republic	49 (0.9)	503 (4.0)	51 (0.9)	511 (3.9)	8 (2.6)	
Germany	49 (0.8)	523 (2.7)	51 (0.8)	532 (2.6)	8 (2.7)	
2 United States	51 (0.5)	536 (2.1)	49 (0.5)	545 (1.9)	9 (1.7)	
Italy	50 (0.7)	503 (3.1)	50 (0.7)	512 (2.9)	9 (3.0)	
Poland	48 (0.9)	476 (2.4)	52 (0.9)	486 (2.5)	9 (2.5)	
Austria	49 (1.2)	504 (2.7)	51 (1.2)	513 (3.3)	9 (2.8)	
Chile	51 (1.4)	457 (2.7)	49 (1.4)	466 (2.8)	9 (3.3)	
Slovenia	48 (0.8)	508 (2.2)	52 (0.8)	518 (3.1)	10 (3.2)	
2 Croatia	50 (0.8)	485 (2.4)	50 (0.8)	495 (2.4)	10 (2.8)	
Czech Republic	48 (1.2)	505 (2.8)	52 (1.2)	516 (2.7)	11 (2.7)	
Spain	49 (0.8)	477 (3.1)	51 (0.8)	488 (3.4)	11 (3.0)	
⁂ Yemen	40 (2.8)	255 (7.0)	60 (2.8)	243 (7.0)	12 (7.6)	
2 Qatar	47 (3.4)	420 (4.7)	53 (3.4)	407 (4.2)	13 (5.6)	
Thailand	49 (0.9)	465 (4.8)	51 (0.9)	451 (5.6)	14 (4.4)	
Saudi Arabia	52 (1.5)	418 (4.6)	48 (1.5)	402 (10.0)	16 (11.2)	
Ψ Oman	49 (0.7)	398 (3.2)	51 (0.7)	372 (3.4)	26 (3.3)	
1 ⁂ Kuwait	54 (1.6)	358 (3.6)	46 (1.6)	323 (5.8)	35 (6.8)	
International Avg.	49 (0.2)	490 (0.5)	51 (0.2)	491 (0.6)		



⁂ Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.
Ψ Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation does not exceed 25% but exceeds 15%.
See Appendix C.2 in the international report for target population coverage notes 1, 2, and 3. See Appendix C.8 for sampling guidelines and sampling participation notes † and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Benchmarking participants					
Dubai, UAE	47 (2.4)	466 (3.5)	53 (2.4)	470 (3.9)	4 (6.7)
Ontario, Canada	49 (0.8)	515 (3.3)	51 (0.8)	521 (3.4)	6 (2.6)
1 3 Florida, US	51 (0.8)	542 (2.8)	49 (0.8)	549 (3.9)	7 (3.3)
2 Alberta, Canada	48 (0.9)	502 (3.1)	52 (0.9)	511 (2.7)	9 (3.1)
Quebec, Canada	50 (1.0)	527 (2.8)	50 (1.0)	538 (2.7)	11 (2.6)
1 2 North Carolina, US	51 (1.3)	548 (4.0)	49 (1.3)	560 (4.9)	12 (3.2)
Abu Dhabi, UAE	50 (2.9)	425 (5.0)	50 (2.9)	409 (6.7)	16 (7.9)



Source: Exhibit 1.10, international mathematics report

3.2 Mathematics attainment by gender: Year 9

The TIMSS 2011 mathematics score for Year 9 (Y9) pupils in England was 507 overall, not significantly different from the centre point of the international scale (500). The average scale score for girls was 508 and for boys 505. This small difference was not statistically significant. Table 3.2 shows the international rankings for gender difference. Of the 56 participants, 21 showed gender differences. Unlike the younger age group, these tended to favour girls (13 of the 21 participants). England is one of 35 participants showing no overall gender difference for mathematics at this age.

Interpreting the data: England's gender differences, Y9 mathematics

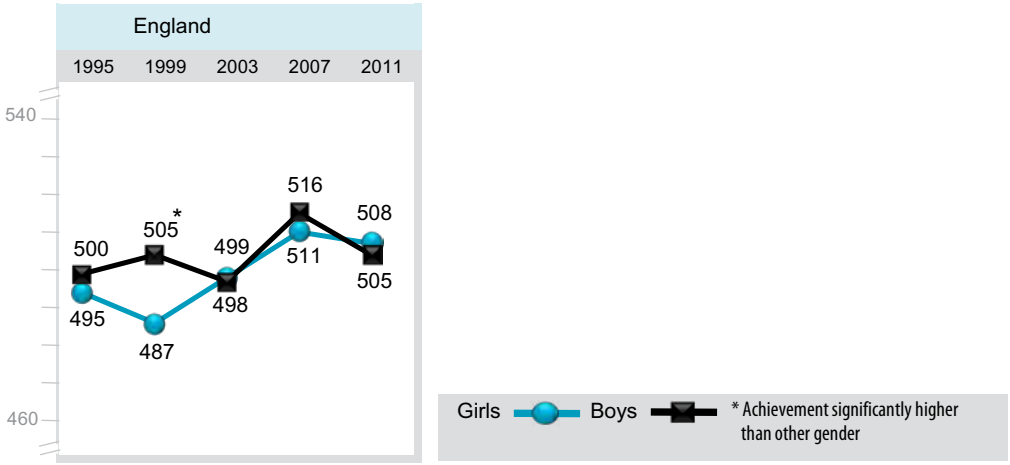
See section 3.1 for a summary of how to interpret this table.

Figure 3.2 shows the TIMSS gender trends over time for Y9 mathematics. It shows that the scores of girls and boys have mirrored each other across four of the five cycles of TIMSS in which pupils of this age have participated. The only significant difference at this grade occurred in TIMSS 1999, when boys performed 18 score points higher than girls. This was the same cohort of pupils which had previously formed the TIMSS 1995 Y5 sample, which also showed a gender difference. Following that difference, both groups came back into alignment in 2003 and the performance of both improved in 2007, remaining stable (not significantly different) in 2011.

Interpreting the data: England's Y9 gender trends in mathematics

The diagram shows England's mean scale score for boys (indicated by a square) and girls (indicated by a circle) in each cycle from 1995 onwards. Only the difference in 1999 was statistically significant.

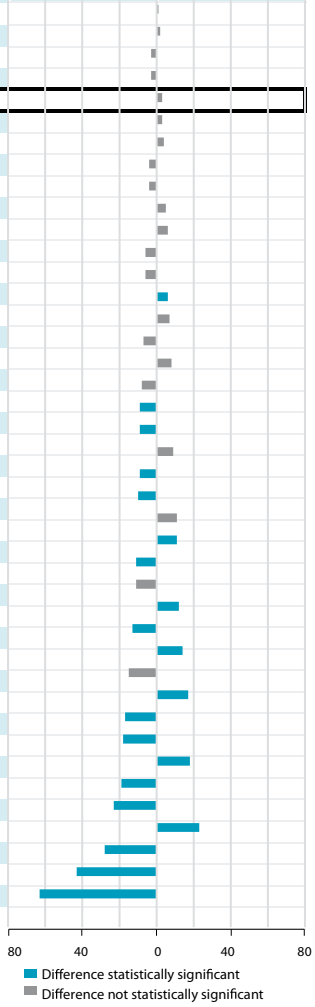
Figure 3.2: Gender trends in Y9 mathematics achievement in England



Source: Exhibit 1.13, international mathematics report

Table 3.2 TIMSS 2011 gender differences, mathematics at ages 13 –14

Country	Girls		Boys		Difference (Absolute Value)	Gender Difference	
	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score		Girls Scored Higher	Boys Scored Higher
⁂ Morocco	47 (0.8)	371 (2.3)	53 (0.8)	371 (2.7)	0 (3.2)		
[2] Russian Federation	49 (0.9)	539 (3.8)	51 (0.9)	539 (3.9)	1 (2.9)		
Kazakhstan	49 (0.8)	486 (4.1)	51 (0.8)	488 (4.5)	2 (3.3)		
Norway	49 (0.7)	476 (2.9)	51 (0.7)	473 (2.9)	3 (3.1)		
‡ England	48 (2.0)	508 (5.7)	52 (2.0)	505 (6.6)	3 (5.6)		
[1] Georgia	47 (0.9)	430 (4.1)	53 (0.9)	432 (4.4)	3 (4.0)		
Ukraine	50 (1.0)	478 (4.0)	50 (1.0)	481 (4.9)	3 (4.4)		
[2] United States	51 (0.6)	508 (2.9)	49 (0.6)	511 (2.8)	4 (2.2)		
Sweden	48 (0.9)	486 (2.1)	52 (0.9)	482 (2.4)	4 (2.4)		
Finland	48 (1.1)	516 (2.7)	52 (1.1)	512 (2.7)	4 (2.3)		
Slovenia	49 (0.9)	502 (2.4)	51 (0.9)	507 (2.8)	5 (2.8)		
Hungary	49 (1.1)	502 (3.9)	51 (1.1)	508 (3.9)	6 (3.5)		
Hong Kong SAR	49 (1.6)	588 (5.0)	51 (1.6)	583 (4.3)	6 (5.5)		
Chinese Taipei	48 (1.0)	613 (3.7)	52 (1.0)	606 (3.8)	6 (4.1)		
Korea, Rep. of	52 (2.5)	610 (3.5)	48 (2.5)	616 (3.1)	6 (3.1)		
Ψ Iran, Islamic Rep. of	46 (2.3)	411 (5.9)	54 (2.3)	418 (5.9)	7 (8.1)		
Ψ Macedonia, Rep. of	49 (0.9)	430 (5.8)	51 (0.9)	423 (5.6)	7 (4.7)		
Japan	49 (1.1)	566 (3.1)	51 (1.1)	574 (3.5)	8 (4.1)		
[3] Israel	50 (1.6)	520 (3.9)	50 (1.6)	512 (5.2)	8 (4.4)		
[2] Singapore	49 (0.7)	615 (3.7)	51 (0.7)	607 (4.5)	9 (3.5)		
Turkey	49 (0.7)	457 (3.8)	51 (0.7)	448 (4.7)	9 (3.5)		
Australia	50 (1.6)	500 (4.7)	50 (1.6)	509 (7.3)	9 (6.9)		
[1] Lithuania	49 (0.7)	507 (2.6)	51 (0.7)	498 (3.2)	9 (3.0)		
Armenia	49 (0.8)	472 (3.1)	51 (0.8)	462 (3.2)	10 (3.1)		
Ψ Syrian Arab Republic	50 (1.7)	375 (5.3)	50 (1.7)	385 (5.3)	11 (5.7)		
Italy	49 (0.9)	493 (2.9)	51 (0.9)	504 (2.8)	11 (2.9)		
Romania	48 (0.9)	464 (4.6)	52 (0.9)	453 (4.2)	11 (3.6)		
Ψ Qatar	50 (3.3)	415 (5.8)	50 (3.3)	404 (5.5)	11 (9.5)		
Lebanon	55 (1.9)	444 (4.2)	45 (1.9)	456 (4.7)	12 (4.7)		
Ψ Indonesia	50 (1.2)	392 (4.9)	50 (1.2)	379 (4.5)	13 (4.0)		
Chile	53 (1.5)	409 (3.2)	47 (1.5)	424 (3.0)	14 (3.6)		
Ψ Saudi Arabia	48 (1.2)	401 (4.1)	52 (1.2)	387 (8.0)	15 (8.9)		
Tunisia	52 (0.7)	417 (3.1)	48 (0.7)	433 (3.1)	17 (2.5)		
United Arab Emirates	50 (1.7)	464 (2.7)	50 (1.7)	447 (3.1)	17 (4.2)		
Thailand	55 (1.6)	435 (4.2)	45 (1.6)	417 (5.3)	18 (4.4)		
New Zealand	47 (2.0)	478 (5.5)	53 (2.0)	496 (6.2)	18 (4.7)		
Malaysia	51 (1.2)	449 (5.2)	49 (1.2)	430 (6.2)	19 (4.4)		
Ψ Palestinian Nat'l Auth.	52 (1.7)	415 (4.2)	48 (1.7)	392 (5.6)	23 (7.0)		
⁂ Ghana	47 (0.8)	318 (4.8)	53 (0.8)	342 (4.3)	23 (2.9)		
Ψ Jordan	49 (1.7)	420 (4.3)	51 (1.7)	392 (5.9)	28 (7.4)		
Ψ Bahrain	50 (0.8)	431 (2.5)	50 (0.8)	388 (3.1)	43 (4.0)		
Ψ Oman	51 (2.1)	397 (3.1)	49 (2.1)	334 (3.8)	63 (4.6)		
International Avg.	50 (0.2)	469 (0.6)	50 (0.2)	465 (0.7)			



⁂ Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

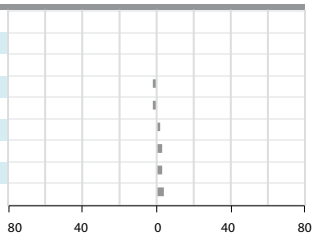
Ψ Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation does not exceed 25% but exceeds 15%.

See Appendix C.3 in the international report for target population coverage notes 1, 2, and 3. See Appendix C.9 for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Benchmarking Participants

[2] Ontario, Canada	49 (0.9)	512 (2.7)	51 (0.9)	512 (3.1)	0 (3.1)
Quebec, Canada	51 (1.4)	531 (2.9)	49 (1.4)	532 (2.5)	0 (2.7)
[1] Minnesota, US	52 (1.5)	545 (4.9)	48 (1.5)	545 (5.1)	0 (3.9)
[1] Alabama, US	51 (1.6)	467 (6.3)	49 (1.6)	465 (6.2)	2 (3.9)
Abu Dhabi, UAE	47 (2.7)	450 (3.9)	53 (2.7)	448 (5.7)	2 (6.4)
[2] Alberta, Canada	50 (0.9)	504 (3.3)	50 (0.9)	506 (2.7)	2 (3.0)
[1 3] North Carolina, US	52 (1.0)	535 (6.2)	48 (1.0)	539 (8.3)	3 (5.1)
[1 2] California, US	49 (1.1)	491 (5.6)	51 (1.1)	494 (5.0)	3 (4.1)
[1] Colorado, US	51 (1.5)	516 (5.4)	49 (1.5)	520 (5.0)	4 (3.4)



Source: Exhibit 1.11, international mathematics report

3.3 Science attainment by gender: Year 5

The TIMSS 2011 science score for Year 5 (Y5) pupils in England was 529, above the centre point of the international scale. The scale score for girls was 529 and for boys, 528. This very small difference was not significant. Table 3.3 shows the international rankings for gender difference. Of the 57 participants at this age range, 32 showed gender differences. As was the case for mathematics, boys generally performed better than girls: although the reverse applied for 12 participants. England is one of 25 participants showing no overall gender difference for science at this age.

Interpreting the data: England's gender differences, Y5 science

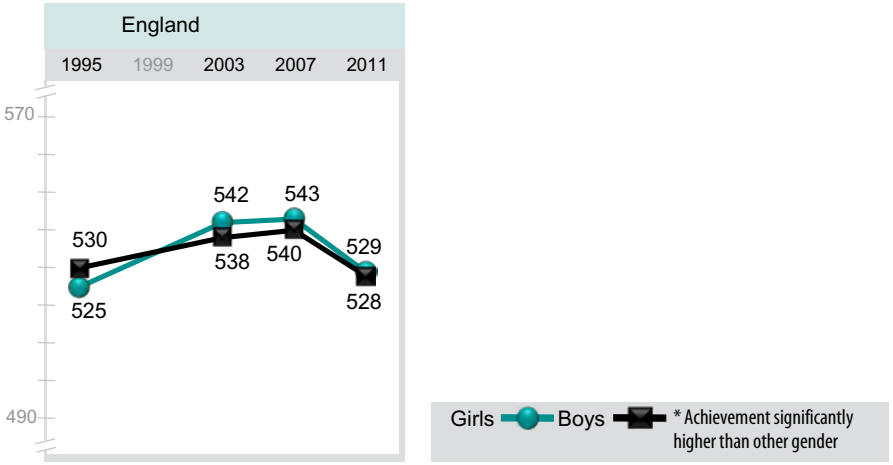
See section 3.1 for a summary of how to interpret this table.

Figure 3.3 shows the TIMSS gender trends over time for Y5 science. It shows that the scores of girls and boys have mirrored each other closely across the four cycles of TIMSS in which pupils of this age have participated. There have been no significant differences in any of the TIMSS years for Y5 science.

Interpreting the data: England's Y5 gender trends in science

The diagram shows England's mean scale score for boys (indicated by a square) and girls (indicated by a circle) in each cycle from 1995 onwards (the 1999 cycle of TIMSS included only older pupils, not the 9 –10 year olds). None of the differences are statistically significant.

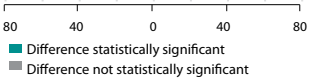
Figure 3.3: Gender trends in Y5 science achievement in England



Source: Exhibit 1.12, international science report

Table 3.3 TIMSS 2011 gender differences, science at ages 9 –10

Country	Girls		Boys		Difference (Absolute Value)	Gender Difference	
	Per cent of Students	Average Scale Score	Per cent of Students	Average Scale Score		Girls Scored Higher	Boys Scored Higher
Australia	49 (1.0)	516 (3.1)	51 (1.0)	516 (3.7)	0 (3.9)		
Romania	48 (0.9)	505 (6.9)	52 (0.9)	506 (5.7)	0 (4.7)		
Finland	49 (0.8)	570 (2.9)	51 (0.8)	570 (3.0)	0 (3.0)		
Ireland	49 (2.3)	516 (4.0)	51 (2.3)	516 (4.6)	1 (5.5)		
New Zealand	49 (0.8)	496 (3.0)	51 (0.8)	497 (2.6)	1 (3.2)		
England	48 (1.0)	529 (3.3)	52 (1.0)	528 (3.3)	1 (3.1)		
1 2 Lithuania	48 (0.8)	514 (2.4)	52 (0.8)	515 (3.0)	1 (2.6)		
Russian Federation	49 (1.0)	553 (3.5)	51 (1.0)	552 (3.8)	1 (2.4)		
† Northern Ireland	49 (1.3)	517 (3.2)	51 (1.3)	516 (3.2)	1 (3.8)		
2 Denmark	51 (0.7)	527 (3.3)	49 (0.7)	529 (3.1)	2 (3.0)		
Iran, Islamic Rep. of	49 (2.9)	452 (5.8)	51 (2.9)	454 (5.7)	2 (8.8)		
2 Serbia	48 (0.9)	514 (3.6)	52 (0.9)	517 (3.7)	3 (3.9)		
Sweden	49 (1.0)	532 (3.0)	51 (1.0)	535 (3.2)	4 (3.0)		
‡ Norway	51 (1.1)	492 (2.5)	49 (1.1)	496 (3.2)	4 (3.1)		
2 Singapore	49 (0.6)	581 (3.7)	51 (0.6)	585 (3.7)	4 (2.7)		
Turkey	48 (0.6)	465 (5.0)	52 (0.6)	461 (4.7)	4 (3.8)		
Hungary	49 (1.0)	532 (4.0)	51 (1.0)	537 (3.9)	5 (2.9)		
2 Croatia	50 (0.8)	514 (2.5)	50 (0.8)	518 (2.5)	5 (2.7)		
Portugal	49 (1.1)	519 (4.6)	51 (1.1)	524 (3.8)	5 (3.2)		
Armenia	47 (0.8)	419 (4.0)	53 (0.8)	414 (4.3)	5 (3.4)		
Japan	49 (0.5)	556 (2.7)	51 (0.5)	561 (2.1)	5 (2.8)		
Slovenia	48 (0.8)	517 (2.8)	52 (0.8)	523 (3.4)	6 (3.2)		
2 Hong Kong SAR	46 (1.2)	532 (3.6)	54 (1.2)	538 (4.3)	6 (2.5)		
Poland	48 (0.9)	502 (3.0)	52 (0.9)	508 (2.9)	6 (2.8)		
Malta	49 (0.5)	443 (2.2)	51 (0.5)	449 (2.8)	6 (3.3)		
Chinese Taipei	47 (0.6)	548 (2.6)	53 (0.6)	555 (2.4)	7 (2.3)		
Italy	50 (0.7)	520 (3.2)	50 (0.7)	528 (3.0)	7 (2.9)		
Korea, Rep. of	48 (0.4)	583 (2.4)	52 (0.4)	590 (2.3)	8 (2.3)		
2 Kazakhstan	48 (0.8)	490 (5.1)	52 (0.8)	498 (5.5)	8 (3.0)		
2 Azerbaijan	47 (0.8)	442 (6.3)	53 (0.8)	434 (5.7)	8 (4.0)		
Slovak Republic	49 (0.9)	528 (4.3)	51 (0.9)	536 (3.6)	8 (2.7)		
1 Georgia	48 (0.9)	459 (3.2)	52 (0.9)	451 (5.1)	9 (3.9)		
Ж Morocco	48 (0.8)	268 (5.1)	52 (0.8)	259 (4.9)	9 (4.4)		
Spain	49 (0.8)	500 (2.8)	51 (0.8)	510 (3.7)	10 (2.8)		
Thailand	49 (0.9)	476 (5.7)	51 (0.9)	467 (6.6)	10 (5.0)		
2 United States	51 (0.5)	539 (2.3)	49 (0.5)	549 (2.1)	10 (1.5)		
† Netherlands	52 (1.0)	526 (2.4)	48 (1.0)	537 (2.6)	10 (2.1)		
Belgium (Flemish)	50 (0.9)	503 (2.6)	50 (0.9)	514 (2.3)	11 (2.9)		
Chile	51 (1.4)	474 (2.8)	49 (1.4)	486 (2.8)	12 (2.9)		
Germany	49 (0.8)	522 (3.0)	51 (0.8)	534 (3.2)	12 (2.5)		
Austria	49 (1.2)	525 (2.8)	51 (1.2)	538 (3.6)	12 (2.9)		
Czech Republic	48 (1.2)	529 (2.9)	52 (1.2)	544 (2.7)	15 (2.6)		
United Arab Emirates	50 (1.6)	437 (3.4)	50 (1.6)	419 (3.8)	18 (5.3)		
Bahrain	50 (1.6)	461 (5.5)	50 (1.6)	438 (4.6)	23 (7.0)		
Ψ Tunisia	47 (0.8)	359 (5.6)	53 (0.8)	334 (5.6)	25 (4.3)		
2 Qatar	47 (3.4)	408 (5.1)	53 (3.4)	382 (5.7)	26 (6.5)		
Ж Yemen	40 (2.8)	225 (7.3)	60 (2.8)	198 (8.8)	27 (8.0)		
Oman	49 (0.7)	394 (4.7)	51 (0.7)	360 (4.6)	34 (3.8)		
Saudi Arabia	52 (1.5)	453 (4.7)	48 (1.5)	405 (9.9)	48 (11.0)		
1 Ψ Kuwait	54 (1.6)	371 (5.5)	46 (1.6)	319 (7.1)	53 (8.6)		
International Avg.	49 (0.2)	487 (0.6)	51 (0.2)	485 (0.6)			



Ж Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.
Ψ Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation does not exceed 25% but exceeds 15%.
See Appendix C.2 in the international report for target population coverage notes 1, 2, and 3. See Appendix C.8 for sampling guidelines and sampling participation notes † and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

England	48 (1.0)	529 (3.3)	52 (1.0)	528 (3.3)	1 (3.1)	
1 2 Lithuania	48 (0.8)	514 (2.4)	52 (0.8)	515 (3.0)	1 (2.6)	
Russian Federation	49 (1.0)	553 (3.5)	51 (1.0)	552 (3.8)	1 (2.4)	
† Northern Ireland	49 (1.3)	517 (3.2)	51 (1.3)	516 (3.2)	1 (3.8)	
2 Denmark	51 (0.7)	527 (3.3)	49 (0.7)	529 (3.1)	2 (3.0)	
Iran, Islamic Rep. of	49 (2.9)	452 (5.8)	51 (2.9)	454 (5.7)	2 (8.8)	
2 Serbia	48 (0.9)	514 (3.6)	52 (0.9)	517 (3.7)	3 (3.9)	
Sweden	49 (1.0)	532 (3.0)	51 (1.0)	535 (3.2)	4 (3.0)	
‡ Norway	51 (1.1)	492 (2.5)	49 (1.1)	496 (3.2)	4 (3.1)	
2 Singapore	49 (0.6)	581 (3.7)	51 (0.6)	585 (3.7)	4 (2.7)	

Source: Exhibit 1.10, international science report

3.4 Science attainment by gender: Year 9

The TIMSS 2011 science score for Year 9 (Y9) pupils in England was 533, above the centre point of the international scale. The scale score for girls was 534 and for boys, 532. This small difference was not significant. Table 3.4 shows the international rankings for gender difference. Of the 56 participants at this age range, 33 showed gender differences, about half favouring girls and half boys. England is one of 23 participants showing no overall gender difference for science at this age.

Interpreting the data: England's gender differences, Y9 science

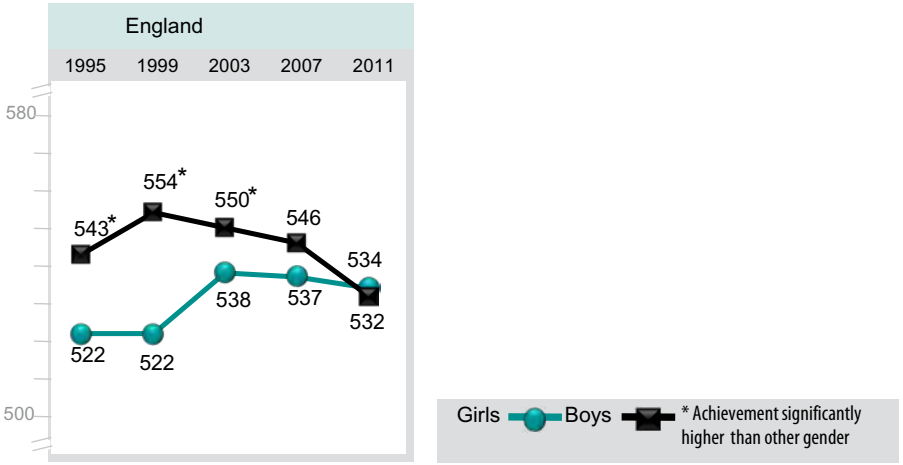
See section 3.1 for a summary of how to interpret this table.

Figure 3.4 shows the TIMSS gender trends over time for Y9 science. It shows that the scores of girls and boys were initially relatively far apart but have gradually come into alignment. Boys scored significantly more highly than girls in 1995, 1999 and 2003. In 2007, a small difference in scores persisted but this was not statistically significant. The scores have aligned in 2011 to a two-point difference only, which is not significant. The alignment has been achieved through the scores of boys dropping over time and those of girls increasing over time. As noted in chapter 1, the overall scale scores (combined scores of boys and girls) have not differed significantly for Y9 science over time across any of the TIMSS cycles.

Interpreting the data: England's Y9 gender trends in science

The diagram shows England's mean scale score for boys (indicated by a square) and girls (indicated by a circle) in each cycle from 1995 onwards. Differences up to 2003 were significant. Those in 2007 and 2011 were not significant.

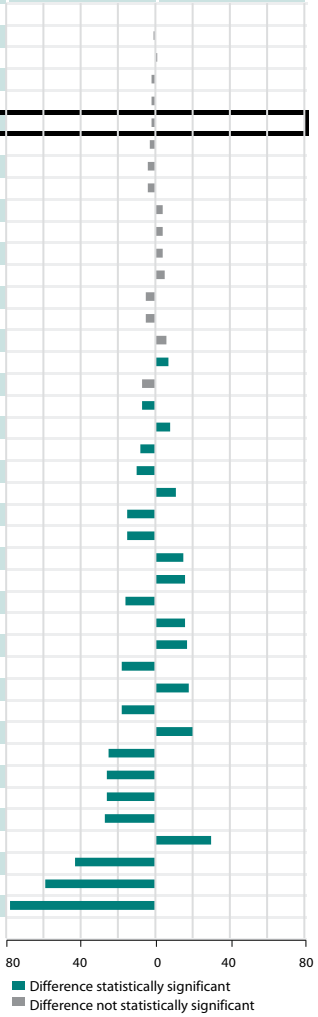
Figure 3.4: Gender trends in Y9 science achievement in England



Source: Exhibit 1.13, international science report

Table 3.4 TIMSS 2011 gender differences, science at ages 13 –14

Country	Girls		Boys		Difference (Absolute Value)	Gender Difference	
	Per cent of Students	Average Scale Score	Per cent of Students	Average Scale Score		Girls Scored Higher	Boys Scored Higher
Chinese Taipei	48 (1.0)	564 (2.7)	52 (1.0)	564 (2.8)	0 (3.0)		
Norway	49 (0.7)	495 (3.2)	51 (0.7)	494 (3.0)	1 (3.4)		
[2] Singapore	49 (0.7)	589 (4.2)	51 (0.7)	591 (5.3)	1 (4.1)		
Hong Kong SAR	49 (1.6)	536 (4.5)	51 (1.6)	534 (3.7)	2 (4.6)		
Romania	48 (0.9)	466 (3.8)	52 (0.9)	464 (4.0)	2 (3.4)		
‡ England	48 (2.0)	534 (5.0)	52 (2.0)	532 (6.2)	2 (5.6)		
Sweden	48 (0.9)	511 (2.7)	52 (0.9)	508 (3.1)	3 (3.0)		
Morocco	47 (0.8)	378 (2.6)	53 (0.8)	374 (2.7)	4 (3.0)		
Kazakhstan	49 (0.8)	492 (4.6)	51 (0.8)	488 (4.6)	4 (3.6)		
Lebanon	55 (1.9)	404 (5.4)	45 (1.9)	408 (6.5)	4 (6.7)		
Slovenia	49 (0.9)	541 (3.0)	51 (0.9)	545 (3.4)	4 (3.4)		
Ukraine	50 (1.0)	499 (3.7)	50 (1.0)	503 (4.3)	4 (4.1)		
Korea, Rep. of	52 (2.5)	558 (2.6)	48 (2.5)	563 (2.4)	5 (3.1)		
Finland	48 (1.1)	555 (2.4)	52 (1.1)	550 (3.1)	5 (2.7)		
Iran, Islamic Rep. of	46 (2.3)	477 (5.3)	54 (2.3)	472 (5.3)	5 (7.0)		
Syrian Arab Republic	50 (1.7)	424 (4.4)	50 (1.7)	429 (4.9)	6 (5.2)		
[2] Russian Federation	49 (0.9)	539 (3.6)	51 (0.9)	546 (3.5)	7 (2.9)		
[3] Israel	50 (1.6)	519 (3.7)	50 (1.6)	512 (5.2)	7 (4.2)		
Indonesia	50 (1.2)	409 (5.1)	50 (1.2)	402 (4.5)	7 (3.6)		
Japan	49 (1.1)	554 (2.9)	51 (1.1)	562 (2.9)	8 (3.3)		
[1] Lithuania	49 (0.7)	518 (3.0)	51 (0.7)	510 (3.1)	8 (3.3)		
[1] Georgia	47 (0.9)	425 (3.3)	53 (0.9)	415 (3.5)	10 (3.4)		
[2] United States	51 (0.6)	519 (2.8)	49 (0.6)	530 (2.9)	11 (2.4)		
Malaysia	51 (1.2)	434 (6.3)	49 (1.2)	419 (7.3)	15 (5.5)		
Thailand	55 (1.6)	458 (3.9)	45 (1.6)	443 (5.2)	15 (4.9)		
Italy	49 (0.9)	493 (3.1)	51 (0.9)	508 (2.6)	15 (2.8)		
Chile	53 (1.5)	454 (3.2)	47 (1.5)	470 (2.9)	16 (3.6)		
Turkey	49 (0.7)	491 (3.2)	51 (0.7)	475 (4.3)	16 (3.2)		
Australia	50 (1.6)	511 (4.5)	50 (1.6)	527 (6.5)	16 (5.9)		
Tunisia	52 (0.7)	431 (2.6)	48 (0.7)	447 (2.9)	17 (2.6)		
Macedonia, Rep. of	49 (0.9)	417 (5.6)	51 (0.9)	399 (6.1)	18 (4.7)		
Hungary	49 (1.1)	513 (3.5)	51 (1.1)	531 (3.7)	18 (3.7)		
Armenia	49 (0.8)	446 (3.5)	51 (0.8)	428 (3.6)	18 (3.4)		
New Zealand	47 (2.0)	501 (4.6)	53 (2.0)	522 (5.1)	20 (3.9)		
United Arab Emirates	50 (1.7)	477 (2.9)	50 (1.7)	452 (3.3)	25 (4.2)		
Qatar	50 (3.3)	432 (7.0)	50 (3.3)	406 (5.4)	26 (10.7)		
Saudi Arabia	48 (1.2)	450 (3.5)	52 (1.2)	424 (6.4)	26 (7.2)		
Palestinian Nat'l Auth.	52 (1.7)	434 (3.8)	48 (1.7)	406 (5.4)	27 (6.8)		
Ψ Ghana	47 (0.8)	290 (5.7)	53 (0.8)	320 (5.4)	30 (4.0)		
Jordan	49 (1.7)	471 (4.3)	51 (1.7)	428 (6.4)	43 (7.6)		
Bahrain	50 (0.8)	482 (2.2)	50 (0.8)	423 (3.6)	59 (4.4)		
Oman	51 (2.1)	458 (2.9)	49 (2.1)	380 (4.4)	78 (4.9)		
International Avg.	50 (0.2)	480 (0.6)	50 (0.2)	474 (0.7)			



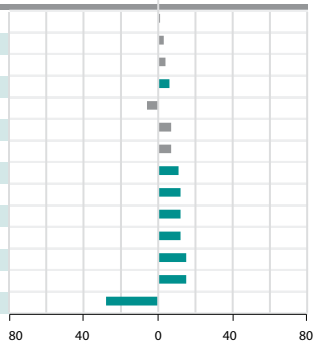
Ψ Reservations about reliability of average achievement because the percentage of students with achievement too low for estimation does not exceed 25% but exceeds 15%.

See Appendix C.3 for target population coverage notes 1, 2, and 3. See Appendix C.9 for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Benchmarking Participants

[2] Ontario, Canada	49 (0.9)	521 (2.6)	51 (0.9)	522 (3.0)	1 (2.7)
[1 2] Connecticut, US	49 (1.0)	530 (4.5)	51 (1.0)	533 (5.9)	3 (5.1)
Quebec, Canada	51 (1.4)	518 (3.0)	49 (1.4)	522 (3.0)	4 (3.0)
[2] Alberta, Canada	50 (0.9)	542 (2.8)	50 (0.9)	549 (2.5)	6 (2.5)
Abu Dhabi, UAE	47 (2.7)	465 (4.5)	53 (2.7)	458 (6.0)	6 (6.9)
[1 2] Massachusetts, US	50 (1.0)	564 (5.8)	50 (1.0)	570 (5.1)	7 (3.6)
[1] Alabama, US	51 (1.6)	482 (6.3)	49 (1.6)	489 (6.8)	7 (4.0)
[1] Colorado, US	51 (1.5)	537 (4.7)	49 (1.5)	548 (5.2)	11 (4.5)
[1 3] North Carolina, US	52 (1.0)	526 (5.7)	48 (1.0)	537 (7.7)	12 (4.7)
[1 2] California, US	49 (1.1)	493 (5.0)	51 (1.1)	504 (5.0)	12 (4.0)
[1] Minnesota, US	52 (1.5)	548 (4.9)	48 (1.5)	559 (5.3)	12 (3.8)
[1 2] Florida, US	49 (1.9)	522 (8.5)	51 (1.9)	537 (7.6)	15 (6.8)
[1 2] Indiana, US	52 (1.1)	526 (4.9)	48 (1.1)	541 (5.4)	15 (4.0)
Dubai, UAE	48 (4.6)	500 (4.6)	52 (4.6)	472 (5.8)	28 (9.3)



Source: Exhibit 1.11, international science report

3.5 The language context for TIMSS 2011 in England

In TIMSS 2011, headteachers were asked what percentage of their pupils had English as their first language.[24] Table 3.5 summarises the responses. The table shows that almost a quarter of England's Y5 pupils are taught in schools where 50 per cent or less of pupils speak English as their first language. This is more than the 15 per cent reported in this category in 2007. There has also been an increase (albeit less pronounced) at Y9.

The data shown in the international reports[25] suggest that the greater the percentage of pupils who have the language of the test as their native language, the higher the score for that group on the assessment. However, it is unlikely that these apparent associations are statistically significant.[26]

Table 3.5 Headteacher reports of size of school population with English as their first language

	Y5		Y9	
	2011	**2007**	**2011**	**2007**
Percentage of pupils in schools where more than 90% have English as their first language	56%	68%	66%	72%
Percentage of pupils in schools where 51 –90% have English as their first language	22%	17%	21%	22%
Percentage of pupils in schools where 50% or less have English as their first language	22%	15%	13%	6%

Source: Exhibits 5.5 and 5.6 international mathematics report and international science report and Exhibit 8.2 in the TIMSS 2007 international reports (Mullis et al, 2008; Martin et al, 2008)

Similar apparent trends are seen for pupils' reports of the frequency with which they speak English at home.[27] The majority of pupils reported speaking English at home *always or almost always*, particularly at Y9 (see Table 3.6). Again, there is a change since 2007, with fewer Y5 pupils reporting that they *always or almost always* speak English at home. It is noticeable that the percentages do not correspond to those in Table 3.5. This is partly because pupils for whom English is not the first language may, nevertheless, speak it with some degree of fluency, and therefore may speak it at home at times (and at school), even where it is not their first language.

24 For Y5, the wording of the question in England was: "Approximately what percentage of children in your school have English as their first language?" The Y9 question was identical apart from reference to 'students' in place of 'children'.

25 See Exhibits 5.5 and 5.6 in the international mathematics and science reports.

26 No tests of statistical significance were conducted in this international analysis but, given the size of the standard errors for the achievement scores, it is unlikely that these apparent associations are significant.

27 Pupils were asked "How often do you speak English at home?"

The more frequently that pupils reported speaking English at home, the better they appeared to do on the assessments of mathematics and science.[28] It is likely that this is true for both subjects at Y5 and for science at Y9. However, it is likely that the apparent finding for Y9 mathematics is not statistically significant.[29] Similar trends were found in TIMSS 2007 for Y5.[30]

Table 3.6 Pupil reports of frequency of speaking English at home

	Y5		Y9	
	2011	**2007**	**2011**	**2007**
Percentage of pupils always or almost always speaking English at home	81%	93%	95%	97%
Percentage of pupils sometimes speaking English at home	17%	6%	4%	2%
Percentage of pupils never speaking English at home	2%	1%	1%	0%

Source of Y9 data: Exhibit 4.6 in international mathematics and science reports

Source of Y5 data: derived from national dataset[31]

28 Derived from Exhibit 4.6 in the international mathematics and science reports, and national dataset; there was insufficient data to report average achievement for those who reported never speaking English at home.

29 No tests of statistical significance were conducted but, given the size of the standard errors for the achievement scores, it is likely that all associations are significant, except for Y9 mathematics.

30 See Exhibit 4.2 in the 2007 international mathematics and science reports (Mullis *et al*, 2008; Martin *et al*, 2008); percentages across the *sometimes* and *never* categories were too low to report achievement data for Y9 in 2007.

31 See the international database on the TIMSS 2011 page at: http://timss.bc.edu

Chapter 4 Pupils' engagement

Chapter outline

This chapter summarises pupils' engagement in mathematics and science in Year 5 (Y5, ages 9–10) and Year 9 (Y9, ages 13–14) in 2011.

As well as pupils' engagement and teachers' approaches towards engaging pupils, this chapter explores pupils' attitudes towards mathematics and science: whether they like and (for Y9 only) value the subjects and their confidence in mathematics and science.

Findings for mathematics are presented first (Y5 then Y9), followed by findings for science (Y5 then Y9). Outcomes for England are compared with those of other countries where relevant.

Key findings

- On average, in England, Y5 and Y9 pupils' responses indicated that they *Somewhat Like* learning mathematics and science. They were also, on average, *Somewhat Confident in* mathematics and science and *Somewhat Engaged* in their mathematics and science lessons.
- More Y5 than Y9 pupils in England were positive about learning mathematics and science. Just under half of Y5 pupils *Like Learning Mathematics* and *Like Learning Science*.
- The scales used to measure pupil attitudes towards mathematics and science have changed between the 2007 and 2011 TIMSS cycles; a comparison of the elements that have remained the same suggest that pupil attitudes towards mathematics and science have changed little.
- In England, for both science and mathematics, the Y9 pupils who were most positive about learning the subject also had the highest achievement. The same was not the case at Y5.
- More Y5 than Y9 pupils in England were *Confident* about their abilities in mathematics and science.
- In England, the pupils who were most *Confident* in mathematics and science were also those who had higher average achievement scores.
- Just under half of Y9 pupils in England were classified as *Valuing* mathematics; the equivalent figure for science was a little lower.[32]
- In England, under half of Y5 pupils were classified as *Engaged* in their mathematics and science lessons. The comparable figures were lower at Y9. Low percentages of pupils *Engaged* in their mathematics and science lessons were not unusual internationally, even among the highest performing countries.
- In England, a relatively high percentage of pupils were taught by teachers who used the listed engagement practices in *Most Lessons*. This was true for both mathematics and science at both ages.
- International analysis shows that high performance overall in a country was not necessarily linked to high percentages of pupils responding positively to questions about their attitudes towards mathematics and science.

32 There was no equivalent question at Y5.

4.1 Mathematics Y5

4.1.1 Pupils' attitudes: liking the subject

Pupils' attitudes were measured by their responses to five statements about learning mathematics (these statements can be seen in Table 4.1). The international analysis used responses to these statements to create the *Students Like Learning Mathematics* scale (see the Interpreting the data box below). Pupils were categorised into three bands: *Like Learning Mathematics, Somewhat Like Learning Mathematics* and *Do Not Like Learning Mathematics* (details of how pupils were assigned to each band is provided in Table 4.1). In England, the average scale score was 9.8, within the *Somewhat Like Learning Mathematics* category overall.

Forty-four per cent of Y5 pupils were in the most positive category of *Like Learning Mathematics*.[33] Internationally, the percentages of pupils in this category ranged from 76 per cent (Georgia) to 23 per cent (Korea). As seen in Korea, several of the highest performing countries were, like England, positioned towards the lower end of this range.

Interpreting the data: indices and scales

In order to summarise data from a questionnaire, responses to several related items are sometimes combined to form an index or scale. The respondents to the questionnaire items are grouped according to their responses and the way in which responses have been categorised is shown for each index or scale. The data in an index or scale is often considered to be more valid and reliable than the responses to individual items.

Table 4.1 Pupils like learning mathematics

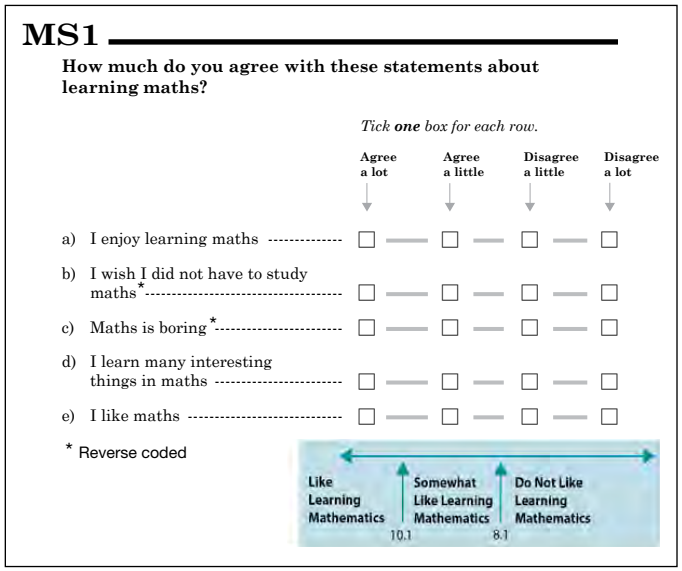
Reported by Students

Students were scored according to their degree of agreement with five statements on the *Students Like Learning Mathematics* scale. Students who **Like Learning Mathematics** had a score on the scale of at least 10.1, which corresponds to their "agreeing a lot" with three of the five statements and "agreeing a little" with the other two, on average. Students who **Do Not Like Learning Mathematics** had a score no higher than 8.1, which corresponds to their "disagreeing a little" with three of the five statements and "agreeing a little" with the other two, on average. All other students **Somewhat Like Learning Mathematics**.

Country	Like Learning Mathematics		Somewhat Like Learning Mathematics		Do Not Like Learning Mathematics		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achieveme	Per cent of Students	Average Achievement	
England	44 (1.4)	548 (4.4)	37 (1.1)	543 (4.0)	19 (1.1)	530 (5.5)	9.8 (0.06)
International Avg.	48 (0.2)	509 (0.5)	36 (0.1)	478 (0.6)	16 (0.1)	466 (0.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

33 It is not possible to compare these outcomes with TIMSS 2007 because the scale method has changed. See section 4.2.2 for more information.



Source: Exhibit 8.1, international mathematics report

The international averages indicated that, as pupils' mathematics achievement increased, so did the extent to which they like the subject. The data cannot determine why this is so; it could be because pupils who like mathematics are better at it, or because pupils who are better at mathematics like it more. In England, the apparent differences in achievement of pupils in the different categories of liking mathematics are unlikely[34] to be significant.[35] However, the association was likely to be significant in some other countries, including the high performers of Singapore, Japan and Chinese Taipei.[36]

4.1.2 Pupils' confidence

Pupils' confidence was measured using their responses to a set of statements about their mathematical skills and abilities (the statements and details of how pupils were then assigned to one of the three confidence bands are provided in Table 4.2). A third of Y5 pupils in England (33 per cent) were in the *Confident* in mathematics category, with 48 per cent in the *Somewhat Confident* category, and 19 per cent categorised as *Not Confident* in mathematics (see Table 4.2). In England, the average score on the *Students Confident in Mathematics* scale was 10.0, within the *Somewhat Confident* category overall.

Internationally, the percentages of pupils of this age in the *Confident* in mathematics category ranged from 9 per cent (Japan) to 49 per cent (Poland). As was the case for liking mathematics, several of the highest performing countries had relatively low percentages in this category. For example, as noted, Japan had the lowest percentage of pupils in this category. Also, in Singapore, the highest overall performing country in mathematics among 9–10 year olds, just 21 per cent of pupils

34 Tests of statistical significance were not carried out in the international analysis. However, based on the size of the standard errors, it is not likely that the apparent differences are statistically significant across all three categories.

35 Throughout this report, the term 'significant' refers to statistical significance.

36 It is worth noting that such associations can apply to both high and low performing countries. For example, in a high ranking country, more positive pupils may do better than less positive pupils, even though these pupils achieve, on average, at a higher level than those in other countries. The same may be true of a low ranking country: its more positive pupils may do relatively better than its lower performing pupils, even though they achieve, on average, at a lower level overall.

were categorised as *Confident* in mathematics. The comparable figure in Korea was 11 per cent.

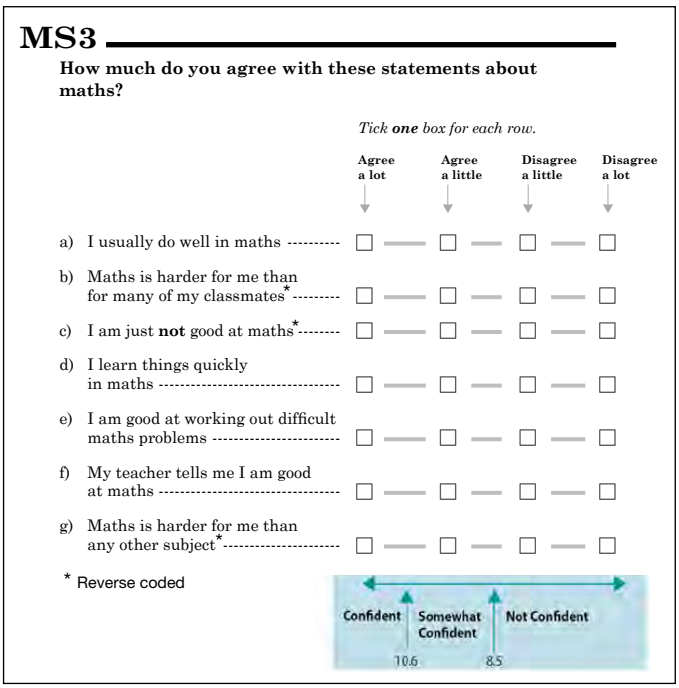
Table 4.2 Pupils confident in mathematics

Reported by Students

Students were scored according to their degree of agreement with seven statements on the *Students Confident in Mathematics* scale. Students **Confident** with mathematics had a score on the scale of at least 10.6, which corresponds to their "agreeing a lot" with four of the seven statements and "agreeing a little" with the other three, on average. Students who were **Not Confident** had a score no higher than 8.5, which corresponds to their "disagreeing a little" with four of the seven statements and "agreeing a little" with the other three, on average. All other students were **Somewhat Confident** with mathematics.

Country	Confident		Somewhat Confident		Not Confident		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	33 (1.0)	572 (4.6)	48 (0.9)	538 (3.8)	19 (0.7)	503 (4.4)	10.0 (0.04)
International Avg.	34 (0.1)	527 (0.5)	46 (0.1)	484 (0.5)	21 (0.1)	452 (0.7)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Source: Exhibit 8.4, international mathematics report

Internationally and in England there was a clear pattern of decreasing achievement with decreasing levels of confidence. In England, among the pupils who were classified as *Confident* in mathematics the average achievement was 572, whereas among those classified as *Not Confident*, the average achievement was lower at 503. These differences are likely to be statistically significant.[37] As with pupil attitudes, this could be because pupils who are confident in mathematics are better at it, or because pupils who are better at mathematics are more confident in the subject.

37 Tests of statistical significance were not carried out in the international analysis. Based on the size of the standard errors, it is likely that these apparent differences are statistically significant.

4.1.3 Pupils' reported engagement in lessons

Pupils' engagement was measured by their responses to five statements about their mathematics lessons. The international analysis uses responses to these statements to create the *Pupils Engaged in Mathematics Lessons* scale (see Table 4.3 for details of the statements used). Pupils were allocated to one of three categories of pupil engagement based on their responses: *Engaged, Somewhat Engaged* and *Not Engaged in mathematics*. In England, the average scale score was 9.8, within the Somewhat Engaged category overall.

Table 4.3 shows that among Y5 pupils in England, 41 per cent were classified as *Engaged* in mathematics lessons, 51 per cent as *Somewhat Engaged*, and only 8 per cent were in the *Not Engaged* category. Internationally, the percentage of pupils classified as *Engaged* in mathematics lessons ranged from 9 per cent (Japan) to 65 per cent (Tunisia). Again, the countries that performed best overall in mathematics at this age group did not necessarily have the highest percentages of pupils categorised as *Engaged* in lessons. Japan is one example (9 per cent) and Singapore, the highest performing country overall in mathematics at this age group, had 36 per cent of pupils *Engaged*, less than the international average.

Internationally, there was an association between engagement and achievement that is likely to be significant. However, the apparent differences across the three categories in England are not likely to be significant.

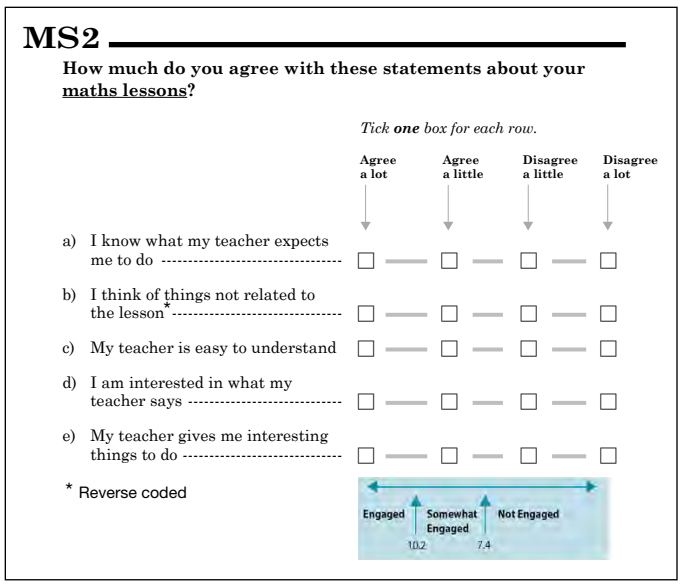
Table 4.3 Pupils engaged in mathematics lessons

Reported by Students

Students were scored according to their degree of agreement with five statements on the *Engaged in Mathematics Lessons* scale. Students **Engaged** in mathematics lessons had a score on the scale of at least 10.2, which corresponds to their "agreeing a lot" with three of the five statements and "agreeing a little" with the other two, on average. Students who were **Not Engaged** had a score no higher than 7.4, which corresponds to their "disagreeing a little" with three of the five statements and "agreeing a little" with the other two, on average. All other students were **Somewhat Engaged** in mathematics lessons.

Country	Engaged		Somewhat Engaged		Not Engaged		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	41 (1.6)	548 (4.8)	51 (1.4)	540 (3.7)	8 (0.6)	538 (7.7)	9.8 (0.06)
International Avg.	42 (0.2)	507 (0.5)	49 (0.2)	482 (0.5)	8 (0.1)	464 (1.0)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



MS2

How much do you agree with these statements about your maths lessons?

*Tick **one** box for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I know what my teacher expects me to do	☐	☐	☐	☐
b) I think of things not related to the lesson*	☐	☐	☐	☐
c) My teacher is easy to understand	☐	☐	☐	☐
d) I am interested in what my teacher says	☐	☐	☐	☐
e) My teacher gives me interesting things to do	☐	☐	☐	☐

* Reverse coded

Source: Exhibit 8.17, international mathematics report

4.1.4 Teachers' reported approaches to engaging pupils in lessons

For this scale measure, pupils were scored according to their teachers' responses to how often they used each of six teaching practices in their lessons. Table 4.4 provides further information on the statements to which teachers responded, and shows how the responses were categorised. In England, the average scale score was 10.3, within the category of using the listed engagement practices in *Most Lessons* overall.

Table 4.4 presents the data for England, showing that most Y5 pupils (86 per cent) were taught by teachers who were categorised as using the listed engagement practices in *Most Lessons*. Internationally, the percentages of pupils in this category ranged from 24 per cent (Denmark) to 95 per cent (Florida). England was placed towards the top of the range internationally, and higher than the six highest performing countries in mathematics at this age group (Singapore, Korea, Hong Kong, Chinese Taipei, Japan and Northern Ireland: between 39 and 80 per cent of pupils in these highest performing countries were taught by teachers categorised as using these engagement practices in *Most Lessons*).

Interpreting the data: scaled data from teachers

Some of the data presented in this chapter is reported by teachers. Reported percentages refer to pupils and can usually (unless otherwise indicated) be interpreted as the percentage of pupils whose teacher reported a particular practice or gave a particular response to a questionnaire item.

When interpreting the data from pupils, headteachers and teachers it is important to take account of the relative sample sizes. Participants are expected to sample a minimum of 150 schools in each year group and a minimum of 4,000 students for each target year group (these figures represent the numbers *drawn* in the sample; the *achieved* sample numbers may be less). The achieved ranges for participating schools internationally were 96 to 459 for Y5, and 95 to 501 for Y9.[38] These wide ranges reflected the fact that some participants had fewer than 150 schools available and some participants chose to over-sample schools. Just over half of participants sampled between 150 and 200 schools for each age group.

For TIMSS 2011 in England, the number of participating schools was 125 at Y5 and 118 at Y9. Numbers of participants within these schools were:

- 3,397 Y5 and 3,482 Y9 pupils.
- 125 and 118 headteachers respectively answered the Y5 and Y9 School Questionnaire.
- 194 Y5 class teachers completed a Teacher Questionnaire for mathematics and 199 for science.
- 213 Y9 teachers completed the Mathematics Teacher Questionnaire.
- 757 Y9 teachers completed the Science Teacher Questionnaire (the number of science teachers was greater as the Y9 pupils were sampled by mathematics class).

See Appendix A for more information about numbers of participants and sampling method.

38 These figures refer to countries and exclude benchmarking participants.

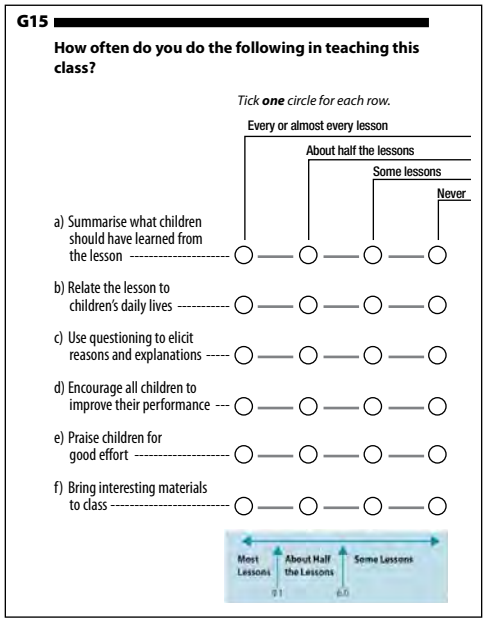
Table 4.4 Teaching to engage pupils in learning

Reported by Teachers

Students were scored according to their teachers' responses to how often they used each of six instructional practices on the *Engaging Students in Learning* scale. Students with teachers who used engagement practices in **Most Lessons** had a score on the scale of at least 9.1, which corresponds to their teachers using three of the six practices "every or almost every lesson" and using the other three in "about half the lessons," on average. Students with teachers who used engagement practices in **Some Lessons** had a score no higher than 6.0, which corresponds to their teachers using three of the six practices in "some lessons" and using the other three in "about half the lessons," on average. All other students had teachers who used engagement practices in **About Half the Lessons**.

Country	Most Lessons		About Half the Lessons		Some Lessons		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	86 (3.1)	545 (3.9)	14 (3.1)	538 (11.8)	0 (0.0)	~ ~	10.3 (0.14)
International Avg.	69 (0.5)	492 (0.6)	30 (0.5)	488 (1.0)	2 (0.1)	~ ~	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.



Source: Exhibit 8.14, international mathematics report

While there was an international association between frequency of using the listed engagement activities and pupil achievement, the apparent difference in England is not likely to be significant.

4.2 Mathematics Y9

4.2.1 Pupils' attitudes: liking the subject

As explained in section 4.1.1, pupils' attitudes in terms of liking mathematics were measured based on their responses to five statements about learning mathematics. Pupils were then allocated to one of three scale categories: *Like Learning Mathematics, Somewhat Like Learning Mathematics*, and *Do Not Like Learning Mathematics*. The statements, and details on how pupils were allocated to categories, are provided in Table 4.5. In England at Y9, the average scale score was 9.4, within the *Somewhat Like Learning Mathematics* category overall.

Compared with the equivalent figure for Y5 pupils, a much smaller percentage (14 per cent) of Y9 pupils were allocated to the *Like Learning Mathematics* category (see Table 4.5). Internationally, the percentage of pupils in this category ranged from 6 per cent (Slovenia) to 48 per cent (Morocco). As seen in the Y5 data, several of the highest performing countries were, like England, positioned towards the lower end of this range. For example, in Korea, just 8 per cent of Y9 pupils were in the highest category of *Like Learning Mathematics*. However, this was not true of all high-performing countries at this level; for example, Singapore had 32 per cent of pupils in the *Like Learning Mathematics* category.

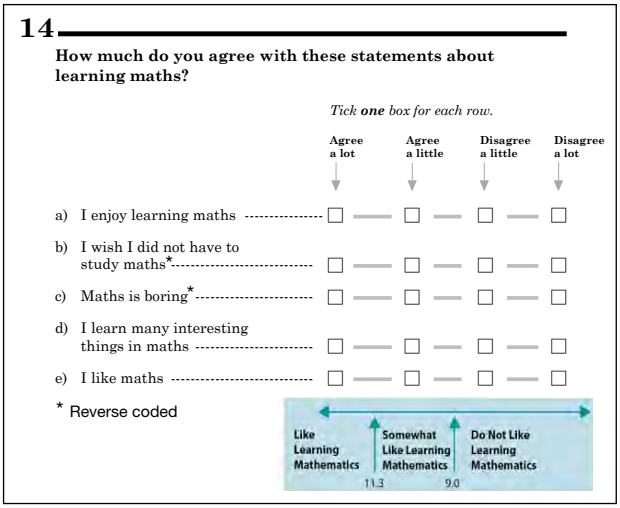
Table 4.5 Pupils like learning mathematics

Reported by students

Students were scored according to their degree of agreement with five statements on the *Pupils like learning mathematics* scale. Students who **Like Learning Mathematics** had a score on the scale of at least 11.3, which corresponds to their "agreeing a lot" with three of the five statements and "agreeing a little" with the other two, on average. Students who **Do Not Like Learning Mathematics** had a score no higher than 9.0, which corresponds to their "disagreeing a little" with three of the five statements and "agreeing a little" with the other two, on average. All other students **Somewhat Like Learning Mathematics**.

Country	Like Learning Mathematics		Somewhat Like Learning Mathematics		Do Not Like Learning Mathematics		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	14 (1.0)	548 (8.9)	44 (1.3)	517 (5.7)	42 (1.7)	484 (5.2)	9.4 (0.07)
International Avg.	26 (0.2)	504 (0.8)	42 (0.1)	467 (0.6)	31 (0.2)	443 (0.7)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



14

How much do you agree with these statements about learning maths?

*Tick **one** box for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I enjoy learning maths	☐	☐	☐	☐
b) I wish I did not have to study maths*	☐	☐	☐	☐
c) Maths is boring*	☐	☐	☐	☐
d) I learn many interesting things in maths	☐	☐	☐	☐
e) I like maths	☐	☐	☐	☐

* Reverse coded

Source: Exhibit 8.2, international mathematics report

The average achievement score of the 14 per cent of pupils categorised as liking mathematics (548) was higher than the average for those categorised as not liking mathematics (484). Although significance tests have not been carried out in the international analysis, the apparent differences across the three categories are likely to be statistically significant based on the size of the standard errors. It is not possible to say whether pupils are better at mathematics because they like the subject, or whether they like the subject because they are good at it.

4.2.2 Comparison with TIMSS 2007: liking the subject

As outlined above, the data show that the percentage of Y9 pupils in England with the most positive attitude towards mathematics in 2011 is relatively low at 14 per cent.

It is useful to look back at the findings from TIMSS 2007 to establish whether there has been a change over time. However, as the scale used to report these findings has changed since 2007 it is not easy to make direct comparisons.

In 2007, the *Positive Affect Toward Mathematics* (PATM) scale was used to measure pupils' attitudes towards mathematics.[39] In England, 40 per cent of Y9 pupils were in the *High PATM* group. Although a direct comparison between the two scales is not possible, three statements included in the 2007 scale were common to the 2011 scale:[40]

- *I enjoy learning mathematics*
- *Mathematics is boring*
- *I like mathematics.*

These common statements can be used to explore the difference between the findings in 2007 and 2011. Table 4.6 shows the responses from Y9 pupils in England to the three statements that can be compared. This shows that actually, when the scale is broken down into statements, there is very little difference in pupils' attitudes between the two TIMSS cycles. For example, in 2007, 16 per cent of Y9 pupils agreed a lot with the statement *I like mathematics*, and in 2011 the equivalent figure was very similar at 18 per cent. The findings for the other two statements are very similar; the percentages of Y9 pupils in England agreeing or disagreeing with these three statements is very close in 2011 to the figures reported in 2007.

This would suggest that pupil attitudes towards mathematics have changed little between 2007 and 2011; the apparent differences over time arise from the way in which the scale is constructed.

Parallel analysis was not conducted for Y5 mathematics as the apparent change was smaller for Y5. However, it is likely that the same applies for Y5: that the apparent decrease is simply an effect of the change in the scaling method.

Table 4.6 Attitudes towards Y9 mathematics, responses to specific statements in 2007 and 2011

	Agree a lot (%)	Agree a little (%)	Disagree a little (%)	Disagree a lot (%)
2007				
I enjoy learning mathematics	16	44	25	15
Mathematics is boring	22	32	32	14
I like mathematics	16	42	24	18
2011				
I enjoy learning mathematics	18	45	22	14
Mathematics is boring	21	39	26	13
I like mathematics	18	41	25	17

Source: data derived from 2007 and 2011 national datasets[41]

39 A parallel scale was devised for science: the Positive Affect Toward Science (PATS) scale.

40 The measure of pupil attitudes changed for TIMSS 2011, with two additional statements: *I wish I did not have to study mathematics*; and *I learn many interesting things in mathematics*.

41 See Foy and Olson (2009) and http://timssandpirls.bc.edu/timss2011/index.html

The effect of the change in scale is also evident in the findings for other countries. For example, in 2007 in the United States, 41 per cent of pupils had a high PATM score, and in Sweden 39 per cent had a high PATM score. In 2011, both of these countries showed an apparent decrease in pupils liking the subject (to 19 per cent in the United States and 13 per cent in Sweden). Several high performing countries (including Hong Kong, Chinese Taipei and Japan) also appeared to have fewer pupils reporting that they like learning mathematics at this age.

This exploration of the data therefore suggests that the apparent decreases in positive attitudes nationally and internationally are not real decreases.

4.2.3 Pupils' attitudes: valuing the subject

Information on the extent to which pupils value mathematics and science was collected for pupils in Y9 only. Pupils were scored according to their level of agreement with six statements about mathematics and then categorised into one of three bands: *Value Mathematics, Somewhat Value Mathematics* and *Do Not Value Mathematics*. Table 4.7 gives further information on how pupils were assigned to each band. In England, the average scale score was 10.1, within the *Somewhat Value Mathematics* category overall.

Table 4.7 shows that in England, just under half of Y9 pupils (48 per cent) were placed in the highest category (*Value Mathematics*). Internationally, the percentage of pupils in this category ranged from 13 per cent (Japan, Chinese Taipei) to 78 per cent (Ghana). Compared with England, the five highest-performing countries in mathematics at ages 13–14 each had a smaller percentage of pupils categorised as valuing mathematics. For example, in addition to Japan and Chinese Taipei at the bottom of the range internationally, the equivalent figures for Singapore, Hong Kong and Korea were relatively low: 43 per cent, 26 per cent and 14 per cent respectively.

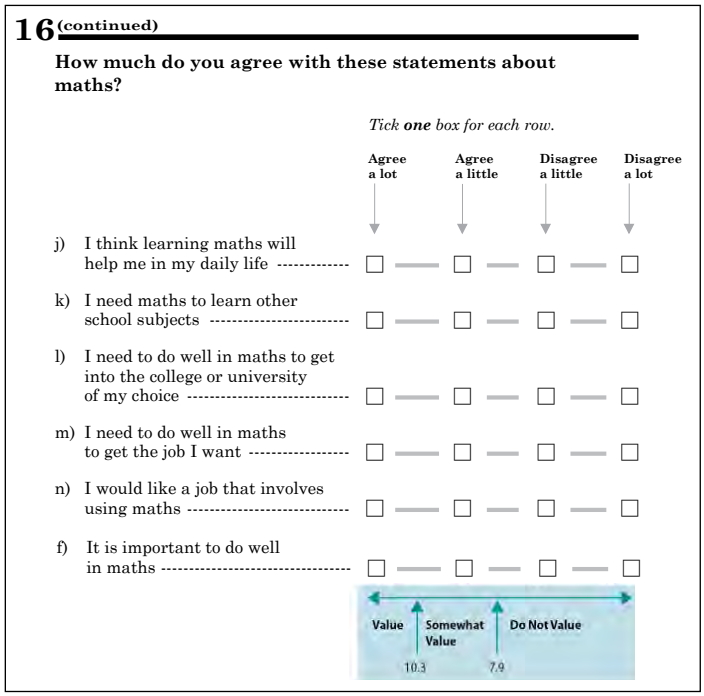
Table 4.7 Pupils value mathematics

Reported by Students

Students were scored according to their degree of agreement with six statements on the *Students Value Mathematics* scale. Students who **Value** mathematics had a score on the scale of at least 10.3, which corresponds to their "agreeing a lot" with three of the six statements and "agreeing a little" with the other three, on average. Students who **Do Not Value** mathematics had a score no higher than 7.9, which corresponds to their "disagreeing a little" with three of the six statements and "agreeing a little" with the other three, on average. All other students **Somewhat Value** mathematics.

Country	Value		Somewhat Value		Do Not Value		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	48 (1.2)	513 (6.1)	43 (1.1)	506 (5.8)	10 (0.6)	479 (6.6)	10.1 (0.05)
International Avg.	46 (0.2)	482 (0.7)	39 (0.1)	463 (0.6)	15 (0.1)	439 (0.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Item f was asked in Question 14 but also contributed to this scale.

Source: Exhibit 8.3, international mathematics report

Within England, the average achievement scores of those who *Value* or *Somewhat Value* mathematics are not likely to be significantly different from each other, but both were higher, probably significantly so, than the average scores of those who *Do Not Value* mathematics. It is not possible to conclude whether pupils who value mathematics to some degree perform better in the subject, or whether pupils who are good at mathematics place more value on the subject.

4.2.4 Pupils' confidence

Pupils were assigned to one of three categories (*Confident, Somewhat Confident* and *Not Confident*) based on their responses to nine statements on the *Students Confident in Mathematics* scale (see Table 4.8 for further details on how pupils were assigned to each category). In England, the average scale score was 10.3, within the *Somewhat Confident* category overall.

Internationally, the percentages of pupils in this category ranged from 2 per cent (Japan, Thailand) to 32 per cent (Ontario). In England, 16 per cent of Y9 pupils were categorised as *Confident* in mathematics, a lower figure than the equivalent (33 per cent) for Y5. Just over half (53 per cent) of Y9 pupils were categorised as *Somewhat Confident* and around a third (32 per cent) were categorised as *Not Confident* in mathematics.

Among the highest performing countries the levels of pupils' confidence in mathematics were low. This mirrors the findings for Y5. The five highest performing countries in mathematics at this older age group all had a lower scale score than England in terms of pupil confidence. In Korea, for example, the highest overall performing country in mathematics for 13–14 year olds, just 3 per cent of pupils were classified as *Confident* in mathematics.

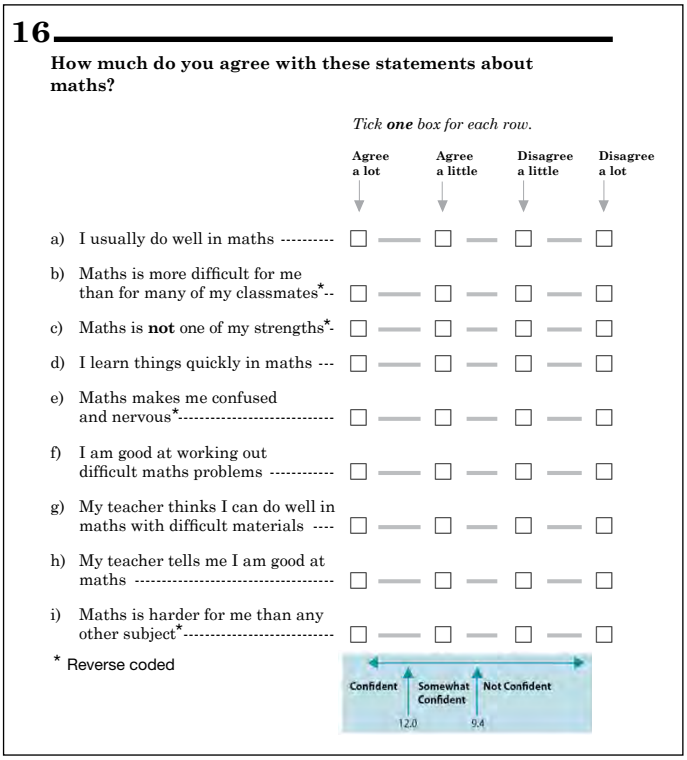
Table 4.8 Pupils confident in mathematics

Reported by Students

Students were scored according to their degree of agreement with nine statements on the *Students Confident in Mathematics* scale. Students **Confident** with mathematics had a score on the scale of at least 12.0, which corresponds to their "agreeing a lot" with five of the nine statements and "agreeing a little" with the other four, on average. Students who were **Not Confident** had a score no higher than 9.4, which corresponds to their "disagreeing a little" with five of the nine statements and "agreeing a little" with the other four, on average. All other students were **Somewhat Confident** with mathematics.

Country	Confident		Somewhat Confident		Not Confident		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	16 (1.1)	571 (6.2)	53 (1.1)	514 (5.4)	32 (1.6)	465 (5.4)	10.3 (0.07)
International Avg.	14 (0.1)	539 (0.9)	45 (0.1)	478 (0.6)	41 (0.2)	435 (0.6)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



16

How much do you agree with these statements about maths?

*Tick **one** box for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I usually do well in maths	☐	☐	☐	☐
b) Maths is more difficult for me than for many of my classmates*	☐	☐	☐	☐
c) Maths is **not** one of my strengths*	☐	☐	☐	☐
d) I learn things quickly in maths	☐	☐	☐	☐
e) Maths makes me confused and nervous*	☐	☐	☐	☐
f) I am good at working out difficult maths problems	☐	☐	☐	☐
g) My teacher thinks I can do well in maths with difficult materials	☐	☐	☐	☐
h) My teacher tells me I am good at maths	☐	☐	☐	☐
i) Maths is harder for me than any other subject*	☐	☐	☐	☐

* Reverse coded

Source: Exhibit 8.5, international mathematics report

As with the findings for pupils in Y5, pupil achievement was higher among those with a higher level of confidence. In England, among the pupils who were categorised as *Confident* in mathematics the average achievement was 571, and among those categorised as *Not Confident* the average achievement was more than 100 scale points lower, at 465. The differences across all categories are likely to be statistically significant.[42] However, this could be because pupils who are confident in mathematics perform better, or because pupils who are better at mathematics feel more confident.

42 Tests of statistical significance were not carried out in the international analysis. Based on the size of the standard errors, it is likely that the apparent differences across the three categories are statistically significant.

4.2.5 Pupils' reported engagement in lessons

Pupils' engagement was measured by their responses to five statements about their mathematics lessons. These statements and further details on how pupils were allocated to the *Engaged in Mathematics Lessons* scale bands can be found in Table 4.9. In England, the average scale score was 9.4, within the *Somewhat Engaged* category overall.

In England, a fairly low proportion (14 per cent) of Y9 pupils were categorised as *Engaged* (see Table 4.9). This is a much lower level of engagement than was reported at Y5 in England (41 per cent). The majority of Y9 pupils in England (58 per cent) were categorised as *Somewhat Engaged*, and 27 per cent were categorised as *Not Engaged* in mathematics.

Internationally, the percentages of pupils in the *Engaged* category ranged from 2 per cent (Korea) to 51 per cent (Armenia). Korea had the lowest percentage of pupils classified as *Engaged* in mathematics lessons, despite having the highest overall achievement score for mathematics among this age group. With the exceptions of Singapore and Russian Federation (16 and 24 per cent respectively), the other high-performing countries in mathematics at this age group had very few pupils who were classified as *Engaged* in mathematics lessons.

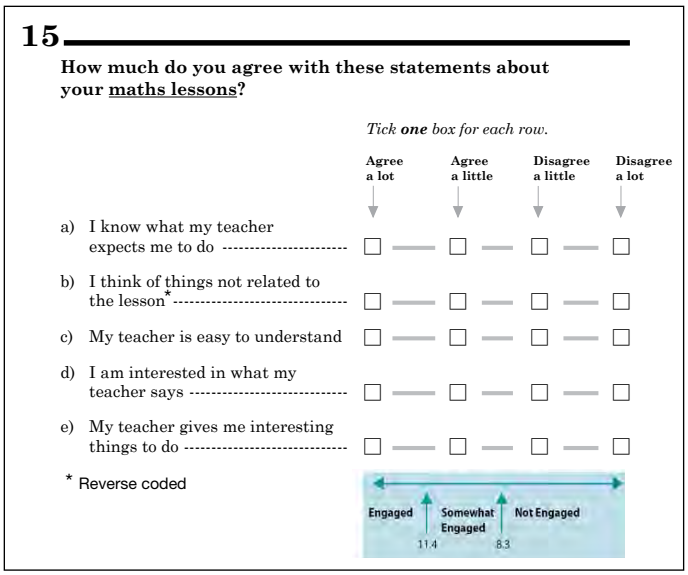
Table 4.9 Pupils engaged in mathematics lessons

Reported by Students

Students were scored according to their degree of agreement with five statements on the *Engaged in Mathematics Lessons* scale. Students **Engaged** in mathematics lessons had a score on the scale of at least 11.4, which corresponds to their "agreeing a lot" with three of the five statements and "agreeing a little" with the other two, on average. Students who were **Not Engaged** had a score no higher than 8.3, which corresponds to their "disagreeing a little" with three of the five statements and "agreeing a little" with the other two, on average. All other students were **Somewhat Engaged** in mathematics lessons.

Country	Engaged		Somewhat Engaged		Not Engaged		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	14 (1.0)	536 (8.6)	58 (1.2)	512 (5.4)	27 (1.7)	483 (6.6)	9.4 (0.08)
International Avg.	25 (0.2)	484 (0.8)	54 (0.2)	468 (0.6)	21 (0.2)	449 (0.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Source: Exhibit 8.18, international mathematics report

Internationally, there was an association between engagement and achievement that is likely to be statistically significant. In England, the average achievement score for those in the *Engaged* category was 536, and for those in the *Not Engaged* category it was lower at 483. These differences are likely to be statistically significant across the three categories.[43]

4.2.6 Teachers' reported approaches to engaging pupils

For this scale measure, pupils were placed into categories according to their teachers' responses about how often they used each of four teaching practices in their lessons. Table 4.10 shows the statements to which teachers responded, and shows how the responses were categorised. In England, the average scale score was 10.6, within the category of using the listed engagement practices in *Most Lessons* overall.

Within England, the majority of pupils (92 per cent) were taught by teachers categorised as using the listed engagement practices in *Most Lessons*. Internationally, the percentages of pupils in this category ranged from 46 per cent (Chinese Taipei) to 97 per cent (California). England was towards the top of the range internationally, and higher than the highest performing countries in mathematics at this age group (Korea, Singapore, Chinese Taipei, Hong Kong, Japan and the Russian Federation).

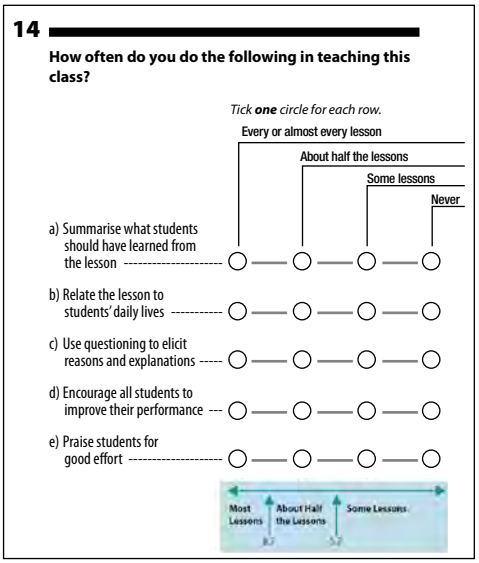
Table 4.10 Teaching to engage pupils in learning

Reported by Teachers

Students were scored according to their teachers' responses to how often they used each of four instructional practices on the *Engaging Students in Learning* scale. Students with teachers who used engagement practices in **Most Lessons** had a score on the scale of at least 8.7, which corresponds to their teachers using two of the four practices "every or almost every lesson" and using the other two in "about half the lessons," on average. Students with teachers who used engagement practices in **Some Lessons** had a score no higher than 5.7, which corresponds to their teachers using two of the four practices in "some lessons" and using the other two in "about half the lessons," on average. All other students had teachers who used engagement practices in **About Half the Lessons**.

Country	Most Lessons		About Half the Lessons		Some Lessons		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	92 (1.8)	508 (5.9)	6 (1.9)	512 (31.3)	2 (1.6)	~ ~	10.6 (0.16)
International Avg.	80 (0.4)	469 (0.7)	17 (0.4)	459 (1.8)	3 (0.2)	484 (4.5)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.



Item b did not contribute to this scale.

Source: Exhibit 8.15, international mathematics report.

43 Although tests for significance have not been conducted in the international analysis, based on the size of the standard errors, these differences are likely to be statistically significant.

While there is some indication of a possible international association between frequency of using the listed engagement activities and pupil achievement, the apparent difference in England is not likely to be significant.

4.3 Science Y5

4.3.1 Pupils' attitudes: liking the subject

As with mathematics, pupils' attitudes were measured by their responses to five statements about learning science (these statements can be seen in Table 4.11). The international analysis used responses to these statements to create the *Students Like Learning Science* scale. Pupils were categorised into three bands: *Like Learning Science, Somewhat Like Learning Science* and *Do Not Like Learning Science* (details of how pupils were assigned to each band is provided in Table 4.11). In England, the average scale score was 9.4, within the *Somewhat Like Learning Science* category overall.[44]

In England, 44 per cent of Y5 pupils were in the highest category of the *Like Learning Science* scale, the same percentage as for Y5 mathematics. Internationally, the percentages of pupils in the *Like Learning Science* category ranged from 33 per cent (Azerbaijan) to 73 per cent (Turkey). The percentages of pupils within each category in England were similar to the percentages seen within each category in the Czech Republic. However, England's percentage in the *Like Learning Science* category was lower than that of most other higher performing participants in science at Y5. The two exceptions were Korea and Finland, with smaller percentages than England in the *Like Learning Science* category (39 and 36 per cent respectively).

In the international averages, and in most of the highest performing countries in science at this age group, the spread of pupils across the three categories peaked within the *Like Learning Science* category. Korea and Finland were, again, exceptions to this: in both of these countries, the percentages of pupils peaked within the *Somewhat Like Learning Science* category.

Table 4.11 Pupils like learning science

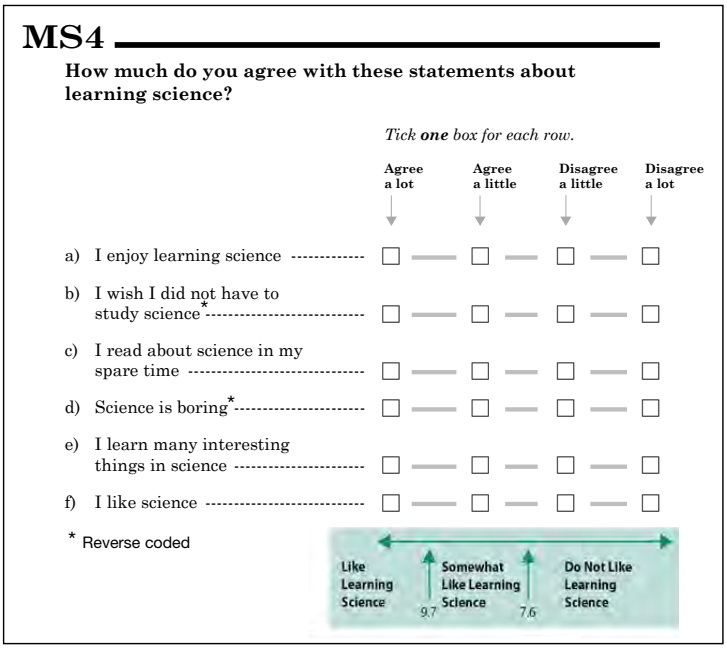
Reported by students

Students were scored according to their degree of agreement with five statements on the *Students Like Learning Science* scale. Students who **Like Learning Science** had a score on the scale of at least 9.7, which corresponds to their "agreeing a lot" with three of the five statements and "agreeing a little" with the other two, on average. Students who **Do Not Like Learning Science** had a score no higher than 7.6, which corresponds to their "disagreeing a little" with three of the five statements and "agreeing a little" with the other two, on average. All other students **Somewhat Like Learning Science**.

Country	Like Learning Science		Somewhat Like Learning Science		Do Not Like Learning Science		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	44 (1.5)	535 (4.1)	35 (1.1)	528 (4.1)	21 (1.1)	518 (3.9)	9.4 (0.07)
International Avg.	53 (0.2)	504 (0.5)	35 (0.1)	469 (0.7)	12 (0.1)	461 (1.1)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

44 It is not possible to compare these outcomes with TIMSS 2007 because the scale method has changed. See section 4.4.2 for more information.



Item c did not contribute to this scale.

Source: Exhibit 8.1, international science report.

The international averages indicate that, as pupils' science achievement increased, so did the extent to which they like the subject. However, the data cannot determine why this is so; it could be because pupils who like science are better at it, or because pupils who are better at science like it more. However, in England, the apparent differences in achievement of pupils in the different categories of liking science are unlikely to be significant.

4.3.2 Pupils' confidence

Pupils' confidence was measured by their responses to six statements on the *Students Confident in Science* scale. Based on their responses, pupils were categorised into three bands: *Confident, Somewhat Confident* or *Not Confident*. In England, the average scale score was 9.5; within the *Somewhat Confident* category overall.

Y5 pupils in England were reasonably evenly split across the three categories of confidence levels: approximately a third (33 per cent) were categorised as *Confident* in science, with 38 per cent *Somewhat Confident*, and 29 per cent *Not Confident* in science (see Table 4.12). Internationally, the percentage of pupils classified as *Confident* in science ranged from 15 per cent (Korea) to 62 per cent (Croatia). As was the case for mathematics, several of the highest performing countries had relatively low percentages of pupils in this category. Again, Korea was the highest overall performing country in science among this age group, but had the lowest percentage of pupils classified as *Confident* in science. Singapore and Japan also had low percentages of pupils classified as *Confident* in science, at 26 and 17 per cent respectively. Among the highest performers in science at Y5, Alberta had the highest percentage in the *Confident* in science category: 53 per cent.

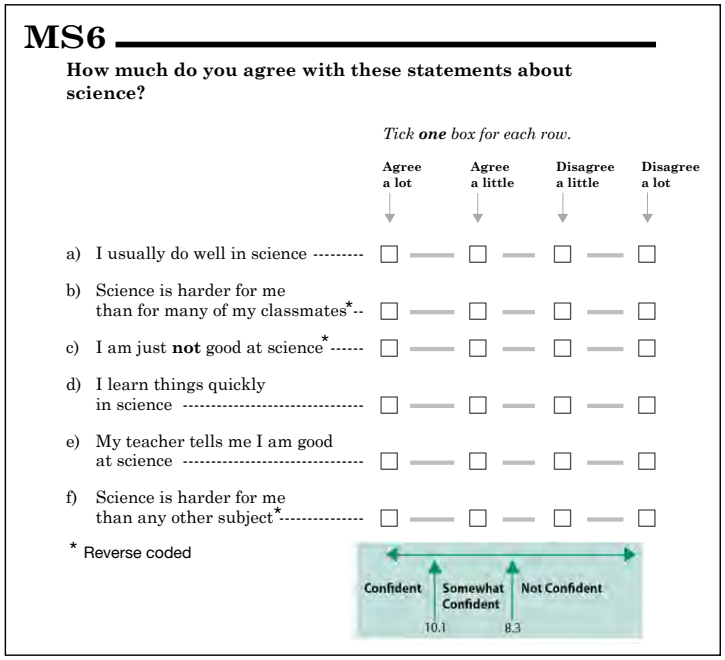
Table 4.12 Pupils confident in science

Reported by students

Students were scored according to their degree of agreement with six statements on the *Pupils Confident in Science* scale. Students **Confident** with science had a score on the scale of at least 10.1, which corresponds to their "agreeing a lot" with three of the six statements and "agreeing a little" with the other three, on average. Students who were **Not Confident** had a score no higher than 8.3, which corresponds to their "disagreeing a little" with three of the six statements and "agreeing a little" with the other three, on average. All other students were **Somewhat Confident** with science.

Country	Confident		Somewhat Confident		Not Confident		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	33 (1.3)	549 (4.5)	38 (1.1)	530 (3.8)	29 (1.1)	506 (3.4)	9.5 (0.05)
International Avg.	43 (0.2)	514 (0.5)	36 (0.1)	480 (0.6)	21 (0.1)	446 (0.8)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



MS6

How much do you agree with these statements about science?

*Tick **one** box for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I usually do well in science	☐	☐	☐	☐
b) Science is harder for me than for many of my classmates*	☐	☐	☐	☐
c) I am just **not** good at science*	☐	☐	☐	☐
d) I learn things quickly in science	☐	☐	☐	☐
e) My teacher tells me I am good at science	☐	☐	☐	☐
f) Science is harder for me than any other subject*	☐	☐	☐	☐

* Reverse coded

Source: Exhibit 8.4, international science report

Internationally and in England, there was a clear pattern of decreasing achievement with decreasing levels of confidence. This pattern was also seen across most of the highest performing countries.

In England, among the pupils classified as *Confident* in science the average achievement was 549, and among those classified as *Not Confident*, the average achievement was lower at 506. The differences across all three categories are likely to be statistically significant. Again, the finding could be due to pupils who are confident in science being better at it, or the opposite: those pupils who are better at science may be more confident in the subject.

4.3.3 Pupils' reported engagement in lessons

As for mathematics, pupils' engagement was reported on the *Engaged in Science Lessons* scale. The position on this scale was calculated by pupils' responses to five statements, and further details can be found in Table 4.13. In England, the average scale score was 9.8, within the *Somewhat Engaged* category overall.

As seen in Table 4.13, 44 per cent of Y5 pupils in England were categorised as being *Engaged* in science lessons, 47 per cent *Somewhat Engaged*, and only 9 per cent *Not Engaged*. A similar spread of percentages of pupils across the three categories was seen in the Czech Republic, Singapore and Chinese Taipei. Internationally, the percentage of pupils classified as *Engaged* in science lessons ranged from 12 per cent (Japan) to 65 per cent (Tunisia). Again, the countries that performed best in science at this age group did not necessarily have the highest percentages of pupils classified as *Engaged* in lessons. Japan is one example and Korea and Finland also had low percentages in this category: 19 and 23 per cent respectively. One exception was the Russian Federation, another high performing country, where more than half of pupils were classified as *Engaged* in science lessons (59 per cent).

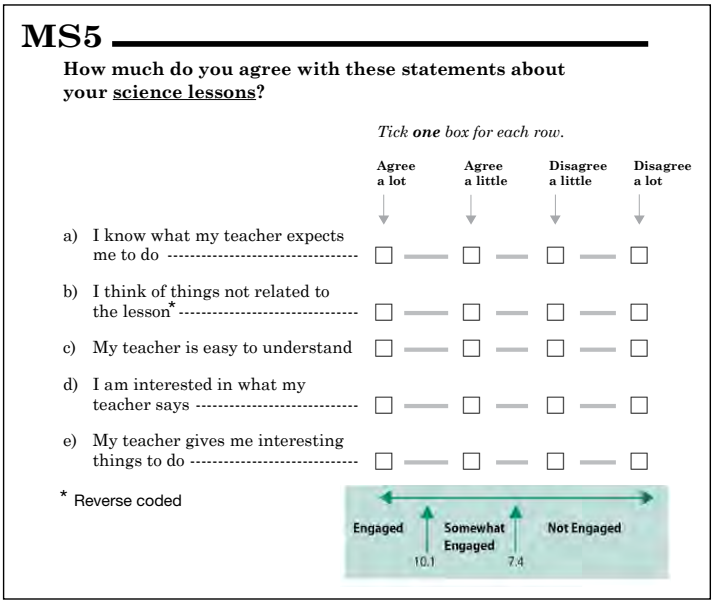
Table 4.13 Pupils engaged in science lessons

Reported by students

Students were scored according to their degree of agreement with five statements on the *Engaged in Science Lessons* scale. Students **Engaged** in science lessons had a score on the scale of at least 10.1, which corresponds to their "agreeing a lot" with three of the five statements and "agreeing a little" with the other two, on average. Students who were **Not Engaged** had a score no higher than 7.4, which corresponds to their "disagreeing a little" with three of the five statements and "agreeing a little" with the other two, on average. All other students were **Somewhat Engaged** in science lessons.

Country	Engaged		Somewhat Engaged		Not Engaged		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	44 (1.2)	534 (4.1)	47 (1.1)	527 (3.2)	9 (0.7)	520 (5.6)	9.8 (0.05)
International Avg.	45 (0.2)	504 (0.6)	47 (0.2)	476 (0.6)	8 (0.1)	457 (1.2)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



MS5

How much do you agree with these statements about your science lessons?

*Tick **one** box for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I know what my teacher expects me to do	☐	☐	☐	☐
b) I think of things not related to the lesson*	☐	☐	☐	☐
c) My teacher is easy to understand	☐	☐	☐	☐
d) I am interested in what my teacher says	☐	☐	☐	☐
e) My teacher gives me interesting things to do	☐	☐	☐	☐

* Reverse coded

Source: Exhibit 8.17, international science report

Internationally, there was an association between engagement and achievement that is likely to be significant. However, the apparent differences across the three categories in England are not likely to be significant.

4.3.4 Teachers' reported approaches to engaging pupils

For the *Engaging Students in Learning* scale, pupils were categorised into three bands (*Most Lessons, About Half the Lessons* and *Some Lessons*) based on their teachers' responses to how frequently they used each of six teaching practices in their lessons. Table 4.14 provides further information on the statements to which teachers responded, and shows how the bands were calculated. In England, the average scale score was 10.3, within the category of using the listed engagement practices in *Most Lessons* overall.

The majority (85 per cent) of Y5 pupils in England were taught by teachers categorised as using the listed engagement practices in *Most Lessons*. Internationally, the percentage of pupils in this category ranged from 27 per cent (Denmark) to 96 per cent (Florida), placing England towards the top of the range.

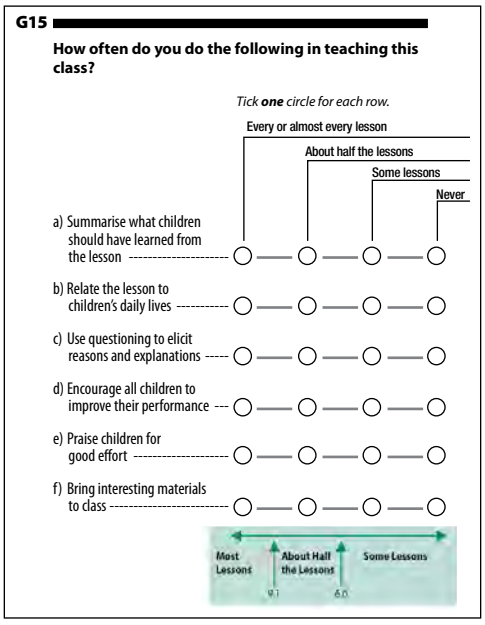
Table 4.14 Teaching to engage pupils in learning

Reported by Teachers

Students were scored according to their teachers' responses to how often they used each of six instructional practices on the *Engaging Students in Learning* scale. Students with teachers who used engagement practices in **Most Lessons** had a score on the scale of at least 9.1, which corresponds to their teachers using three of the six practices "every or almost every lesson" and using the other three in "about half the lessons," on average. Students with teachers who used engagement practices in **Some Lessons** had a score no higher than 6.0, which corresponds to their teachers using three of the six practices in "some lessons" and using the other three in "about half the lessons," on average. All other students had teachers who used engagement practices in **About Half the Lessons**.

Country	Most Lessons		About Half the Lessons		Some Lessons		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	85 (3.1)	529 (3.6)	15 (3.1)	530 (8.9)	0 (0.0)	~ ~	10.3 (0.13)
International Avg.	71 (0.5)	487 (0.6)	27 (0.4)	484 (1.2)	2 (0.1)	~ ~	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.



Source: Exhibit 8.14, international science report

While there appeared to be an association internationally[45] between frequency of using the listed engagement practices and pupil achievement, the apparent small difference in England is not likely to be statistically significant.

45 Significance tests have not been carried out in the international analysis. However, the size of the standard errors suggests that this apparent international finding may be borderline significant.

4.4 Science Y9

4.4.1 Pupils' attitudes: liking the subject

Regarding pupils' attitudes at Y9, in England the average scale score was 9.9, within the *Somewhat Like Learning Science* category overall. A smaller percentage of Y9 pupils in England were in the highest category of the *Students Like Learning Science* scale compared with science at Y5: 32 per cent of Y9 pupils in England were in this category compared with 44 per cent at Y5 (see Table 4.15).

Internationally, the percentages of pupils in the *Like Learning Science* category at this age group ranged from 11 per cent (Korea) to 56 per cent (Tunisia). Again, several of the highest performing countries were positioned towards the lower end of this range. For example, in Chinese Taipei (the second highest performing country in science overall at this age group) just 17 per cent of pupils were in the *Like Learning Science* category.

Table 4.15 Pupils like learning science

Reported by Students

For general/integrated science[46], students were scored according to their degree of agreement with five statements on the *Students Like Learning Science* scale. Students who **Like Learning Science** had a score on the scale of at least 10.8, which corresponds to their "agreeing a lot" with three of the five statements and "agreeing a little" with the other two, on average. Students who **Do Not Like Learning Science** had a score on the scale no higher than 8.4, which corresponds to their "disagreeing a little" with three of the five statements and "agreeing a little" with the other two, on average. All other students **Somewhat Like Learning Science**. For biology, chemistry, physics, and earth science, a comparable procedure was used.

Students Like Learning General/Integrated Science

General/Integrated Science	Like Learning Science		Somewhat Like Learning Science		Do Not Like Learning Science		Average Scale Score
Country	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
England	32 (1.3)	562 (5.4)	45 (0.9)	532 (5.0)	23 (1.1)	500 (4.9)	9.9 (0.06)
International Avg.	35 (0.2)	515 (0.8)	44 (0.2)	472 (0.8)	21 (0.2)	450 (1.1)	

Centerpoint of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

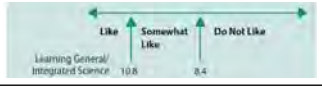
17

How much do you agree with these statements about learning science?

*Tick **one** box for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I enjoy learning science	☐	☐	☐	☐
b) I wish I did not have to study science*	☐	☐	☐	☐
c) I read about science in my spare time	☐	☐	☐	☐
d) Science is boring*	☐	☐	☐	☐
e) I learn many interesting things in science	☐	☐	☐	☐
f) I like science	☐	☐	☐	☐

* Reverse coded



Item c did not contribute to this scale.

Source: Exhibit 8.2, international science report.

46 The international analysis includes data for integrated science and separate sciences (Biology, Chemistry Physics and Earth Science). In England, science is treated as an integrated subject in the curriculum. Therefore the Y9 science data for England is classified in the general/integrated science section of the international report. See Chapter 5 for further information.

For this age group, there was a strong relationship between achievement and pupils liking science: the pupils in the *Do Not Like Learning Science* category generally had lower achievement scores. This association is likely to be significant and can be seen in the data for England and several of the highest performing countries.

In England, among the pupils in the *Like Learning Science* category, the average achievement score was 562. Among the pupils in the *Do Not Like Learning Science* category, the average achievement score was lower at 500. These differences are likely to be statistically significant across the three categories. However, it could be that pupils who like science are better at it, or the opposite may be true: that pupils who are better at science may like it more.

4.4.2 Comparison with TIMSS 2007: liking the subject

The apparent difference over time in positive pupil attitudes is not as marked for Y9 science as it was for Y9 mathematics (as outlined in section 4.2.2). Even so, the data show 32 per cent with the most positive attitudes in 2011, compared with 55 per cent in the *High Positive Attitude Toward Science* category in 2007. As outlined in the mathematics section, direct comparisons between these figures should not be made because the scale used to report these findings has changed since 2007.

As with mathematics, three statements used to construct the attitudinal scales in 2007 were common to the 2011 scale:[47]

- *I enjoy learning science*
- *Science is boring*
- *I like science.*

Table 4.16 breaks down the responses to these three common statements. As with mathematics, it is clear that there has not been such a dramatic decrease in positive attitudes towards science as the percentages might at first suggest. Indeed, the data show that the percentages of Y9 pupils agreeing a lot with the statements *I enjoy learning science* and *I like science* have increased in 2011.

Parallel analysis was not conducted for Y5 science as the change was less apparent for Y5. However, it is likely that the same applies for Y5: that the apparent decrease is simply an effect of the change in the scaling method.

47 In 2011, two additional statements were used in this scale, *I wish I did not have to study science*, and *I learn many interesting things in science.*

Table 4.16 Attitudes towards Y9 science, responses to specific statements in 2007 and 2011

	Agree a lot (%)	Agree a little (%)	Disagree a little (%)	Disagree a lot (%)
2007				
I enjoy learning science	28	41	20	11
Science is boring	15	24	37	24
I like science	28	41	18	13
2011				
I enjoy learning science	37	42	14	7
Science is boring	11	26	31	31
I like science	35	39	17	9

Source: data derived from 2007 and 2011 national datasets[48]

4.4.3 Pupils' attitudes: valuing the subject

Information relating to the extent to which pupils value science was collected for pupils in Y9 only. Pupils were scored according to their level of agreement with six statements about science and then categorised into one of three bands: *Value Science, Somewhat Value Science* and *Do Not Value Science*. Table 4.17 gives further information on how pupils were assigned to each band. In England, the average scale score was 10.1, within the *Somewhat Value Science* category overall.

Table 4.17 shows that in England, 41 per cent of Y9 pupils were categorised as valuing science, 37 per cent were in the *Somewhat Value Science* category, and a smaller group (22 per cent) were in the *Do Not Value Science* category. Internationally, the percentage of pupils in the *Value Science* category ranged from 10 per cent (Japan) to 80 per cent (Ghana).

Table 4.17 Pupils value science

Reported by Students

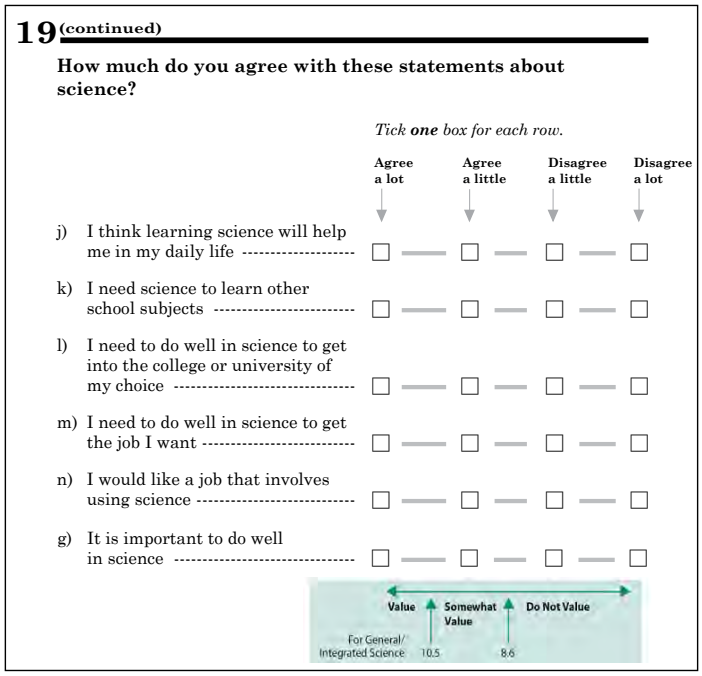
Students were scored according to their degree of agreement with six statements on the *Students Value Science* scale. Students who **Value** science had a score on the scale of at least 10.5, which corresponds to their "agreeing a lot" with three of the six statements and "agreeing a little" with the other three, on average. Students who **Do Not Value** science had a score no higher than 8.6, which corresponds to their "disagreeing a little" with three of the six statements and "agreeing a little" with the other three, on average. All other students **Somewhat Value** science.

Students Value General/Integrated Science

General/Integrated Science	Value		Somewhat Value		Do Not Value		Average Scale Score
Country	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	41 (1.3)	547 (5.9)	37 (0.9)	530 (4.7)	22 (0.9)	516 (5.9)	10.1 (0.05)
International Avg.	41 (0.2)	502 (0.8)	33 (0.2)	477 (0.8)	26 (0.2)	457 (1.1)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

48 See Foy and Olson, 2009 and http://timssandpirls.bc.edu/timss2011/index.html



19 (continued)

How much do you agree with these statements about science?

*Tick **one** box for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
j) I think learning science will help me in my daily life	☐	☐	☐	☐
k) I need science to learn other school subjects	☐	☐	☐	☐
l) I need to do well in science to get into the college or university of my choice	☐	☐	☐	☐
m) I need to do well in science to get the job I want	☐	☐	☐	☐
n) I would like a job that involves using science	☐	☐	☐	☐
g) It is important to do well in science	☐	☐	☐	☐

Item g was asked in Question 17 but also contributed to this scale.

Source: Exhibit 8.3, international science report.

Internationally, there was an association between pupils valuing science and their achievement: it could be that pupils who value science perform better in the subject, or that pupils who are good at science value the subject more. However, within England, the apparent differences between the three categories are unlikely to be statistically significant.

4.4.4 Pupils' confidence

Pupils' confidence was measured by collating pupils' responses to nine statements, which were used to create the *Students Confident in Science* scale (Table 4.18 contains further detail on the statements used, and how pupils were allocated to categories). In England, the average scale score was 10.2, within the *Somewhat Confident in Science* category overall.

Almost a quarter of Y9 pupils in England (23 per cent) were categorised as *Confident* in science, with around half of pupils (52 per cent) in the *Somewhat Confident* category, and the remaining quarter (25 per cent) in the lowest category of *Not Confident*.

Internationally, the percentage of pupils classified as *Confident* ranged from 3 per cent (Japan) to 37 per cent (Tunisia). Several of the highest performing countries were positioned towards the lower end of this range. In Singapore, for example, just 14 per cent of pupils were categorised as *Confident* in science.

Table 4.18 Pupils confident in science

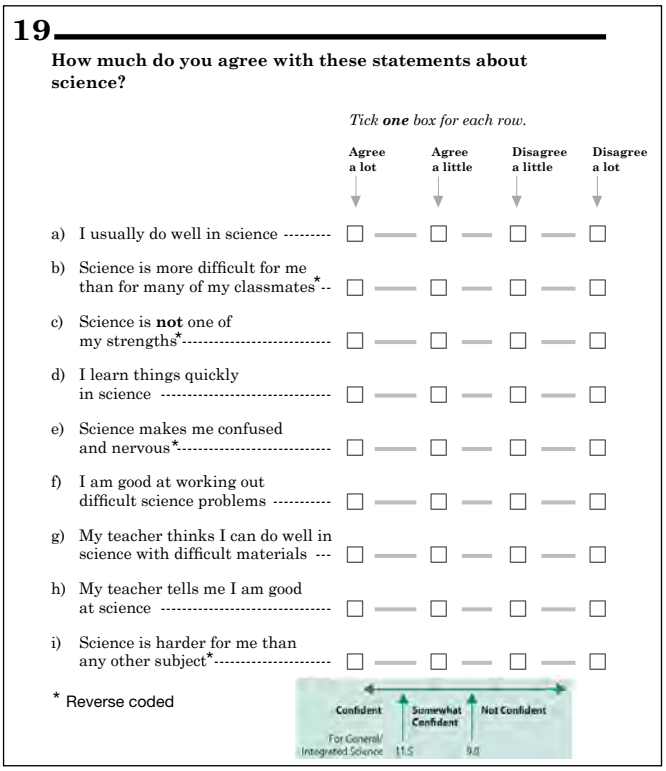
Reported by Students

Students were scored according to their degree of agreement with nine statements on the *Students Confident in Science* scale. Students **Confident** with science had a score on the scale of at least 11.5, which corresponds to their "agreeing a lot" with five of the nine statements and "agreeing a little" with the other four, on average. Students who were **Not Confident** had a score no higher than 9.0, which corresponds to their "disagreeing a little" with five of the nine statements and "agreeing a little" with the other four, on average. All other students were **Somewhat Confident** with science.

Students Confident in General/Integrated Science

General/Integrated Science	Confident		Somewhat Confident		Not Confident		Average Scale Score
Country	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	23 (1.2)	579 (5.2)	52 (1.2)	529 (5.4)	25 (1.2)	503 (5.0)	10.2 (0.06)
International Avg.	20 (0.2)	536 (1.0)	49 (0.2)	482 (0.8)	31 (0.2)	450 (0.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



19

How much do you agree with these statements about science?

*Tick **one** box for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I usually do well in science	☐	☐	☐	☐
b) Science is more difficult for me than for many of my classmates*	☐	☐	☐	☐
c) Science is **not** one of my strengths*	☐	☐	☐	☐
d) I learn things quickly in science	☐	☐	☐	☐
e) Science makes me confused and nervous*	☐	☐	☐	☐
f) I am good at working out difficult science problems	☐	☐	☐	☐
g) My teacher thinks I can do well in science with difficult materials	☐	☐	☐	☐
h) My teacher tells me I am good at science	☐	☐	☐	☐
i) Science is harder for me than any other subject*	☐	☐	☐	☐

* Reverse coded

Source: Exhibit 8.5, international science report

Within England, pupils' achievement was higher among those who were categorised as *Confident* in science: these pupils had an average achievement score of 579, compared with the average achievement score of 503 for those categorised as *Not Confident* in science. The differences are likely to be statistically significant across the three categories. The same pattern is true of the international data and is likely to be statistically significant.

4.4.5 Pupils' reported engagement in lessons

Pupils were asked to respond to five statements regarding their levels of engagement in science lessons. Their responses to these statements were then used to group them into three categories relating to their engagement. The statements and details

of how pupils were assigned to a category can be found in Table 4.19. In England, the average scale score was 9.8, within the *Somewhat Engaged* category overall.

Among Y9 pupils in England, nearly a quarter (24 per cent) were categorised as *Engaged* in science lessons, the majority (54 per cent) were in the *Somewhat Engaged* category, and 22 per cent were in the *Not Engaged* category (see Table 4.19). Internationally, the percentages of pupils classified as *Engaged* in science lessons at this age group ranged from 4 per cent (Korea) to 55 per cent (Tunisia). Again, the countries that performed best in science at this age group did not necessarily have the highest percentages of pupils classified as *Engaged* in science lessons. For example, in Singapore, 20 per cent of pupils were in the *Engaged* category, and in Chinese Taipei and Japan the equivalent percentages were much lower at 9 per cent and 5 per cent respectively. Korea, as already noted, had the lowest percentage of pupils classified as *Engaged* in science lessons.

Table 4.19 Pupils engaged in science lessons

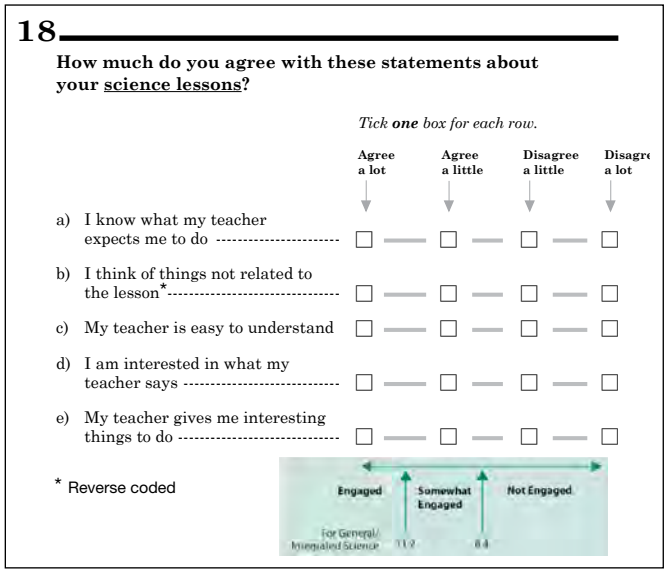
Reported by Students

Students were scored according to their degree of agreement with five statements on the *Engaged in Science Lessons* scale. Students **Engaged** in science lessons had a score on the scale of at least 11.2, which corresponds to their "agreeing a lot" with three of the five statements and "agreeing a little" with the other two, on average. Students who were **Not Engaged** had a score no higher than 8.4, which corresponds to their "disagreeing a little" with three of the five statements and "agreeing a little" with the other two, on average. All other students were **Somewhat Engaged** in science lessons.

Students Engaged in General/Integrated Science Lessons

General/Integrated Science	Engaged		Somewhat Engaged		Not Engaged		Average Scale Score
Country	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	24 (1.1)	551 (5.4)	54 (0.9)	533 (5.6)	22 (1.3)	518 (5.9)	9.8 (0.06)
International Avg.	29 (0.2)	508 (0.9)	51 (0.2)	479 (0.8)	21 (0.2)	457 (1.3)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



18

How much do you agree with these statements about your science lessons?

*Tick **one** box for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagr a lot
a) I know what my teacher expects me to do	☐	☐	☐	☐
b) I think of things not related to the lesson*	☐	☐	☐	☐
c) My teacher is easy to understand	☐	☐	☐	☐
d) I am interested in what my teacher says	☐	☐	☐	☐
e) My teacher gives me interesting things to do	☐	☐	☐	☐

* Reverse coded

Source: Exhibit 8.18, international science report

Internationally, there was an association between levels of engagement in science lessons and achievement scores, which is likely to be statistically significant. However, the apparent differences in England are not likely to be statistically significant across all of the three categories.

4.4.6 Teachers' reported approaches to engaging pupils

For the *Engaging Students in Learning* scale, pupils were categorised into three bands (*Most Lessons, About Half the Lessons* and *Some Lessons*) based on their teachers' responses to how frequently they used each of four teaching practices in their lessons. Table 4.20 provides further information on the statements to which teachers responded, and shows how the bands were calculated. In England, the average scale score was 10.8, within the category of the listed engagement practices being used in *Most Lessons* overall.

In England, the vast majority of Y9 pupils (93 per cent) were taught by teachers who were categorised as using the listed engagement practices in *Most Lessons*. Internationally, the percentage of pupils in this category ranged from 44 per cent (Japan) to 95 per cent (Dubai), placing England towards the top of the range and higher than the highest performing countries in science at this age group.

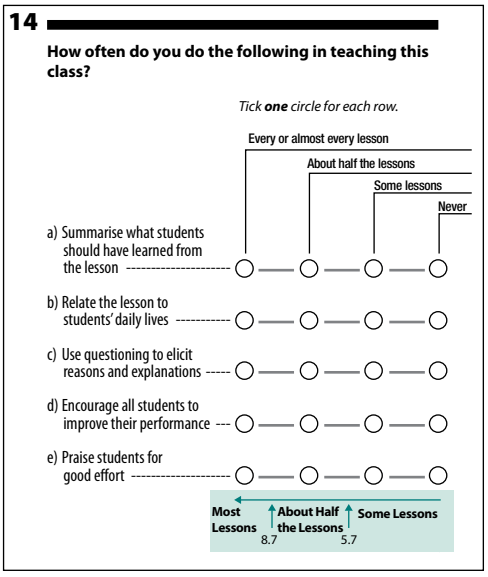
Table 4.20 Teaching to engage pupils in learning

Reported by Teachers

Students were scored according to their teachers' responses to how often they used each of four instructional practices on the *Engaging Students in Learning* scale. Students with teachers who used engagement practices in **Most Lessons** had a score on the scale of at least 8.7, which corresponds to their teachers using two of the four practices "every or almost every lesson" and using the other two in "about half the lessons," on average. Students with teachers who used engagement practices in **Some Lessons** had a score no higher than 5.7, which corresponds to their teachers using two of the four practices in "some lessons" and using the other two in "about half the lessons," on average. All other students had teachers who used engagement practices in **About Half the Lessons**.

Country	Most Lessons		About Half the Lessons		Some Lessons		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England r	93 (1.6)	532 (5.6)	7 (1.6)	533 (13.0)	1 (0.4)	~ ~	10.8 (0.10)
International Avg.	80 (0.4)	478 (0.6)	17 (0.4)	474 (1.5)	3 (0.2)	509 (5.6)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students.



Item b did not contribute to this scale.

Source: Exhibit 8.15, international science report

While there was some indication of a possible association internationally between frequency of using the listed engagement practices and pupil achievement, the apparent small differences in England are unlikely to be statistically significant.

Chapter 5 Attainment by content and cognitive domains

Chapter outline

This chapter summarises pupils' attainment across the content and cognitive domains for each subject and by gender. TIMSS assesses content domains in mathematics and science, and the cognitive domains of Knowing, Applying and Reasoning in both subjects. More information about each domain is given in sections 5.1 to 5.4.

This chapter focuses on performance in England in mathematics and science in Year 5 (Y5, ages 9–10) and Year 9 (Y9, ages 13–14) in 2011 and over time. Further information about international performance on these domains is available in the international reports. Findings for mathematics are presented first, followed by findings for science.

Key findings

- In England, there were significant[49] differences in achievement across the content and cognitive domains for both subjects at both age ranges (see below). There were some significant differences over time.
- There were no gender differences in performance on either the content or cognitive domains at either age.
- International performance on the content and cognitive domains varied greatly, including among the high performers for each subject at each age range.

Mathematics Y5:

- Y5 pupils performed above England's average mathematics score in Data Display but below it for Number.
- They also performed above their average mathematics score in Knowing, but below it in Reasoning.
- There were no significant differences for Y5 mathematics between TIMSS 2007 and 2011.

Mathematics Y9:

- Y9 pupils scored above England's average mathematics score in both Number and Data and Chance, but lower in Algebra and Geometry.
- They performed below their average in Knowing.
- Performance in Y9 Geometry declined significantly between 2007 and 2011.

49 Findings listed as 'significant' throughout this report are statistically significant.

Science Y5:

- Y5 pupils did better than England's average on Physical Science but lower on Earth Science.
- They performed above their average in Applying science.
- Performance in Physical Science and Earth Science declined significantly between 2007 and 2011.
- Knowing and Reasoning in science also declined between 2007 and 2011.

Science Y9:

- Y9 pupils performed below England's average at Chemistry.
- They performed above their average at Reasoning in science.
- Their performance in Physics declined between 2007 and 2011.

5.1 Mathematics domains, Y5

What TIMSS assesses at ages 9–10

The content domains assessed for Y5 mathematics are:

- Number - Whole number; Fractions and decimals; Number sentences with whole numbers; Patterns and relationships
- Geometric Shapes and Measures - Points, lines and angles; Two- and three-dimensional shapes
- Data Display - Reading and interpreting; Organizing and representing.

The cognitive domains are:

- Knowing – Recall; Recognize; Compute; Retrieve; Measure; Classify/Order
- Reasoning – Select; Represent; Model; Implement; Solve Routine Problems
- Applying – Analyze; Generalize/Specialize; Integrate/Synthesize; Justify; Solve Non-routine Problems

More information is available in the TIMSS Assessment framework (Mullis *et al*, 2009).

5.1.1 Mathematics content domains, Y5

Table 5.1 shows that England's Y5 pupils scored significantly higher on Data Display (a scale score of 549) compared with their overall mean score of 542. They scored significantly lower on Number. Their mean score for Geometric Shapes and Measures was similar to their overall score for mathematics.

Internationally just over half of the 57 TIMSS participants[50] at this age range performed more highly on Number at Y5, including most of the countries which performed better than England: the exceptions were Korea and Japan which performed at their own average in Number. England was one of just 11 participants scoring less well on Number. International performance on the Geometric Shapes and Measures and Data Display domains was more mixed.[51]

Table 5.1 Y5 attainment in the mathematics content domains

Country	Overall Mathematics Average Scale Score	Number		Geometric Shapes and Measures		Data Display	
		Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score
England	542 (3.5)	539 (3.7)	-3 (1.1) ▼	545 (3.9)	3 (1.6)	549 (4.6)	7 (2.9) ▲

▲ Subscale score significantly higher than overall mathematics score

▼ Subscale score significantly lower than overall mathematics score

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.1, international mathematics report

In TIMSS 2007, the only significant difference in attainment across the Y5 mathematics domains was for Number, for which the score was significantly lower than England's mean score in that survey. Scores for Data Display and Geometric Shapes and Measures were not significantly different from England's mean score in 2007.

Table 5.2 shows the mean scores for each content domain for England in TIMSS 2011 compared with TIMSS 2007. It records no significant changes in relative performance on the Y5 mathematics content domains. Despite the small change in the relative score for Data Display, the non-significant difference from the mean in 2007 has become significant in 2011.

Table 5.2 Y5 trends in the mathematics content domains, 2007 to 2011

Country	Number			Geometric Shapes and Measures		
	2011 Average Scale Score	2007 Average Scale Score	Difference	2011 Average Scale Score	2007 Average Scale Score	Difference
England	539 (3.7)	535 (3.1)	4 (4.8)	545 (3.9)	552 (3.3)	-6 (5.1)

Country	Data Display		
	2011 Average Scale Score	2007 Average Scale Score	Difference
England	549 (4.6)	551 (3.1)	-1 (5.6)

▲ 2011 average significantly higher

▼ 2011 average significantly lower

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.5, international mathematics report

50 50 countries and 7 benchmarking participants at this age range.

51 See Exhibit 3.1, international mathematics report.

5.1.2 Mathematics cognitive domains, Y5

In TIMSS 2007, there were no significant differences in pupils' Y5 mathematics scores across the three cognitive domains of Knowing, Applying and Reasoning. However, there were some differences in TIMSS 2011. Tables 5.3 and 5.4 summarise the findings for the cognitive domains.

England's score on the Y5 Applying items was not significantly different from its overall Y5 mathematics score in 2011 (see Table 5.3). However, in TIMSS 2011, pupils did significantly better on the Knowing items and significantly less well on the Reasoning items.

Table 5.3 Y5 attainment in the mathematics cognitive domains

Country	Overall Mathematics Average Scale Score	Knowing		Applying		Reasoning	
		Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score
England	542 (3.5)	552 (4.3)	10 (2.7) ▲	542 (3.7)	0 (1.5)	531 (3.7)	-11 (2.2) ▼

▲ Subscale score significantly higher than overall mathematics score

▼ Subscale score significantly lower than overall mathematics score

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.3, international mathematics report

Almost half of the 2011 participants had higher scores for Knowing (relative to their own mean scores for mathematics), including all of the participants doing better than England in mathematics at Y5. Relative performance on Applying and Reasoning was more variable across countries.[52]

The cognitive domains in 2011 did not show any significant changes in score when compared with TIMSS 2007 (see Table 5.4). However, there were some small changes in the scores on each of the cognitive domains in TIMSS 2011 and these have resulted in significant differences between England's overall Y5 mathematics score and its scores on the cognitive domains in TIMSS 2011.

Table 5.4 Y5 trends in the mathematics cognitive domains, 2007 to 2011

Country	Knowing			Applying		
	2011 Average Scale Score	2007 Average Scale Score	Difference	2011 Average Scale Score	2007 Average Scale Score	Difference
England	552 (4.3)	546 (3.7)	6 (5.6)	542 (3.7)	542 (3.3)	0 (5.0)

Country	Reasoning		
	2011 Average Scale Score	2007 Average Scale Score	Difference
England	531 (3.7)	539 (3.4)	-8 (5.0)

▲ 2011 average significantly higher

▼ 2011 average significantly lower

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.7, international mathematics report

52 See Exhibit 3.3, international mathematics report.

5.1.3 Mathematics content and cognitive domains by gender, Y5

England had no significant gender differences in the TIMSS 2011 Y5 mathematics content domains (see Table 5.5) or cognitive domains (Table 5.6).

The international average pattern was for boys to do significantly better than girls in Number, and for girls to do significantly better than boys in Geometric Shapes and Measures and in Data Display. For the cognitive domains, there was more variability across countries, with an average gender difference only for Reasoning, on which boys internationally did significantly better at ages 9–10.

Table 5.5 Gender differences in the Y5 mathematics content domains

Country	Number		Geometric Shapes and Measures		Data Display	
	Girls	Boys	Girls	Boys	Girls	Boys
England	536 (4.3)	542 (3.8)	544 (4.6)	547 (4.1)	551 (6.3)	547 (4.9)
International Avg.	493 (0.5)	496 (0.6) ▲	485 (0.6) ▲	483 (0.7)	486 (0.7) ▲	482 (0.7)

▲ Average significantly higher than other gender

▼ Average significantly lower than other gender

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.9, international mathematics report

Table 5.6 Gender differences in the Y5 mathematic cognitive domains

Country	Knowing		Applying		Reasoning	
	Girls	Boys	Girls	Boys	Girls	Boys
England	550 (4.6)	554 (5.0)	540 (4.1)	544 (4.2)	529 (5.0)	533 (3.8)
International Avg.	492 (0.6)	492 (0.6)	488 (0.6)	489 (0.6)	487 (0.6)	489 (0.6) ▲

▲ Average significantly higher than other gender

▼ Average significantly lower than other gender

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.11, international mathematics report

5.2 Mathematics domains, Y9

What TIMSS assesses at ages 13–14

The content domains assessed for Y9 mathematics are:

- Number – Whole numbers; Fractions and decimals; Integers; Ratio, proportion and percent
- Algebra – Patterns; Algebraic expressions; Equations/formulas and functions
- Geometry - Geometric shapes; Geometric measurement; Location and movement
- Data and Chance - Data organization and representation; Data interpretation; Chance.
- The cognitive domains are as for Y5 mathematics (see section 5.1).

More information is available in the TIMSS Assessment Framework (Mullis *et al*, 2009).

5.2.1 Mathematics content domains, Y9

Table 5.7 shows that England's Y9 pupils scored significantly higher than their own mean score (507) in two content domains: Number (512) and Data and Chance (543). They scored significantly lower on the remaining two domains: Algebra (489) and Geometry (498).

Table 5.7 Y9 attainment in the mathematics content domains

Country	Overall Mathematics Average Scale Score	Number		Algebra	
		Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score
‡ England	507 (5.5)	512 (5.8)	5 (1.4) ▲	489 (5.7)	-17 (1.5) ▼

Country	Geometry		Data and Chance	
	Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score
‡ England	498 (5.7)	-9 (2.7) ▼	543 (6.8)	36 (2.8) ▲

▲ Subscale score significantly higher than overall mathematics score

▼ Subscale score significantly lower than overall mathematics score

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

See Appendix C.9 in the international report for sampling guidelines and sampling participation notes † and ‡.

Source: Exhibit 3.2, international mathematics report

International profiles against the Y9 mathematics content domains were variable. None of the countries or benchmarking participants[53] that did better than England in Y9 mathematics had a flat profile: all scored better on some domains than others.[54]

As was the case for Y5 mathematics, England's Y9 profile in 2011 differed from that of TIMSS 2007, when the only significant difference across domains was for Data and Chance (significantly higher than England's mean score in 2007).[55] The trends in Y9 mathematics performance are summarised in Table 5.8.

The change in the profile of attainment in Y9 mathematics coincided with two policy changes: the demise of the National Strategies in 2011; and a change to the key stage 3 (KS3) mathematics curriculum. The intended content of the newer version of the KS3 curriculum is similar to that of the previous version but is summarised, whereas the previous version gave a more detailed outline of the content to be taught.

53 42 countries and 14 benchmarking participants participated at this age range.

54 See Exhibit 3.2, international mathematics report.

55 Although England's Algebra score has not changed significantly between 2007 and 2011, the 2011 Algebra score is significantly different from England's 2011 mean score.

Table 5.8 Y9 trends in the mathematics content domains, 2007 to 2011

Country	Number			Algebra		
	2011 Average Scale Score	2007 Average Scale Score	Difference	2011 Average Scale Score	2007 Average Scale Score	Difference
England	512 (5.8)	511 (5.4)	1 (7.9)	489 (5.7)	496 (5.1)	-7 (7.6)

Country	Geometry			Data and Chance		
	2011 Average Scale Score	2007 Average Scale Score	Difference	2011 Average Scale Score	2007 Average Scale Score	Difference
England	498 (5.7)	513 (5.0)	-15 (7.6) ▼	543 (6.8)	552 (6.0)	-9 (9.1)

▲ 2011 average significantly higher

▼ 2011 average significantly lower

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.6, international mathematics report

5.2.2 Mathematics cognitive domains, Y9

In TIMSS 2007, there were no significant differences in pupils' Y9 mathematics scores on the three cognitive domains of Knowing, Applying and Reasoning. However, one difference arose in TIMSS 2011: the score for Knowing was lower than the other domains, relative to England's mean score. Although England's score on the Y9 Knowing items in 2011 was not significantly different from its Knowing score in 2007, the change in the scores on these items was sufficient to create a significant difference between England's overall Y9 mathematics score and its scores on the 2011 Knowing items. Tables 5.9 and 5.10 summarise the findings for the cognitive domains.

As was the case for Y5 mathematics, international profiles against the Y9 mathematics cognitive domains were variable. None of the countries or benchmarking participants which did better than England in Y9 mathematics had a flat profile on the cognitive domains. All scored higher on some domains than others, and the domains in each case varied.[56]

Table 5.9 Y9 attainment in the mathematics cognitive domains

Country	Overall Mathematics Average Scale Score	Knowing		Applying		Reasoning	
		Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score
‡ England	507 (5.5)	501 (5.4)	-5 (1.1) ▼	508 (5.5)	2 (1.2)	510 (5.5)	3 (2.0)

▲ Subscale score significantly higher than overall mathematics score

▼ Subscale score significantly lower than overall mathematics score

See Appendix C.9 in the international report for sampling guidelines and sampling participation notes † and ‡

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.4, international mathematics report

56 See Exhibit 3.4, international mathematics report.

Table 5.10 Y9 trends in the mathematics cognitive domains, 2007 to 2011

Country	Knowing			Applying		
	2011 Average Scale Score	2007 Average Scale Score	Difference	2011 Average Scale Score	2007 Average Scale Score	Difference
England	501 (5.4)	508 (4.6)	-6 (7.1)	508 (5.5)	514 (5.1)	-5 (7.4)

Country	Reasoning		
	2011 Average Scale Score	2007 Average Scale Score	Difference
England	510 (5.5)	518 (4.9)	-8 (7.4)

▲ 2011 average significantly higher

▼ 2011 average significantly lower

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.8, international mathematics report

5.2.3 Mathematics content and cognitive domains by gender, Y9

As was the case for Y5 mathematics, England had no significant gender differences in the TIMSS 2011 Y9 mathematics content domains (see Table 5.11) or cognitive domains (Table 5.12).

The international average pattern at Y9 was for boys to do significantly better than girls in Number, and for girls to do significantly better than boys in Algebra, Geometry and Data and Chance. For the cognitive domains, the international averages show that girls tended to do significantly better than boys at Knowing and Reasoning. This is different from Y5 internationally, where girls and boys scored the same on average for Knowing, but boys were better at Reasoning.

Table 5.11 Gender differences in the Y9 mathematics content domains

Country	Number		Algebra		Geometry		Data and Chance	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
‡ England	510 (6.0)	515 (6.9)	495 (5.8)	485 (6.6)	501 (5.8)	495 (6.7)	542 (7.2)	544 (8.8)
International Avg.	464 (0.7)	468 (0.7) ▲	476 (0.7) ▲	464 (0.7)	464 (0.7) ▲	461 (0.8)	459 (0.7) ▲	456 (0.8)

▲ Average significantly higher than other gender

▼ Average significantly lower than other gender

See Appendix C.9 in the international report for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.10, international mathematics report

Table 5.12 Gender differences in the Y9 mathematic cognitive domains

Country	Knowing		Applying		Reasoning	
	Girls	Boys	Girls	Boys	Girls	Boys
‡ England	503 (5.4)	500 (6.5)	508 (5.6)	509 (6.5)	513 (5.8)	507 (6.5)
International Avg.	471 (0.7) ▲	464 (0.7)	465 (0.6)	465 (0.7)	466 (0.7) ▲	463 (0.8)

▲ Average significantly higher than other gender

▼ Average significantly lower than other gender

See Appendix C.9 in the international report for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.12, international mathematics report

5.3 Science domains, Y5

What TIMSS assesses at ages 9–10

The content domains assessed in Y5 science are:

- Life Science – Characteristics and life processes of living things; Life cycles, reproduction and heredity; Interaction with the environment; Ecosystems; Human health
- Physical Science – Classification and properties of matter; Sources and effects of energy; Forces and motion
- Earth Science - Earth's structure, physical characteristics and resources; Earth's processes, cycles and history; Earth in the solar system.

In England, elements of TIMSS Earth Science are taught through other subjects, such as geography.

The cognitive domains are:

- Knowing – Recall/Recognize; Define; Describe; Illustrate with Examples; Demonstrate Knowledge of Scientific Instruments
- Reasoning – Compare/Contrast/Classify; Use Models; Relate; Interpret Information; Find Solutions; Explain
- Applying – Analyze; Integrate/Synthesize; Hypothesize/Predict; Draw Conclusions; Generalize; Evaluate; Justify.

More information is available in the TIMSS Assessment Framework (Mullis *et al*, 2009).

5.3.1 Science content domains, Y5

Table 5.13 shows that England's Y5 pupils scored significantly higher on Physical Science (535) and significantly lower on Earth Science (522), compared with their overall mean score for Y5 science of 529.

Internationally, England was one of just 11 participants scoring more highly on Physical Science. In contrast, like England, almost half of the TIMSS participants at this age range (26 of 57) had lower relative scores on Earth Science[57]. All but two of the participants which did better than England at Y5 science had relative strengths and weaknesses across the domains; only Finland and Alberta had a flat profile of achievement across all three domains.

In TIMSS 2007, there were no significant differences in England's attainment across the Y5 science content domains. However, in 2011, Y5 pupils scored less well than in 2007 on both Physical Science and Earth Science (see Table 5.14).

57 See Exhibit 3.1, international science report.

Table 5.13 Y5 attainment in the science content domains

Country	Overall Science Average Scale Score	Life Science		Physical Science		Earth Science	
		Average Scale Score	Difference from Overall Science Score	Average Scale Score	Difference from Overall Science Score	Average Scale Score	Difference from Overall Science Score
England	529 (2.9)	530 (2.8)	1 (1.5)	535 (3.5)	7 (2.2) ▲	522 (3.8)	-7 (2.2) ▼

▲ Subscale score significantly higher than overall science score
▼ Subscale score significantly lower than overall science score
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.1, international science report

Table 5.14 Y5 trends in the science content domains, 2007 to 2011

Country	Life Science			Physical Science		
	2011 Average Scale Score	2007 Average Scale Score	Difference	2011 Average Scale Score	2007 Average Scale Score	Difference
England	530 (2.8)	536 (3.1)	-6 (4.2)	535 (3.5)	546 (3.3)	-10 (4.8) ▼

Country	Earth Science		
	2011 Average Scale Score	2007 Average Scale Score	Difference
England	522 (3.8)	542 (3.4)	-19 (5.1) ▼

▲ 2011 average significantly higher
▼ 2011 average significantly lower
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.5, international science report

5.3.2 Science cognitive domains, Y5

In TIMSS 2007, there were no significant differences in pupils' Y5 science scores on the three cognitive domains of Knowing, Applying and Reasoning. However, one significant difference arose in TIMSS 2011: in Y5 science, England's pupils performed better at Applying relative to their overall average score. They performed at their own average level at Knowing and Reasoning. Y5 scores on Knowing and Reasoning in science have declined significantly since TIMSS 2007. Tables 5.15 and 5.16 summarise the findings for the cognitive domains.

There was a mixed picture internationally in terms of profiles across the cognitive domains. Of the highest achievers in science at Y5, only Alberta had a flat profile across all three cognitive domains.[58]

58 See Exhibit 3.3, international science report.

Table 5.15 Y5 attainment in the science cognitive domains

Country	Overall Science Average Scale Score	Knowing		Applying		Reasoning	
		Average Scale Score	Difference from Overall Science Score	Average Scale Score	Difference from Overall Science Score	Average Scale Score	Difference from Overall Science Score
England	529 (2.9)	529 (3.2)	0 (1.9)	532 (3.1)	4 (1.4) ▲	526 (4.4)	-2 (3.6)

▲ Subscale score significantly higher than overall science score
▼ Subscale score significantly lower than overall science score
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.3, international science report

Table 5.16 Y5 trends in the science cognitive domains, 2007 to 2011

Country	Knowing			Applying		
	2011 Average Scale Score	2007 Average Scale Score	Difference	2011 Average Scale Score	2007 Average Scale Score	Difference
England	529 (3.2)	547 (3.4)	-19 (4.7) ▼	532 (3.1)	537 (3.2)	-4 (4.5)

Country	Reasoning		
	2011 Average Scale Score	2007 Average Scale Score	Difference
England	526 (4.4)	540 (2.8)	-14 (5.2) ▼

▲ 2011 average significantly higher
▼ 2011 average significantly lower
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.7, international science report

5.3.3 Science content and cognitive domains by gender, Y5

As was the case for Y5 mathematics, England had no significant gender differences in the TIMSS 2011 Y5 science content domains (see Table 5.17) or cognitive domains (Table 5.18).

The international average pattern was for girls to do significantly better than boys in Life Science, while the converse was true for Physical Science and Earth Science: boys on average did better at these. All of the countries and benchmarking participants which did better than England in science at Y5 had at least one gender difference across the Y5 science content domains.[59]

For the cognitive domains, there was a more scattered picture. The international averages show that there were no significant gender differences overall for Knowing or Applying, but that Reasoning items were generally answered better by girls overall. Among the highest performers in science at this age range, all but one had at least one gender difference across the cognitive domains. The exception was Finland, with a flat gender profile across all three cognitive domains.[60]

59 See Exhibit 3.9, international science report.
60 See Exhibit 3.11, international science report.

Table 5.17 Gender differences in the Y5 science content domains

Country	Life Science		Physical Science		Earth Science	
	Girls	Boys	Girls	Boys	Girls	Boys
England	534 (3.6)	527 (4.1)	532 (3.5)	538 (4.9)	520 (4.5)	524 (3.9)
International Avg.	489 (0.6) ▲	481 (0.6)	484 (0.6)	485 (0.7) ▲	479 (0.7)	483 (0.7) ▲

▲ Average significantly higher than other gender

▼ Average significantly lower than other gender

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.9, international science report

Table 5.18 Gender differences in the Y5 science cognitive domains

Country	Knowing		Applying		Reasoning	
	Girls	Boys	Girls	Boys	Girls	Boys
England	527 (3.9)	530 (4.0)	533 (3.7)	532 (3.9)	533 (6.3)	521 (4.4)
International Avg.	486 (0.6)	485 (0.7)	485 (0.6)	484 (0.6)	485 (0.7) ▲	478 (0.7)

▲ Average significantly higher than other gender

▼ Average significantly lower than other gender

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.11, international science report

5.4 Science domains, Y9

What TIMSS assesses at ages 13–14

The content domains assessed in Y9 science are:

- Biology - Characteristics, classification and life processes of organisms; Cells and their functions; Life cycles, reproduction and heredity; Diversity, adaptation and natural selection; Ecosystems; Human health
- Chemistry - Classification and composition of matter; Properties of matter; Chemical change
- Physics - Physical states and changes in matter; Energy transformations, heat and temperature; Light and sound; Electricity and magnetism; Forces and motion
- Earth Science - Earth's structure and physical features; Earth's processes, cycles and history; Earth's resources, their use and conservation; Earth in the solar system and the universe.

In England, elements of TIMSS Earth Science are taught through other subjects, such as geography.

The cognitive domains are as for Y5 science (see section 5.3).

More information is available in the TIMSS Assessment Framework (Mullis *et al*, 2009).

5.4.1 Science content domains, Y9

Table 5.19 shows that England's Y9 pupils scored significantly lower than their own mean score (533) on one science content domain: Chemistry (529). They scored at their average level on the remaining three domains: Biology (533), Physics (533) and Earth Science (536). This is a different profile from Y5 science, where pupils scored more highly on Physical Science (which includes elements of chemistry at Y5) and less well on Earth Science.

International profiles against the Y9 science content domains were variable. None of the countries or benchmarking participants which did better than England in Y9 science had a flat profile: all did better, or less well, in some domains than others.[61]

England's Y9 pupils performed less well in Physics in TIMSS 2011, relative to their 2007 performance (see Table 5.20). No other domains showed significant differences from 2007.[62]

Table 5.19 Y9 attainment in the science content domains

Country	Overall Science Average Scale Score	Biology		Chemistry	
		Average Scale Score	Difference from Overall Science Score	Average Scale Score	Difference from Overall Science Score
‡ England	533 (4.9)	533 (4.9)	0 (1.1)	529 (5.2)	-4 (1.6) ▼

Country	Physics		Earth Science	
	Average Scale Score	Difference from Overall Science Score	Average Scale Score	Difference from Overall Science Score
‡ England	533 (4.6)	0 (2.0)	536 (5.3)	3 (2.8)

▲ Subscale score significantly higher than overall science score

▼ Subscale score significantly lower than overall science score

See Appendix C.9 in the international report for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.2, international science report

61 See Exhibit 3.2, international science report.

62 Although England's Chemistry score has not changed significantly between 2007 and 2011, the 2011 Chemistry score is significantly different from England's 2011 mean score.

Table 5.20 Y9 trends in the science content domains, 2007 to 2011

Country	Biology			Chemistry		
	2011 Average Scale Score	2007 Average Scale Score	Difference	2011 Average Scale Score	2007 Average Scale Score	Difference
England	533 (4.9)	544 (4.8)	-11 (6.9)	529 (5.2)	539 (4.6)	-11 (6.9)

Country	Physics			Earth Science		
	2011 Average Scale Score	2007 Average Scale Score	Difference	2011 Average Scale Score	2007 Average Scale Score	Difference
England	533 (4.6)	549 (4.4)	-15 (6.4) ▼	536 (5.3)	531 (5.0)	5 (7.3)

▲ 2011 average significantly higher

▼ 2011 average significantly lower

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.6, international science report.

5.4.2 Science cognitive domains, Y9

In TIMSS 2007, there were no significant differences in pupils' Y9 science scores on the three cognitive domains of Knowing, Applying and Reasoning. However, one difference arose in TIMSS 2011: Reasoning showed a higher score than the other domains, relative to England's mean score. This is a different profile than seen for Y9 mathematics (where Knowing was lower) and for Y5 science (where Applying was higher).

Although England's Y9 score on the science Reasoning items in 2011 was not significantly different from its Reasoning score in 2007, its difference from the overall score in 2011 was statistically significant. Tables 5.21 and 5.22 summarise the findings for the cognitive domains.

As was the case for Y5 science, there was a mixed picture internationally in terms of profiles across the cognitive domains. Of the highest achievers in science at Y9, only Minnesota and Singapore had a flat profile across all three cognitive domains: all other high performers did better in some domains than others, and the domains in each case varied.[63]

Table 5.21 Y9 attainment in the science cognitive domains

Country	Overall Science Average Scale Score	Knowing		Applying		Reasoning	
		Average Scale Score	Difference from Overall Science Score	Average Scale Score	Difference from Overall Science Score	Average Scale Score	Difference from Overall Science Score
‡ England	533 (4.9)	533 (5.1)	0 (1.6)	531 (4.7)	-2 (1.3)	537 (4.8)	4 (1.5) ▲

▲ Subscale score significantly higher than overall science score

▼ Subscale score significantly lower than overall science score

See Appendix C.9 in the international report for sampling guidelines and sampling participation notes † and ‡.

Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.4, international science report

63 See Exhibit 3.4, international science report.

Table 5.22 Y9 trends in the science cognitive domains, 2007 to 2011

Country	Knowing			Applying		
	2011 Average Scale Score	2007 Average Scale Score	Difference	2011 Average Scale Score	2007 Average Scale Score	Difference
England	533 (5.1)	536 (5.4)	-3 (7.4)	531 (4.7)	540 (4.3)	-8 (6.4)

Country	Reasoning		
	2011 Average Scale Score	2007 Average Scale Score	Difference
England	537 (4.8)	548 (4.5)	-12 (6.5)

▲ 2011 average significantly higher

▼ 2011 average significantly lower

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.8, international science report

5.4.3 Science content and cognitive domains by gender, Y9

As was the case for Y5 science, England had no significant gender differences in the TIMSS 2011 Y9 science content domains (see Table 5.23) or cognitive domains (Table 5.24).

The international average pattern at Y9 was different from that at Y5. At Y9, girls on average performed better at Biology and Chemistry (at Y5, they did better only at Life Science; chemistry is subsumed under the Physical Science domain at Y5). Internationally, boys did better at Earth Science (as was the case at Y5) while there was no gender difference for Physics (boys did better at Physical Science at Y5).

All but one of the countries and benchmarking participants which did better than England in science at Y9 had at least one gender difference across these content domains; Singapore was the exception with no gender differences on the Y9 science content domains.[64]

For the cognitive domains internationally, there was an average trend towards girls doing better than boys on all three cognitive domains. Among the highest performers in science at this age range, all but one had at least one gender difference across the cognitive domains. The exception was Singapore, with a flat profile across all three cognitive domains, corresponding to its flat profile across the content domains.[65]

Table 5.23 Gender differences in the Y9 science content domains

Country	Biology		Chemistry		Physics		Earth Science	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
‡ England	538 (5.4)	529 (6.2)	530 (5.9)	527 (6.2)	531 (5.5)	535 (5.6)	531 (5.6)	541 (6.7)
International Avg.	481 (0.7) ▲	469 (0.8)	482 (0.7) ▲	472 (0.8)	473 (0.7)	474 (0.8)	473 (0.7)	475 (0.8) ▲

▲ Average significantly higher than other gender

▼ Average significantly lower than other gender

See Appendix C.9 in the international report for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.10, international science report

64 See Exhibit 3.10, international science report.

65 See Exhibit 3.12, international science report.

Table 5.24 Gender differences in the Y9 science cognitive domains

Country	Knowing		Applying		Reasoning	
	Girls	Boys	Girls	Boys	Girls	Boys
‡ England	532 (5.3)	535 (6.4)	531 (4.8)	532 (5.9)	540 (5.2)	534 (5.9)
International Avg.	479 (0.7) ▲	476 (0.8)	478 (0.6) ▲	473 (0.7)	478 (0.7) ▲	470 (0.8)

▲ Average significantly higher than other gender

▼ Average significantly lower than other gender

See Appendix C.9 in the international report for sampling guidelines and sampling participation notes † and ‡.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.12, international science report

Chapter 6 The curriculum and teaching

Chapter outline

This chapter presents findings relating to teaching practice and curriculum in mathematics and science in Year 5 (Y5, ages 9–10) and Year 9 (Y9, ages 13–14), reported by teachers, headteachers and National Research Coordinators (or their designated national contact). The chapter first describes how much time is spent teaching mathematics and science, whether teachers emphasise science investigations, and the availability of computers. The degree of correspondence between what pupils learn and the topics assessed in TIMSS is then examined, by presenting data on the inclusion of TIMSS mathematics and science topics in participating countries' intended curricula, in addition to teachers' reports about topics covered in lessons. Findings for Y5 are followed by findings for Y9. Within each sub-section, findings for mathematics are generally presented first, followed by findings for science.

Key findings

- England's national curriculum for mathematics and science up to Y9 includes most of the content assessed by the TIMSS mathematics and science assessments. Compared with pupils in the highest performing countries, Y9 pupils would typically have encountered more of this content in science, but less of it in mathematics. In particular, fewer Y9 pupils in England were taught the Algebra topics, compared with those in the highest performing countries.
- The key stage 2 curriculum includes most of the TIMSS mathematics content, and Y5 pupils would have encountered more of this content than their peers in some of the highest performing countries.
- The key stage 2 curriculum includes less of the TIMSS science content, but more than in many other countries, including some of the highest performers.
- Compared with other TIMSS participants, teaching time for mathematics in England was relatively high in Y5, but relatively low in Y9.
- Teaching time for science was relatively low in England for both Y5 and Y9.
- Y9 pupils were more likely to have computers available in science lessons than in mathematics lessons. This was not so in Y5, where availability was similar for both subjects.

Interpreting the data: scaled data from teachers and headteachers

Most of the data presented in this chapter is reported by teachers and headteachers. Reported percentages refer to pupils and can usually (unless otherwise indicated) be interpreted as the percentage of pupils whose teacher or headteacher reported a particular practice or gave a particular response to a questionnaire item.

When interpreting the data from pupils, headteachers and teachers it is important to take account of the relative sample sizes. Participants are expected to sample a minimum of 150 schools in each year group and a minimum of 4,000 students for each target year group (these figures represent the numbers drawn in the sample; the achieved sample numbers may be less). The achieved ranges for participating schools internationally were 96 to 459 for Y5, and 95 to 501 for Y9.[66] These wide ranges reflected the fact that some participants had fewer than 150 schools available and some participants chose to over–sample schools. Just over half of participants sampled between 150 and 200 schools for each age group.

For TIMSS 2011 in England, the number of participating schools was 125 at Y5 and 118 at Y9. Numbers of participants within these schools were:

- 3,397 Y5 and 3,482 Y9 pupils.
- 125 and 118 headteachers respectively answered the Y5 and Y9 School Questionnaire.
- 194 Y5 class teachers completed a Teacher Questionnaire for mathematics and 199 for science.
- 213 Y9 teachers completed the Mathematics Teacher Questionnaire.
- 757 Y9 teachers completed the Science Teacher Questionnaire (the number of science teachers was greater as the Y9 pupils were sampled by mathematics class).

See Appendix A for more information about numbers of participants and sampling method.

66 These figures refer to countries and exclude benchmarking participants.

Year 5

6.1 Teaching time

Teaching time,[67] for all age groups and subjects, was reported by headteachers[68] and teachers and calculated using the following formula, to enable direct comparison of teaching time to be made between different countries:

Total Instructional Hours per Year = **Principal Reports of School Days per Week** X **Principal Reports of Instructional Hours per Day**

Hours per Year for Mathematics Instructions = (**Teacher Reports of Weekly Mathematics Instructional Hours** ÷ **Principal Reports of School Days per Week**) X **Principal Reports of School Days per Day**

Source: Exhibit 8.6 International mathematics and science reports

At Y5, England's average achievement score for Y5 mathematics was 542, significantly[69] above the centre point of the mathematics achievement scale. Table 6.1 shows that, in England, the average amount of time for teaching mathematics to Y5 pupils was relatively high at 188 hours per year, 19 per cent of a total 970 teaching hours per year.

England's average achievement score for Y5 science was 529, also significantly above the centre point of the achievement scale. For Y5 science, the average amount of teaching time was 76 hours per year, 8 per cent of a total 970 teaching hours per year, and lower than the international average of 85 hours (see Table 6.1).

The amount of teaching time was variable internationally for both subjects, including among the high performing countries. Teaching time for mathematics was lower than in England in the majority of the high performing countries, but in Singapore and Northern Ireland it was higher than in England (208 hours and 232 hours respectively).

However, in the majority of high performing countries in science, teaching time for science was higher than in England. The exceptions to this were the Russian Federation and Czech Republic, where it was 49 and 60 hours respectively (compared with 76 hours in England). In the Netherlands and Denmark, where average science attainment was not significantly different from England's, teaching time for science was also lower than in England at 42 and 62 hours respectively.

Like the majority of countries, teaching time was higher for mathematics than science at both age groups in England.[70]

67 Teaching time is referred to as 'instructional time' in the international data and report.

68 Headteachers are referred to as principals in the international data and report.

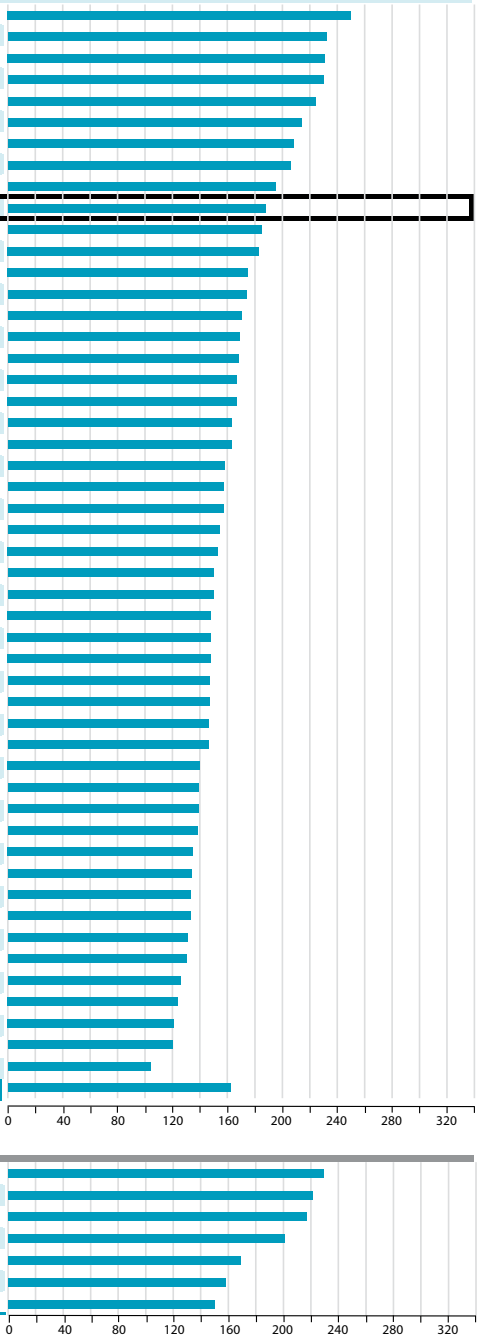
69 Throughout this report, the term 'significant' refers to statistical significance.

70 Trend comparisons with 2007 cannot be made in this instance as the measure used for teaching time in 2007 was different.

Table 6.1 Teaching time at ages 9–10

Mathematics

Country	Total Instructional Hours per Year	Hours per Year for Mathematics Instruction
Portugal	r 940 (13.1)	r 250 (4.3)
Northern Ireland	r 970 (11.0)	s 232 (6.1)
Chile	r 1228 (22.6)	s 231 (6.7)
Australia	1008 (6.9)	s 230 (5.8)
Belgium (Flemish)	r 1010 (16.8)	r 224 (4.1)
Italy	1085 (12.6)	214 (3.9)
Singapore	1012 (0.0)	208 (3.2)
United States	1078 (7.3)	r 206 (4.6)
Netherlands	s 1074 (9.9)	s 195 (7.0)
England	r 970 (8.3)	s 188 (3.3)
Qatar	1068 (9.1)	185 (6.3)
Malta	r 891 (0.2)	r 183 (0.1)
Tunisia	r 963 (22.9)	r 175 (2.9)
Morocco	r 1040 (23.6)	s 174 (3.5)
Oman	s 999 (17.4)	s 170 (3.1)
Slovenia	684 (0.0)	169 (2.6)
New Zealand	925 (3.9)	168 (2.4)
Thailand	r 1201 (20.9)	167 (5.2)
Spain	r 884 (9.7)	r 167 (2.3)
Germany	r 863 (11.2)	r 163 (3.1)
Czech Republic	782 (8.2)	163 (3.0)
Hong Kong SAR	r 1059 (11.2)	r 158 (3.0)
Norway	817 (10.7)	157 (4.1)
Poland	r 764 (13.5)	r 157 (3.0)
United Arab Emirates	r 1025 (8.5)	s 154 (2.4)
Serbia	778 (18.5)	153 (2.1)
Ireland, Rep. of	854 (0.0)	150 (2.8)
Japan	891 (3.7)	150 (1.6)
Georgia	r 748 (18.7)	r 148 (3.9)
Hungary	760 (12.2)	148 (3.3)
Romania	796 (17.9)	148 (3.9)
Saudi Arabia	r 977 (19.4)	r 147 (6.6)
Slovak Republic	780 (8.8)	147 (1.4)
Austria	808 (6.9)	146 (2.1)
Iran, Islamic Rep. of	727 (11.2)	146 (3.9)
Kazakhstan	779 (10.6)	140 (2.7)
Finland	779 (9.8)	139 (2.5)
Armenia	r 851 (17.1)	r 139 (1.7)
Sweden	r 849 (11.3)	s 138 (3.8)
Yemen	r 831 (14.1)	r 135 (6.4)
Croatia	776 (19.4)	134 (2.3)
Chinese Taipei	r 989 (13.4)	133 (3.9)
Lithuania	649 (9.0)	133 (2.6)
Bahrain	964 (10.8)	r 131 (4.4)
Azerbaijan	804 (27.7)	130 (3.3)
Turkey	900 (19.3)	126 (2.5)
Denmark	r 863 (9.4)	s 124 (2.0)
Korea, Rep. of	789 (11.4)	121 (3.0)
Kuwait	r 928 (23.1)	r 120 (4.9)
Russian Federation	r 660 (8.0)	104 (1.0)
International Avg.	897 (2.0)	162 (0.5)
Benchmarking Participants		
Quebec, Canada	916 (5.1)	229 (5.0)
North Carolina, US	r 1113 (22.9)	r 221 (13.5)
Florida, US	r 1073 (19.7)	s 217 (8.8)
Ontario, Canada	969 (7.4)	r 201 (4.1)
Alberta, Canada	1006 (8.8)	s 169 (3.2)
Dubai, UAE	r 993 (0.7)	s 158 (2.3)
Abu Dhabi, UAE	r 1033 (18.1)	s 150 (4.3)



( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

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

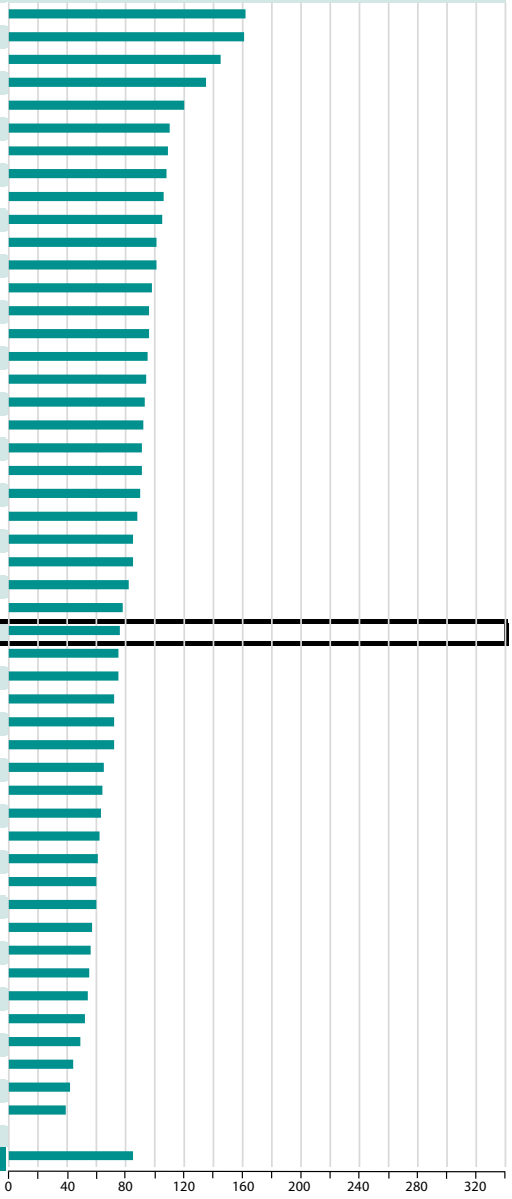
Source: Exhibit 8.6, international mathematics report

Table 6.1 Teaching time at ages 9–10 (continued)

Science

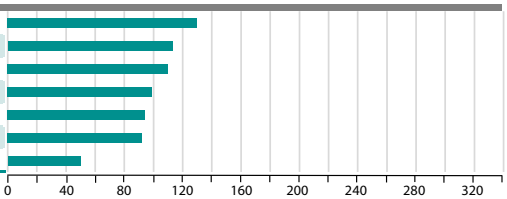
Reported by Principals and Teachers

Country	Total Instructional Hours per Year	Hours per Year for Science Instruction
Portugal	r 940 (13.1)	r 162 (4.1)
Chile	r 1228 (22.6)	s 161 (6.4)
Spain	r 884 (9.7)	r 145 (2.6)
Qatar	1068 (9.1)	135 (6.8)
Oman	s 999 (17.4)	s 120 (2.4)
Georgia	r 748 (18.7)	r 110 (2.7)
Thailand	r 1201 (20.9)	109 (4.9)
United Arab Emirates	r 1025 (8.5)	s 108 (3.0)
Iran, Islamic Rep. of	727 (11.2)	106 (3.2)
United States	1078 (7.3)	r 105 (3.1)
Slovenia	684 (0.0)	101 (1.2)
Slovak Republic	780 (8.8)	101 (4.3)
Finland	779 (9.8)	98 (1.9)
Singapore	1012 (0.0)	96 (2.1)
Austria	808 (6.9)	96 (2.3)
Croatia	776 (19.4)	95 (2.4)
Turkey	900 (19.3)	94 (1.8)
Tunisia	r 963 (22.9)	r 93 (5.4)
Korea, Rep. of	789 (11.4)	92 (2.5)
Yemen	r 831 (14.1)	r 91 (5.6)
Japan	891 (3.7)	91 (0.8)
Chinese Taipei	r 989 (13.4)	90 (2.3)
Hong Kong SAR	r 1059 (11.2)	r 88 (4.2)
Kuwait	r 928 (23.1)	s 85 (5.8)
Bahrain	964 (10.8)	r 85 (2.7)
Saudi Arabia	r 977 (19.4)	r 82 (4.2)
Italy	1085 (12.6)	r 78 (1.8)
England	r 970 (8.3)	s 76 (3.2)
Sweden	r 849 (11.3)	s 75 (3.0)
Germany	r 863 (11.2)	s 75 (3.5)
Hungary	760 (12.2)	72 (2.2)
Serbia	778 (18.5)	72 (5.0)
Northern Ireland	r 970 (11.1)	s 72 (3.9)
Australia	1008 (6.9)	s 65 (2.3)
Poland	r 764 (13.5)	r 64 (3.1)
Ireland, Rep. of	854 (0.0)	63 (6.6)
Denmark	r 863 (9.4)	s 62 (1.9)
Azerbaijan	804 (27.7)	61 (1.4)
Lithuania	649 (9.0)	60 (1.5)
Czech Republic	782 (8.2)	60 (2.2)
Kazakhstan	779 (10.6)	57 (1.3)
Romania	796 (17.9)	56 (6.2)
Norway	817 (10.7)	55 (2.2)
Armenia	r 851 (17.1)	s 54 (0.6)
New Zealand	925 (3.9)	s 52 (3.0)
Russian Federation	r 660 (8.0)	49 (0.7)
Morocco	r 1040 (23.6)	s 44 (5.5)
Netherlands	s 1074 (9.9)	s 42 (2.4)
Malta	r 891 (0.2)	r 39 (0.1)
Belgium (Flemish)	r 1010 (16.8)	- -
International Avg.	897 (2.0)	85 (0.5)



Benchmarking Participants

Alberta, Canada		1006 (8.8)	s	130 (4.1)
Florida, US	r	1073 (19.7)	s	113 (9.6)
Abu Dhabi, UAE	r	1033 (18.1)	s	110 (6.8)
Dubai, UAE	r	993 (0.7)	s	99 (1.6)
North Carolina, US	r	1113 (22.9)	r	94 (6.0)
Ontario, Canada		969 (7.4)	r	92 (3.2)
Quebec, Canada		916 (5.1)		50 (1.7)



( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available.
An "r" indicates data are available for at least 70% but less than 85% of the students. An "s" indicates data are available for at least 50% but less than 70% of the students.

Source: Exhibit 8.6, international science report

6.2 Teachers' emphasis on science investigations

Interpreting the data: indices and scales

In order to summarise data from a questionnaire, responses to several related items are sometimes combined to form an index or scale. The respondents to the questionnaire items are grouped according to their responses and the way in which responses have been categorised is shown for each index or scale. The data in an index or scale is often considered to be more valid and reliable than the responses to individual items.

The emphasis teachers place on science investigations is measured by teachers' responses to six statements about teaching science (these statements can be seen below Table 6.2). The international analysis uses responses to these statements to create the *Emphasize Science Investigation* scale.[71] Pupils were categorised into two bands: those whose teachers emphasise science investigations in *About Half the Lessons or More* and those whose teachers emphasise science investigations in *Less Than Half the Lessons* (details of how pupils were assigned to each band is provided above Table 6.2). In England the average scale score was 10.0; within the *Less Than Half the Lessons* category overall.

Forty–one per cent of Y5 pupils in England were taught by teachers who emphasised science investigations in *About Half the Lessons or More*. Percentages of pupils in England whose teachers did each individual activity on the *Emphasize Science Investigation* scale (see the box below Table 6.2) in half of the lessons or more were higher than in TIMSS 2007 for all six activities.[72]

There was no clear pattern among high performing countries in terms of the frequency of teachers' emphasis on science investigations. For some high performing participants such as Korea, Chinese Taipei, Japan, Singapore and Alberta, a higher proportion of pupils than in England were taught by teachers who emphasised science investigations in *About Half the Lessons or More*. However, in other countries where performance was significantly better than England's at Y5 science, for example Finland, Russian Federation and Czech Republic, a lower proportion of pupils than in England was taught by teachers who emphasised science investigations in *About Half the Lessons or More*. In England, it is likely that there is no significant difference[73] between pupils' average achievement according to the frequency with which their teachers emphasised science investigations.

71 The table is labelled as in the international report; hence American spelling may be used in such labels.

72 Analysis was conducted using the weighted international data and comparing this to the percentages reported by teachers in TIMSS 2007, which were presented as individual activities rather than as a scale. The 2007 data was presented as *Percentage of Students whose teachers reported students doing the activity about half of the lessons or more* for each individual activity. In order to compare the 2011 data to this, the percentages in the response categories *about half the lessons or more* and *every or almost every lesson* were combined to make percentages for each activity that were directly comparable. In 2007 teachers were also asked about an additional activity, *Work Together in Small Groups on Experiments or Investigations*, whereas this was not included in the 2011 *Emphasize Science Investigation* scale: percentages were only compared for the six activities reported by teachers in both surveys.

73 This difference has not been tested formally for statistical significance; this conclusion is drawn from the size of the standard errors relating to the average achievement scores of the two groups of pupils: see Table 6.2.

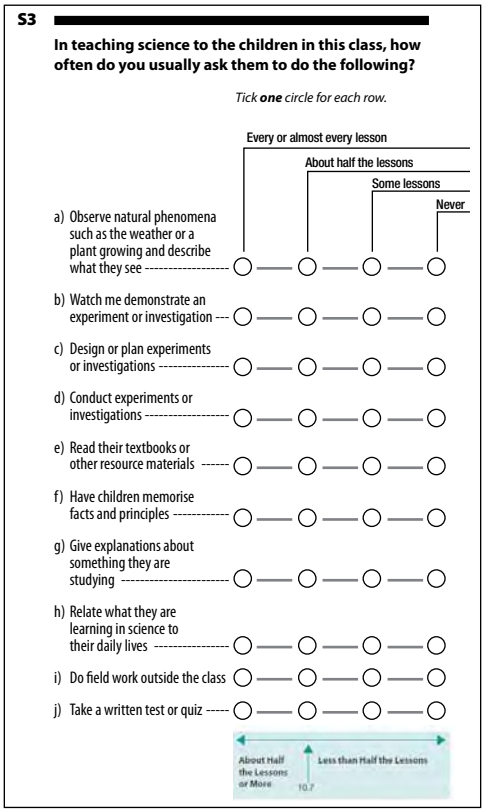
Table 6.2 Teachers' emphasis on science investigations in Y5

Students were scored according to their teachers' responses to how often they used each of six instructional activities on the *Emphasize Science Investigation* scale. Students with teachers who emphasized science investigation in **About Half the Lessons or More** had a score on the scale of at least 10.7, which corresponds to their teachers using all six activities in "about half the lessons," on average. All other students had teachers who emphasized science investigation in **Less than Half the Lessons**.

Country	About Half the Lessons or More		Less than Half the Lessons		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England r	41 (4.7)	535 (7.5)	59 (4.7)	524 (4.4)	10.0 (0.15)
International Avg.	40 (0.5)	488 (0.9)	60 (0.5)	484 (0.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

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



Items e, f, i and j did not contribute to this scale.

Source: Exhibit 8.27, international science report

6.3 Use of computers in Y5 lessons

Mathematics

In England, 71 per cent of Y5 pupils were taught by teachers who reported that computers were available for mathematics lessons (see Table 6.3), one of the highest proportions across all countries, and considerably higher than the international average (42 per cent). Among the countries whose average score for mathematics was significantly higher than England's, computer availability varied substantially: 76 per cent in Northern Ireland, 65 per cent in Singapore; but 31 per cent and 39 per cent in Korea and Hong Kong respectively. The most common uses of computers in mathematics lessons in England were *to practice skills and procedures* and *to explore*

mathematical principles and concepts (60 and 55 per cent respectively had teachers who asked them to use computers for these purposes at least monthly).

Science

In England, 74 per cent of Y5 pupils were taught by teachers who reported that computers were available for use in science lessons (see Table 6.3). The percentage of pupils who had computers available for science lessons was higher in England than in most of the high performing Pacific Rim countries (in Japan the percentage was the same: 74 per cent). Computer availability was very varied across countries. As for mathematics, computer availability for science lessons was particularly low in Korea (35 per cent), the highest performing country in science at this age group. Computer availability was particularly high in Denmark and Northern Ireland. Where pupils did have access *to* computers for their science lessons, they were mainly used *to look up ideas and information*. This was the case across the majority of participants.

Table 6.3 Computer activities in Y5 lessons

Mathematics

Reported by Teachers

Country	Computers Available for Mathematics Lessons			Per cent of Students Whose Teachers Have Them Use Computers At Least Monthly		
	Per cent of Students	Average Achievement				
	Yes	Yes	No	To Explore Mathematics Principles and Concepts	To Look Up Ideas and Information	To Practice Skills and Procedures
England	71 (4.2)	545 (3.9)	542 (8.0)	55 (4.4)	41 (4.4)	60 (4.3)
International Avg.	42 (0.5)	491 (1.1)	490 (0.7)	27 (0.4)	26 (0.5)	34 (0.5)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Science

Reported by Teachers

Country	Computers Available for Science Lessons			Per cent of Students Whose Teachers Have Them Use Computers At Least Monthly			
	Per cent of Students	Average Achievement					
	Yes	Yes	No	To Look Up Ideas and Information	To Do Scientific Procedures or Experiments	To Study Natural Phenomena Through Simulations	To Practice Skills and Procedures
England	74 (4.3)	531 (3.8)	519 (9.3)	68 (5.0)	40 (4.8)	51 (5.1)	43 (4.8)
International Avg.	47 (0.5)	488 (1.0)	486 (0.8)	41 (0.5)	24 (0.4)	25 (0.4)	31 (0.5)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 8.29, international mathematics and science reports

6.4 The Year 5 curriculum

6.4.1 The intended curriculum

The TIMSS 2011 mathematics and science Assessment Frameworks were not designed to match exactly the curriculum of any one participating country. In order to assess the degree of correspondence between national curricula and the topics covered in TIMSS 2011, National Research Coordinators (NRCs), or their designated contact, were asked to indicate whether each of the TIMSS 2011 mathematics and science topics (listed below Table 6.4 for mathematics, and below Table 6.5 for science) was included in their countries' intended curriculum for pupils aged 9–10 (Y5), and, if so, whether the topics were intended to be taught *to all or almost all pupils* or *only the more able pupils* by the end of Y5.[74] The outcomes for England are summarised in Table 6.4 and Table 6.5.

Mathematics

Table 6.4 shows that, in England, 17 of the 18 TIMSS mathematics topics were intended to be taught to all Y5 pupils. One number topic was intended to be taught only to more able students; this was *Adding and subtracting with fractions* (see the box below Table 6.4 for a full list of the TIMSS 2011 mathematics topics). The number of TIMSS mathematics topics covered in the curriculum was similar to countries performing significantly better than England, such as Japan, Singapore, Korea and Northern Ireland, as well as to countries performing at a similar level, such as Belgium (Flemish) and the United States. In countries where topics were not in the curriculum, these were mainly within the content areas of Number and Geometrical Shapes and Measures. Across all countries, it was rare for topics to be taught only to more able pupils in this age group.

Table 6.4 Number of TIMSS mathematics topics intended to be taught by the end of Y5

Reported by National Research Coordinators

Country	All Mathematics (18 Topics)			Number (8 Topics)			Geometric Shapes and Measures (7 Topics)			Data Display (3 Topics)		
	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 4	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 4	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 4	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 4
England	17	1	0	7	1	0	7	0	0	3	0	0
International Avg.	13	1	4	6	0	2	5	0	2	2	0	1

Because of rounding some results may appear inconsistent.

74 NRCs were asked: "According to the national mathematics/science curriculum, what proportion of grade 4 students should have been taught each of the following topics or skills by the end of grade 4?" For countries with no national curriculum, NRCs were advised to "summarize for your state or provincial curricula".

TIMSS 2011 Mathematics Topics

A.Number

1) Concept of whole numbers, including place value and ordering
2) Adding, subtracting, multiplying, and/or dividing with whole numbers
3) Concepts of fractions
4) Adding and subtracting with fractions
5) Cocepts of decimals, including place value and ordering
6) Adding and subtracting with decimals
7) Number sentences
8) Number patterns

B.Geometric Shapes and Measures

1) Lines measuring, estimating length of; parallel and perpendicular lines
2) Comparing and drawing angles
3) Using informal coordinate systems to locate points in plane
4) Elementary properties of common geometric shapes
5) Reflections and rotations
6) Relationships between two-dimensional and three-dimen shapes
7) Finding and estimating areas, perimeters, and volumes

C.Data Display

1) Reading data from tables, pictographs, bar graphs, or pie charts
2) Drawing conclusions from data displays
3) Display data using tables, pictographs, and bar graphs.

Source: Exhibit 8.10, international mathematics report

Science

Table 6.5 shows that in England, 16 of the 20 TIMSS science topics were intended to be taught to all Y5 pupils. All topics in Life Science were included (see the box below Table 6.5 for a full list of the TIMSS 2011 science topics). The topics not included are shown in Table 6.6. The topics not included from the Earth Science domain are likely to be found in other parts of the curriculum, notably Geography.

Table 6.5 Number of TIMSS science topics intended to be taught by the end of Y5

Reported by National Research Coordinators

Country	All Science (20 Topics)			Life Science (6 Topics)			Physical Science (8 Topics)			Earth Science (6 Topics)		
	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 4	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 4	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 4	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 4
England	16	0	4	6	0	0	7	0	1	3	0	3
International Avg.	14	1	5	5	0	1	5	0	2	4	0	2

Because of rounding some results may appear inconsistent.

TIMSS 2011 Science Topics

A. Life Science

1) Major body structures and their functions in humans and other organisms (plant and animals)
2) Life cycles and reproduction in plants and animals
3) Physical features, behavior, and survival of organisms living in different environments
4) Relationships in a given community (e.g., simple food chains, predator-prey relationships)
5) Changes in environments (effects of human activity, pollution and its prevention)
6) Human health (e.g., transmission/prevention of communicable diseases, signs of health/illness, diet, exercise)

B. Physical Science

1) States of matter (solids, liquids, gases) and differences in their physical properties (shape, volume), includeing changes in state of matter by heating and coolng
2) Classification of objects/materials based on physical properties (e.g., weight/mass, volume, magnetic attraction)
3) Forming and separating mixtures
4) Elementary properties of common geometric shapes
5) Common energy sources/forms and their practical uses (e.e., the Sun, electricity, water, wind)
6) Light (e.g.,sources, behavior)
7) Electrical circuits and properties of magnets
8) Forces that cause objects to move (e.g., gravity, push/pull forces)

C. Earth Science

1) Water on Earth (location, types, and movements) and air (composition, proof of its existance, uses)
2) Common features of Earth's landscape (e.g., mountains, plain, rivers, deserts) and relationship to human use (e.g., farming, irrigation, land development)
3) Weather conditions from day to day or over the seasons
4) Fossils of animals and plants (age, location, formation)
5) Earth's solar system (planets, Sun, moon)
6) Day, might, and shadows due to Earth's rotation and its relationship to the Sun

Source: Exhibit 8.10 international science report

Table 6.6 TIMSS 2011 Science topics not intended to be taught by the end of Y5

Physical Science	Earth Science
• *Common energy sources/forms and their practical uses (e.g., the Sun, electricity, water, wind)*	• *Common features of Earth's landscape (e.g., mountains, plains, rivers, deserts) and relationship to human use (e.g., farming, irrigation, land development)* • *Weather conditions from day to day or over the seasons* • *Fossils of animals and plants (age, location, formation)*

Source: information provided by National Research Coordinator

Internationally, there was variation in the number of topics included in curricula, as well as in the content domains these topics were drawn from. However, very few countries intended to teach particular topics only to more able pupils. Compared with the countries with significantly higher average achievement, England's science curriculum included a greater number of TIMSS science topics. In Korea and Singapore fewer than half of the TIMSS topics feature in their respective science curricula. Alberta and participants achieving at a similar level to England, such as Italy and North Carolina also included fewer topics than England, typically in Earth Science. Northern Ireland included all 20 topics, and the Netherlands did not prescribe any grade–specific science curriculum at this level.

6.4.2 Percentage of Y5 pupils taught the TIMSS topics

Teachers were asked to indicate, for their class, whether each of the TIMSS topics was *mostly taught this year, not yet taught* or *just introduced*. Table 6.7 shows the percentage of pupils whose teachers reported that they had been taught the topics either prior to or during the year of the assessment, averaged across topics, presented both as overall percentages and according to content domain.[75]

Mathematics

According to teachers' reports, 91 per cent of pupils in England were taught the TIMSS mathematics topics either before or during the year of the TIMSS assessment. England's overall percentage was higher than in many of the countries performing significantly better, such as Singapore, Korea and Hong Kong. The most commonly taught domain[76] in England was Data Display. Across countries, and particularly in countries where average achievement was significantly higher than England's, the most commonly taught domain was Number. For example, in Singapore, where 85 per cent of pupils were taught the TIMSS mathematics topics either before or during the year of assessment, 100 per cent were taught the Number topics.

Science

In England, 71 per cent of pupils were taught the TIMSS science topics, a higher percentage overall than most of the higher performing countries. In Korea, the highest performing country in this age group, the equivalent figure was 50 per cent and in Japan it was 38 per cent. In the Netherlands, Sweden, Denmark and Germany, as well as in Alberta, fewer pupils were taught the TIMSS science topics. For most of these participants, the most commonly taught domain was Life Science but for Sweden it was Earth Science. The most commonly taught domain in England was Physical Science, whereas in Chinese Taipei, Korea, Finland and Czech Republic, it was Life Science.

Table 6.7 Percentage of Y5 pupils taught the TIMSS topics*

Mathematics

Reported by Teachers

Country	All Mathematics (18 Topics)	Number (8 Topics)	Geometric Shapes and Measures (7 Topics)	Data Display (3 Topics)
England	91 (0.9)	91 (0.8)	89 (1.5)	96 (1.2)
International Avg.	72 (0.2)	76 (0.2)	65 (0.2)	76 (0.4)

* Percentage mostly taught before or in the assessment year averaged across topics.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 8.8, international mathematics and science reports

75 For a full list of the topics, refer back to the boxes below Table 6.4 and Table 6.5.

76 'Most commonly taught domain', here and in section 6.8.2, refers to the content domain within which the highest proportion of pupils had been taught topics before or in the assessment year.

Reported by Teachers

Country	All Science (20 Topics)	Life Science (6 Topics)	Physical Science (8 Topics)	Earth Science (6 Topics)
England	r 71 (1.7)	r 72 (2.4)	r 78 (1.8)	r 62 (2.9)
International Avg.	64 (0.2)	75 (0.2)	57 (0.3)	63 (0.3)

* Percentage mostly taught before or in the assessment year averaged across topics.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Source: Exhibit 8.8, international science report

Year 9

6.5 Teaching time

This was calculated in the same way as for Y5; please refer to section 6.1 for further details.

Mathematics

At Y9, England's average achievement score for mathematics was 507, not significantly different from the centre point of the achievement scale. Table 6.8 shows that, in England, mathematics teaching time for Y9 pupils was 116 hours per year, 12 per cent of a total 992 teaching hours per year.

England was the fourth lowest country overall on this indicator. In contrast, at Y5, it was one of the highest, at 188 hours out of 970 (19 per cent). In most of the countries where average achievement was significantly higher than England's, teaching time for mathematics was higher. However, Japan was the exception: teaching time for Y9 mathematics in Japan was lower at 108 hours.

Science

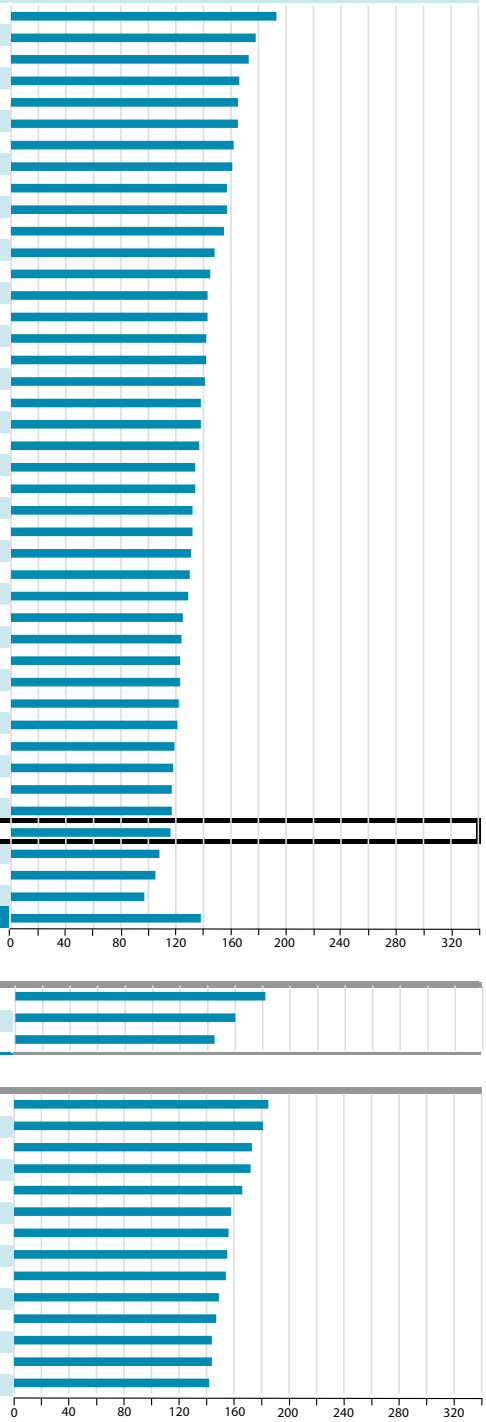
At Y9, England's average achievement score for science was 533, above the centre point of the achievement scale. Average science teaching time for Y9 pupils in England was 102 hours per year, 10 per cent of a total 992 hours (see Table 6.8). This was substantially lower than the international average (158 hours per year). In all of the high performing countries, teaching time for science was higher. For example, in Finland science teaching time was 190 out of 934 hours: around 20 per cent of the total yearly teaching time. However, high teaching time for science was also reported in countries whose average attainment was not significantly different from England's. For example, in the Russian Federation, Hungary and Slovenia, teaching time for Y9 science was even higher than in Finland.

Table 6.8: Teaching Time in Y9

Mathematics

Reported by Principals and Teachers

Country	Total Instructional Hours per Year	Hours per Year for Mathematics Instruction
Chile	r 1245 (23.5)	r 193 (4.5)
Lebanon	r 1028 (12.7)	r 178 (3.9)
Indonesia	r 1494 (40.9)	r 173 (7.9)
Chinese Taipei	1153 (11.7)	166 (2.4)
Israel	r 1108 (14.1)	r 165 (3.0)
Ghana	r 1153 (18.9)	r 165 (6.8)
Qatar	1054 (1.3)	162 (3.6)
Oman	r 1044 (17.7)	r 161 (5.1)
United Arab Emirates	r 1046 (8.0)	r 157 (2.9)
United States	1114 (6.6)	s 157 (3.2)
Italy	1085 (9.4)	155 (2.5)
Morocco	r 1303 (24.9)	r 148 (2.1)
Romania	984 (15.5)	145 (3.7)
Armenia	r 979 (12.8)	r 143 (3.0)
Australia	1039 (7.2)	s 143 (3.5)
Russian Federation	882 (8.7)	142 (2.0)
Bahrain	1019 (1.1)	r 142 (2.5)
New Zealand	959 (4.4)	141 (1.8)
Hong Kong SAR	r 1026 (11.3)	r 138 (2.9)
Singapore	1106 (0.0)	138 (1.7)
Korea, Rep. of	1006 (12.1)	137 (1.8)
Palestinian Nat'l Auth.	918 (7.3)	134 (4.0)
Saudi Arabia	r 1050 (20.9)	r 134 (5.4)
Ukraine	901 (10.7)	132 (3.5)
Lithuania	898 (13.9)	132 (2.7)
Tunisia	r 1299 (25.4)	r 131 (3.0)
Jordan	1041 (11.9)	130 (3.8)
Thailand	r 1270 (15.1)	129 (4.3)
Norway	880 (6.3)	125 (3.4)
Iran, Islamic Rep. of	994 (15.9)	124 (3.3)
Malaysia	r 1198 (13.7)	r 123 (3.4)
Georgia	r 833 (10.8)	r 123 (3.3)
Macedonia, Rep. of	r 1023 (21.4)	s 122 (4.6)
Slovenia	798 (0.0)	121 (1.5)
Hungary	836 (12.2)	119 (1.9)
Syrian Arab Republic	811 (14.2)	r 118 (4.7)
Turkey	889 (16.7)	117 (1.8)
Kazakhstan	920 (9.9)	117 (3.2)
England	r 992 (8.4)	r 116 (2.1)
Japan	1016 (6.7)	108 (1.4)
Finland	934 (11.7)	105 (1.8)
Sweden	r 969 (13.4)	s 97 (2.2)
International Avg.	1031 (2.3)	138 (0.5)
Ninth Grade Participants		
South Africa	r 1193 (11.3)	r 182 (6.7)
Honduras	r 1152 (27.1)	r 160 (5.7)
Botswana	r 1114 (20.1)	r 145 (3.9)
Benchmarking Participants		
North Carolina, US	1159 (16.0)	s 185 (9.7)
Ontario, Canada	r 971 (7.5)	r 181 (3.9)
Colorado, US	1148 (17.0)	r 173 (8.6)
California, US	r 1040 (15.2)	s 172 (8.0)
Alabama, US	r 1135 (16.0)	s 166 (8.9)
Abu Dhabi, UAE	r 1045 (16.6)	r 158 (5.8)
Alberta, Canada	1031 (10.0)	156 (4.2)
Dubai, UAE	r 1022 (1.5)	r 155 (3.6)
Massachusetts, US	1087 (13.6)	r 154 (5.4)
Indiana, US	r 1133 (14.9)	s 149 (6.9)
Quebec, Canada	913 (3.3)	147 (4.1)
Florida, US	r 1119 (17.0)	s 144 (7.4)
Connecticut, US	1071 (19.3)	r 144 (4.4)
Minnesota, US	1043 (14.8)	r 142 (7.5)



( )Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70 but less than 85% of the students. An "s" indicates data are available for at least 50 but less than 70% of the students.

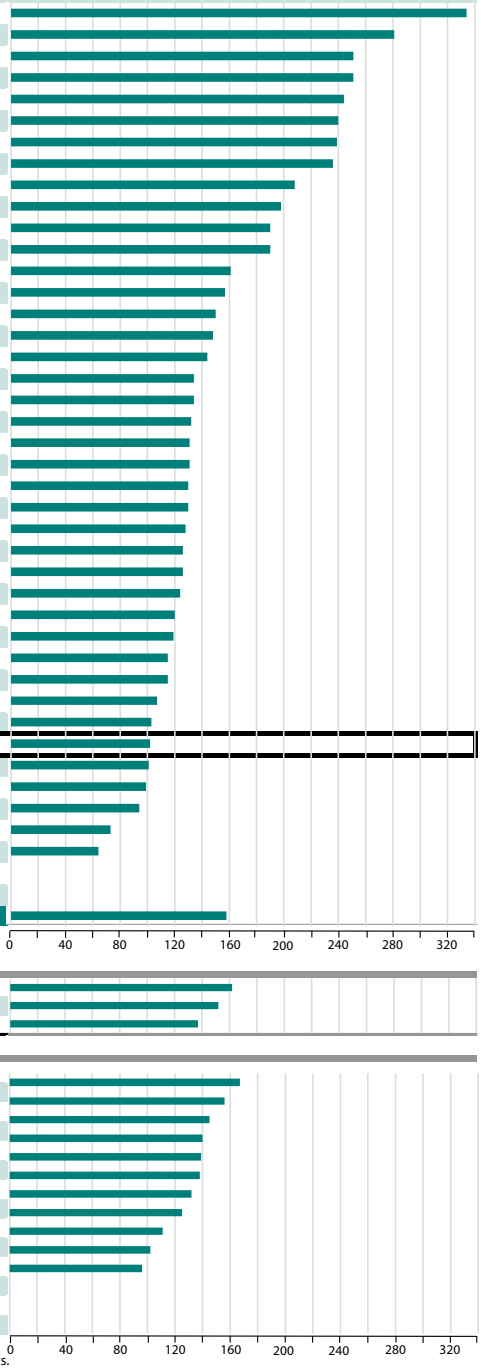
Source: Exhibit 8.7, international mathematics report

Table 6.8 Teaching time in Y9 (continued)

Science

Reported by Principals and Teachers

Country	Total Instructional	Hours per Year for Science Instruction*
Macedonia, Rep. of	r 1023 (21.4)	s 334 (14.7)
Romania	984 (15.5)	281 (10.1)
Lithuania	898 (13.9)	r 251 (5.2)
Slovenia	798 (0.0)	251 (4.6)
Kazakhstan	920 (9.9)	244 (4.8)
Armenia	r 979 (12.8)	s 240 (4.9)
Ukraine	901 (10.7)	239 (4.0)
Hungary	836 (12.2)	236 (4.8)
Russian Federation	882 (8.7)	208 (1.6)
Georgia	r 833 (10.8)	r 198 (6.8)
Finland	934 (11.7)	r 190 (6.0)
Indonesia	r 1494 (40.9)	r 190 (12.2)
Oman	r 1044 (17.7)	s 161 (3.8)
Chinese Taipei	1153 (11.7)	157 (2.7)
Syrian Arab Republic	811 (14.2)	r 150 (7.5)
Ghana	r 1153 (18.9)	r 148 (6.1)
Morocco	r 1303 (24.9)	r 144 (2.0)
Chile	r 1245 (23.5)	r 134 (3.8)
Jordan	1041 (11.9)	134 (3.1)
Israel	r 1108 (14.1)	r 132 (3.9)
Australia	1038 (7.2)	s 131 (4.5)
Qatar	1054 (1.3)	131 (6.9)
New Zealand	959 (4.4)	r 130 (2.6)
Bahrain	1019 (1.1)	r 130 (2.8)
Japan	1016 (6.7)	128 (1.7)
Korea, Rep. of	1006 (12.1)	126 (2.5)
Malaysia	r 1198 (13.7)	126 (3.6)
Saudi Arabia	r 1050 (20.9)	r 124 (6.8)
Iran, Islamic Rep. of	994 (15.9)	120 (3.6)
Thailand	r 1270 (15.1)	119 (2.9)
United Arab Emirates	r 1046 (8.0)	s 115 (2.7)
Singapore	1106 (0.0)	115 (2.1)
Palestinian Nat'l Auth.	918 (7.3)	107 (3.4)
Hong Kong SAR	r 1026 (11.3)	r 103 (4.6)
England	r 992 (8.4)	s 102 (3.1)
Norway	880 (6.3)	101 (3.3)
Turkey	889 (16.7)	99 (1.1)
Sweden	r 969 (13.5)	s 94 (3.1)
Italy	1085 (9.4)	73 (1.0)
Tunisia	r 1299 (25.4)	r 64 (1.9)
Lebanon	r 1028 (12.7)	x x
United States	1114 (6.6)	x x
International Avg.	1031 (2.3)	158 (0.8)
Ninth Grade Participants		
Honduras	r 1152 (27.1)	r 162 (6.9)
South Africa	r 1193 (11.3)	s 152 (5.6)
Botswana	r 1114 (20.2)	r 137 (5.2)
Benchmarking Participants		
Alabama, US	r 1135 (16.3)	s 167 (6.0)
Massachusetts, US	1087 (13.6)	s 156 (6.1)
Alberta, Canada	1031 (10.0)	r 145 (4.0)
Minnesota, US	1043 (14.8)	s 140 (8.3)
Connecticut, US	1071 (19.3)	s 139 (6.2)
Colorado, US	1148 (17.0)	s 138 (6.0)
Indiana, US	r 1132 (14.9)	s 132 (6.5)
Dubai, UAE	r 1022 (1.5)	s 125 (3.6)
Abu Dhabi, UAE	r 1045 (16.6)	s 111 (4.8)
Quebec, Canada	913 (3.3)	r 102 (3.0)
Ontario, Canada	r 972 (7.4)	r 96 (3.5)
California, US	r 1040 (15.1)	x x
Florida, US	r 1119 (17.0)	x x
North Carolina, US	1159 (16.0)	x x



* For countries teaching science as separate subjects, total hours across subjects.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available.
An "r" indicates data are available for at least 70% but less than 85% of the students. An "s" indicates data are available for at least 50% but less than 70% of the students.
An "x" indicates data are available for less than 50% of the students.

Source: Exhibit 8.7, international science report

6.6 Teachers' emphasis on science investigations

Teachers' emphasis on science investigations in Y9 was measured in the same way as described for Y5, using the *Emphasize Science Investigation* scale (see section 6.2). For Y9, an additional question was added to the scale: *use scientific formulas and laws to solve routine problems* (see Table 6.9). England's average scale score was 9.4; within the *Less Than Half the Lessons* category overall.

As Table 6.9 shows, in England, 37 per cent of Y9 pupils were taught by teachers who emphasised science investigations in *About Half the Lessons or More*, lower than the international average (48 per cent). The percentages of pupils in England taught by teachers who emphasised science investigations in *About Half the Lessons or More* appeared to be similar in England at Y5 and Y9. In terms of the difference between age groups, the picture was mixed among countries performing significantly better than England. For example, in Korea, Japan, Chinese Taipei and Singapore, the percentage of pupils taught by teachers who emphasised science investigations in *About Half the Lessons or More* was lower at Y9 than at Y5. However, in Finland, and on average internationally this was higher at Y9 than at Y5.

As for Y5, no clear picture emerged in England relating frequency of emphasis on science investigations to average science achievement. Among pupils in England whose teachers emphasised science investigations in *About Half the Lessons or More*, average achievement appeared to be higher than among the pupils taught by teachers who emphasised science investigations in fewer than half the lessons. However, this difference is unlikely to be statistically significant.[77]

As in section 6.2, since a scale was not used in 2007, comparisons were made between the percentages of pupils whose teachers reported doing the six individual activities that were measured in both surveys. Percentages of pupils whose teachers included each individual activity on the *Emphasize Science Investigation scale in About Half the Lessons or More* were higher in TIMSS 2011 than in TIMSS 2007,[78] apart from *relate what they are learning in science to their everyday lives*, which was slightly lower in 2011 than in 2007.[79]

Table 6.9 Teachers' emphasis on science investigations in Y9

Reported by Teachers

Students were scored according to their teachers' responses to how often they used each of seven instructional activities on the *Emphasize Science Investigation* scale. Students with teachers who emphasized science investigation in **About Half the Lessons or More** had a score on the scale of at least 10.2, which corresponds to their teachers using all seven activities in "about half the lessons," on average. All other students had teachers who emphasized science investigation in **Less than Half the Lessons**.

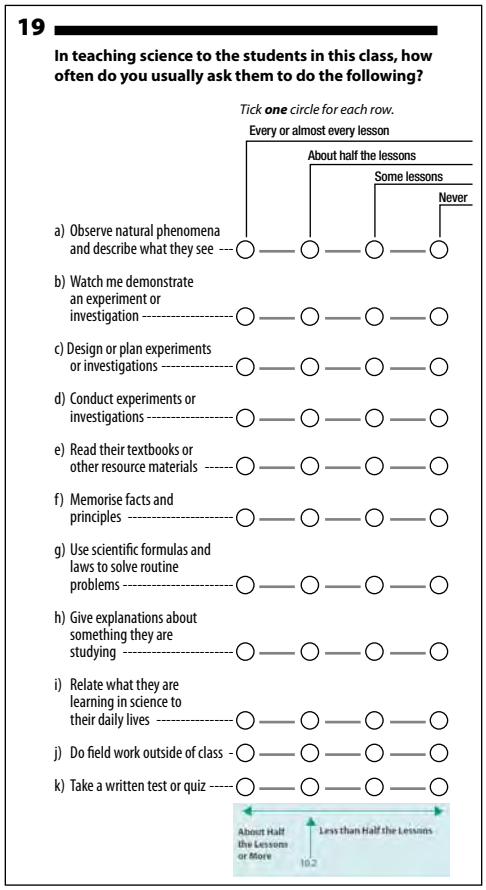
Country	About Half the Lessons or More		Less than Half the Lessons		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England r	37 (2.9)	544 (9.1)	63 (2.9)	525 (6.4)	9.4 (0.12)
International Avg.	48 (0.5)	479 (0.9)	52 (0.5)	474 (0.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.

77 This difference has not been tested formally for statistical significance; this conclusion is drawn from the size of the standard errors relating to the average achievement scores of the two groups of pupils: see Table 6.9.

78 The 2007 data was presented as *Percentage of Students whose teachers reported students doing the activity about half of the lessons or more;* in order to compare the 2011 data to this, the percentages in the response categories *about half the lessons* and *every or almost every lesson* were combined to make percentages for each activity that were directly comparable. In 2007 teachers were also asked about an additional activity, *work together in small groups on experiments or investigations*, whereas this was not included in the 2011 *Emphasize Science Investigation* scale. Percentages were only compared for the six activities reported by teachers in both surveys.

79 Another activity was added to the scale in 2011 for Y9: *use scientific formulas and laws to solve routine problems*. This could not be compared with the 2007 data.



Items e, f, i and j did not contribute to this scale.

Source: Exhibit 8.28, international science report

6.7 Use of computers in Y9 lessons

Mathematics

As shown in Table 6.10, 51 per cent of Y9 pupils in England were taught by teachers who reported that, in their school, computers were available for mathematics lessons, fewer than for Y5. Three of the best performing countries had slightly higher computer availability: Japan, Singapore and Korea. However, this was not the case in all countries performing significantly better than England. For example, in Hong Kong and Chinese Taipei, computer availability for mathematics lessons was just under half that in England. Among the pupils whose teachers said that computers were available during lessons, teachers also reported how frequently pupils did particular computer-based activities. The most frequent activities reported, as was the case at Y5, were *to practice skills and procedures* (38 per cent of pupils had teachers who reported that they did this at least monthly) and *to explore mathematical principles and concepts* (34 per cent of pupils had teachers who reported that they did this at least monthly). The most common activities for which pupils used computers in their mathematics lessons varied across countries.

Science

Table 6.10 shows that 63 per cent of pupils in England were taught by teachers who reported that computers were available for science lessons, fewer than in Y5. Among the highest achieving participants at this age group, generally over half of pupils

were reported to have computers available in their science lessons. In contrast to mathematics lessons, among pupils using computers at least monthly in science lessons, their main use was *to look up ideas and information*, in England and in most countries, as was the case at Y5.

Table 6.10 Computer activities in Y9 lessons

Mathematics

Reported by Teachers

Country	Computers Available for Mathematics Lessons			Per cent of Students Whose Teachers Have Them Use Computers At Least Monthly			
	Per cent of Students	Average Achievement					
	Yes	Yes	No	To Explore Mathematics Principles and Concepts	To Look Up Ideas and Information	To Process and Analyze Data	To Practice Skills and Procedures
England	51 (4.3)	510 (8.5)	501 (7.5)	34 (4.4)	27 (3.9)	24 (4.0)	38 (4.1)
International Avg.	36 (0.5)	470 (1.4)	467 (0.8)	22 (0.5)	23 (0.5)	21 (0.5)	24 (0.5)

Science

Reported by Teachers

Country	Computers Available for Science Lessons			Per cent of Students Whose Teachers Have Them Use Computers At Least Monthly				
	Per cent of Students	Average Achievement						
	Yes	Yes	No	To Look Up Ideas and Information	To Do Scientific Procedures or Experiments	To Study Natural Phenomena Through Simulations	To Process and Analyze Data	To Practice Skills and Procedures
England	r 63 (3.3)	529 (7.6)	538 (5.7)	r 57 (3.1)	r 25 (2.5)	r 37 (2.9)	r 41 (3.2)	r 31 (3.5)
International Avg.	46 (0.5)	481 (1.0)	475 (0.8)	39 (0.5)	28 (0.5)	30 (0.5)	31 (0.5)	33 (0.5)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Source: Exhibit 8.30, International mathematics and science reports

6.8 The Year 9 curriculum

6.8.1 The intended curriculum

As noted for Y5, National Research Coordinators (NRCs), or their designated contacts, were asked to indicate whether each of the TIMSS 2011 mathematics and science topics (listed below Table 6.11 for mathematics, and below Table 6.12 for science) was included in their countries' intended curriculum for pupils aged 13–14, and, if so, whether the topics were intended to be taught to *all* or *almost all pupils or only the more able pupils* by the end of Y9.[80]

Mathematics

As Table 6.11 shows, in England 18 of 19 TIMSS mathematics topics were intended to be taught to all Y9 pupils. The only exception was *Simultaneous (two variables) equations* (within Algebra), which was intended to be taught only to more able pupils (see the box below Table 6.11 for a full list of mathematics topics). Most of the countries with significantly higher average achievement than England included a similar number of topics in their intended curricula, although this was slightly lower in Chinese Taipei, and higher in Japan, Korea and the Russian Federation, where all 19 topics were included. In Chinese Taipei and Singapore, several Geometry and Data and Chance topics were not included. Among participants whose average score was not significantly different from England's (for example Australia, Hungary and Italy), it was typically Algebra topics that were not intended to be taught.

Table 6.11 Number of TIMSS mathematics topics intended to be taught by the end of Y9

Reported by National Research Coordinators

Country	All Mathematics (19 Topics)			Number (5 Topics)			Algebra (5 Topics)		
	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 8	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 8	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 8
England	18	1	0	5	0	0	4	1	0
International Avg.	16	1	2	5	0	0	4	0	1

Country	Geometry (6 Topics)			Data and Chance (3 Topics)		
	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 8	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 8
England	6	0	0	3	0	0
International Avg.	5	0	1	2	0	0

Because of rounding some results may appear inconsistent

80 NRCs were asked: "According to the national mathematics/science curriculum, what proportion of grade 8 students should have been taught each of the following topics or skills by the end of grade 8?" For countries with no national curriculum, NRCs were advised to "summarize for your state or provincial curricula".

TIMSS 2011 Mathematics Topics

A. Number

1) Computing, estimate, or approximating with whole numbers
2) Concepts of fractions and computing with fractions
3) Concepts of decimals and computing with decimals
4) Representing, comparing, ordering, and computing with integers
5) Problem solving involving percents and proportions

B. Algebra

1) Numeric, algebraic, and geometric patterns or sequences
2) Simplifying and evaluating algebraic expressions
3) Simple linear equations and inequations
4) Simultaneous (two variables) equations
5) Representation of functions as ordered pairs, tables, graphs, words, or equations

C.Data Display

1) Geometric properties of angles and geometric shapes
2) Congruent figures and similar triangles
3) Relationship between three-dimentional shapes and their two-dimentional representations
4) Using appropriate measurement formulas for perimeters, circumferences, areas, surface, and volumes
5) Point on the Cartesian plane
6) Translation, reflection, and rotation

D.Data and Chance

1) Reading and displaying data using tables, pictographs, bar graphs, pie charts, and line graphs
2) Interpreting data sets
3) Judging, predicting, and determining the chance of possible outcomes

Source: Exhibit 8.11, international mathematics report

Science

Table 6.12 shows that, in England, 19 out of 20 TIMSS science topics were intended to be taught to all Y9 pupils (see the box below Table 6.12 for the full list of science topics). The one topic not included was *Reasons for increase in world's human population (e.g., advances in medicine, sanitation), and the effects of population growth on the environment* (within Biology). For most participants, much of the science content assessed by TIMSS was included in their intended curricula. Across all participants, there were very few topics that were taught only to more able pupils. Korea was an exception to this, with a quarter of the topics taught only to more able pupils. Among the countries whose average achievement was significantly higher than England's, topics not covered in the curriculum were often within the domain of Biology and at least one other domain, which varied.

Table 6.12 Number of TIMSS science topics intended to be taught by the end of Y9

Reported by National Research Coordinators

Country	All Science (20 Topics)			Biology (7 Topics)			Chemistry (4 Topics)		
	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 8	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 8	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 8
England	19	0	1	6	0	1	4	0	0
International Avg.	17	1	3	6	0	1	3	0	1

Country	Physics (5 Topics)			Earth Science (4 Topics)		
	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 8	Topics Taught to All or Almost All Students	Topics Taught to Only the More Able Students (Top Track)	Not Included in the Curriculum Through Grade 8
England	5	0	0	4	0	0
International Avg.	4	0	1	4	0	0

Because of rounding some results may appear inconsistent

TIMSS 2011 Science Topics

A. Biology

1) Major organs and organ systems in humans and other organisms (structure/function, life processes that maintain stable bodily conditions)
2) Cells anf their functions, including respiration and photosynthesis as cellular processes
3) Reproduction (sexual and asexual) and heredity (passing on of traits, inherited versus acquired/learned characteristics)
4) Role of variation and adaptation in survivial/extinction of species in a changing environment
5) Independance of populations of organisms in an ecosystem (e.g., energy flow, foodwebs, competition, predation) and the impact of changes in the physical environment on populations (e.g., climate, water supply)
6) Reasons for increase in world's human population (e.g., advances in medicin, sanitation), and the importance of diet and exercise in maintaining health

B. Chemistry

1) Classification, composition, and particulate structure of matter (elements, compounds, mixtures, molecules, atoms, protons, neutrons, electrons)
2) Solutions (solvent, solute, concentration/dilution, effect of temperature on solubility)
3) Properties and uses of common acids and bases
4) Chemical change (transformation of reactants, evidence of chemical change, conservation of matter, common oxidation reactions - combustion, rusting, tarnishing)

C.Physics

1) Physical states and changes in matter (explanation of properties in terms if movement and distance between particles; phase change, thermal expansion, and changes in volume and/or pressure)
2) Energy forms, tranformations, heat, and temperature
3) Basic properties/behaviors of light (reflection, refraction, light and color, simple ray diagrams) and sound (transmission through media, loudness, pitch, amplitude, frequency, relative speed of light and sound)
4) Electrical circuits (flow of current; types of circuits - parallel/series; current/voltage relationship) and properties and uses of permanent magnets and electromagnets
5) Forces and motion (types od forces, basic description of motion, effects of density and pressure)

D. Earth Science

1) Earth's structure and physical features (Earth's crust, mantle and core; composition and relative distribution of water, and composition of air)
2) Earth's processes, cycles, and history (rock cycle; water cycle; weather patterns; major geological events; formation of fossils and fossil fuels)
3) Earth's resources, their uses and conservation (e.g., renewable/nonrenewable resources, human use of land/soil, water resources)
4) Earth in the solar system and the universe (phenomena on Earth - day/night, tides, phases of moon, eclipses, seasons; physical features of Earth compared to other bodies; the Sun as a star)

Source: Exhibit 8.11, international science report

6.8.2 Percentage of Y9 pupils taught the TIMSS topics

As for Y5, teachers were asked to indicate, for their class, whether each of the TIMSS topics was *mostly taught this year, not yet taught* or *just introduced*, for each subject. The percentages reported in Table 6.13 represent the proportion of pupils taught by teachers who reported that topics were mostly taught before or in the assessment year, averaged across topics, overall and by content domain.

Mathematics

In England, according to teachers' reports, 84 per cent of pupils were taught the TIMSS mathematics topics either before or during the year of the assessment (see Table 6.13). This is lower than the equivalent percentage at Y5 (91 per cent). England's percentage was lower than some of the countries performing significantly better than England at this age group, including Japan, Korea and Singapore. Across all countries, the most commonly taught content domain was Number, and in most of the highest performing countries, 99 or 100 per cent of pupils were taught these topics.

There were marked differences in the topics taught in Y9 mathematics between England and some of the higher performing countries. This was particularly the case in Chinese Taipei where, for example, 97 per cent of pupils were taught the TIMSS Algebra topics, compared with 77 per cent in England. Conversely, whereas 86 per cent of pupils in England were taught the Data and Chance topics, the comparable figure was 4 per cent in Chinese Taipei.

Science

In England, according to teachers' reports, 87 per cent of pupils were taught the TIMSS science topics (see Table 6.13). This is higher than the equivalent percentage at Y5 (71 per cent). The most commonly taught domain was Chemistry. England's percentage was higher than in all the countries that performed significantly better, as well as in Slovenia and Hong Kong (which performed at a similar level). Among the participants that performed significantly better than England there was variation in the most commonly taught science domain. For example, in Singapore and Korea, Physics was most commonly taught, whereas in Finland, Japan and Chinese Taipei it was Chemistry and in Alberta, Minnesota and Massachusetts, it was Earth Science.

Table 6.13 Percentage of Y9 pupils taught the TIMSS topics*

Mathematics

Reported by Teachers

Country	All Mathematics (19 Topics)	Number (5 Topics)	Algebra (5 Topics)	Geometry (6 Topics)	Data and Chance (3 Topics)
England	84 (1.3)	97 (0.7)	77 (1.8)	78 (2.0)	86 (2.1)
International Avg.	80 (0.1)	98 (0.1)	75 (0.2)	75 (0.2)	66 (0.3)

* Percentage mostly taught before or in the assessment year averaged across topics.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Science

Reported by Teachers

Country	All Science Topics (20 Topics)	Biology (7 Topics)	Chemistry (4 Topics)	Physics (5 Topics)	Earth Science (4 Topics)
England	r 87 (1.3)	r 86 (1.5)	r 91 (1.7)	r 89 (1.9)	r 83 (2.0)
International Avg.	72 (0.2)	68 (0.2)	81 (0.3)	75 (0.2)	68 (0.3)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Source: Exhibit 8.9, international mathematics and science reports

Chapter 7 The school teaching environment

Chapter outline

This chapter presents findings relating to teaching and the school environment, as reported by teachers and headteachers. The chapter firstly explores several factors related to teaching and teaching practices including: teacher training, how prepared teachers feel to teach mathematics and science, levels of career satisfaction, and the extent to which teachers collaborated in order to improve their teaching practice. The next section focuses on the school environment in terms of: the emphasis that schools placed on academic success; whether schools were perceived to be safe and orderly; discipline within the school; the impact of disruptive and uninterested pupils on teaching; and whether pupils had experienced bullying behaviours. Where relevant, England's findings for these teacher- and school-level variables are compared with those of other countries. In addition, where informative, these findings are presented alongside the average achievement in England and other participating countries.

In this chapter, themes that are common across subjects are reported together: all findings relating to Year 5 (Y5) pupils (aged 9 –10) are discussed first, followed by those for Year 9 (Y9) pupils (aged 13 – 14). Where there are differences in the findings for mathematics and science these are highlighted.

Key findings: teaching

- In England, almost two-thirds of Y5 pupils were taught by teachers who did not specialise in mathematics during their training. However, the vast majority of Y5 pupils were taught by teachers who feel *very well prepared* to teach the TIMSS mathematics topics.
- Fewer Y5 pupils, approximately a third, were taught by teachers who specialised in science during their training. Compared to Y5 mathematics, a smaller percentage of pupils, just over two-thirds, had teachers who feel *very well prepared* to teach the TIMSS science topics.
- In contrast to the findings for Y5, three-quarters of Y9 pupils were taught by teachers who specialised in mathematics during their training. As with Y5, almost all Y9 pupils were taught by teachers who feel *very well prepared* to teach the TIMSS mathematics topics.
- Compared with mathematics, more Y9 pupils were taught science by a science specialist. However, fewer pupils than for mathematics had teachers who feel very well prepared to teach the science TIMSS topics.
- Across participating countries, the science content domain that fewest teachers feel prepared to teach is Earth Science. In England, only 70 per cent of pupils were taught by teachers who feel *very well prepared* to teach this content domain (perhaps because some elements of Earth Science are taught through the geography curriculum in England).
- Teacher career satisfaction in England was similar to or higher than in the highest achieving countries. However, higher levels of career satisfaction did not appear to be associated with increased pupil achievement.

- More collaborative teaching practices were reported in primary schools compared with secondary schools. Nearly half of Y5 pupils were taught by teachers who had very collaborative teaching practices, whereas the equivalent proportion for Y9 pupils was approximately a quarter.

Key findings: school environment

- In England, headteachers' and teachers' reports indicated a higher emphasis on academic success compared with other participating countries. This was found at both primary and secondary level for both subjects.
- In England, there was a positive association between average achievement in Y5 mathematics and science and attending a school perceived to be safe and orderly. This relationship was not seen for Y9 mathematics and science.
- Most Y5 pupils attended schools where there were hardly any perceived discipline or safety issues. This was not so for Y9 pupils: fewer than a fifth of Y9 pupils were in schools perceived to have *Hardly Any* discipline or safety issues.
- For both subjects at Y5, there was a difference in the average achievement scores between pupils whose teachers reported that their ability to teach is limited *a lot* (by disruptive or uninterested pupils) and those who reported that their teaching is limited to *some extent* or *not at all*. These differences are likely to be significant.[81] The same only applied to mathematics at Y9.
- Sizeable proportions of pupils (just under half at Y5 and just over two thirds at Y9) reported that they *almost never* experienced bullying behaviours. However, 20 per cent of Y5 pupils in England reported that they experienced some form of bullying behaviour *about weekly*, corresponding to the international average.

81 Throughout this report, the term 'significant' refers to statistical significance.

Interpreting the data: scaled data from teachers and headteachers

Most of the data presented in this chapter is reported by teachers and headteachers. Reported percentages refer to pupils and can usually (unless otherwise indicated) be interpreted as the percentage of pupils whose teacher or headteacher reported a particular practice or gave a particular response to a questionnaire item.

When interpreting the data from pupils, headteachers and teachers it is important to take account of the relative sample sizes. Participants are expected to sample a minimum of 150 schools in each year group and a minimum of 4,000 students for each target year group (these figures represent the numbers *drawn* in the sample; the *achieved* sample numbers may be less). The achieved ranges for participating schools internationally were 96 to 459 for Y5, and 95 to 501 for Y9.[82] These wide ranges reflected the fact that some participants had fewer than 150 schools available and some participants chose to over-sample schools. Just over half of participants sampled between 150 and 200 schools for each age group.

For TIMSS 2011 in England, the number of participating schools was 125 at Y5 and 118 at Y9. Numbers of participants within these schools were:

- 3,397 Y5 and 3,482 Y9 pupils.
- 125 and 118 headteachers respectively answered the Y5 and Y9 School Questionnaire.
- 194 Y5 class teachers completed a Teacher Questionnaire for mathematics and 199 for science.
- 213 Y9 teachers completed the Mathematics Teacher Questionnaire.
- 757 Y9 teachers completed the Science Teacher Questionnaire (the number of science teachers was greater as the Y9 pupils were sampled by mathematics class).

See Appendix A for more information about numbers of participants and sampling method.

7.1 Year 5 (Y5)

7.1.1 Teachers' major area of study during training

In order to establish the percentage of pupils taught by subject specialists, teachers were asked to indicate their main area of study and whether they had specialised in any specific subjects during their post-secondary education (the findings for teachers in England are shown in Table 7.1). In this context a 'subject specialist' is likely to have an academic qualification in the subject taught, whereas a teacher who has studied mathematics or science education may have studied the pedagogy of mathematics or science but may not have an academic qualification in the subject. It is important to recognise that this section reports the percentages of the pupils *taught* by teachers who undertook specific forms of post-secondary education (*not the percentages of teachers* who undertook specific forms of post-secondary education).

82 These figures refer to countries and exclude benchmarking participants.

Table 7.1 Teachers' major area of study during training

Mathematics

Reported by Teachers

Country	Major in Primary Education and Major (or Specialization) in Mathematics		Major in Primary Education but No Major (or Specialization) in Mathematics		Major in Mathematics but No Major in Primary Education		All Other Majors		No Formal Education Beyond Upper-secondary*	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	17 (3.1)	539 (8.5)	65 (4.1)	546 (5.4)	2 (0.5)	~ ~	17 (3.2)	538 (7.8)	0 (0.0)	~ ~
International Avg.	28 (0.5)	490 (1.4)	46 (0.4)	501 (1.0)	10 (0.3)	457 (3.1)	10 (0.3)	486 (2.0)	6 (0.2)	444 (3.0)

*Countries have been increasing their certification requirements and providing professional development to teachers certified under earlier guidelines.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.

Science

Reported by Teachers

Country	Major in Primary Education and Major (or Specialization) in Science		Major in Primary Education but No Major (or Specialization) in Science		Major in Science but No Major in Primary Education		All Other Majors		No Formal Education Beyond Upper-secondary*	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	25 (3.9)	534 (7.6)	50 (4.3)	526 (4.3)	7 (2.1)	555 (17.9)	17 (3.0)	520 (10.9)	1 (1.2)	~ ~
International Avg.	25 (0.4)	482 (1.5)	48 (0.4)	489 (1.3)	12 (0.3)	462 (2.4)	10 (0.3)	479 (1.9)	6 (0.2)	433 (2.9)

*Countries have been increasing their certification requirements and providing professional development to teachers certified under earlier guidelines.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.

Source: Exhibit 7.3, international mathematics and science reports

Mathematics

In England, the majority of pupils in Y5 (65 per cent) were taught mathematics by teachers whose main area of study was primary education without specialisation in mathematics. Only 17 per cent of Y5 pupils were taught mathematics by teachers who were mathematics specialists. However, in Hong Kong, Singapore and Chinese Taipei (countries with significantly higher average achievement than England), a much larger percentage of pupils aged 9-10 were taught by mathematics specialists (66 per cent, 65 per cent and 36 per cent respectively). Notably, there were some high performing countries, namely Northern Ireland and Korea, where a smaller percentage of pupils (10 per cent in each case) were taught by mathematics specialists. There was not a clear pattern within individual countries, or on average, between being taught by a subject specialist and average achievement. This was the case in both the highest performing countries such as Singapore and countries that performed similarly to England.

Science

In England, half of pupils in Y5 were taught science by teachers whose main area of study was primary education (without specialisation in science). Nearly a third of pupils (32 per cent) were taught science by teachers who were science specialists (7 per cent of these were taught by teachers with a specialism in science but not primary education). As was the case for mathematics, there were some high performing countries, including United States and Korea, where a smaller percentage of pupils

(less than 15 per cent) were taught by a subject specialist. However, in Singapore, Russian Federation and Chinese Taipei (also countries with a significantly higher average achievement score than England) a much larger percentage of pupils aged 9-10 were taught science by science specialists (58 per cent, 57 per cent and 49 per cent respectively). As was the case for mathematics at this level, there was not a clear association within individual countries between teacher specialisation during training and the average achievement in science at this level.

7.1.2 Teachers' reports of how well prepared they feel to teach mathematics and science

Teachers were also asked how prepared they feel to teach the mathematics and science content topics assessed by TIMSS (the content topics are listed in Table 7.2). For each topic, teachers had to indicate whether they feel *very well prepared, somewhat prepared* or *not well prepared*.

Table 7.2 Teachers feel "very well" prepared to teach

TIMSS mathematics topics

Reported by Teachers

Country	Per cent of Students Whose Teachers Feel "Very Well" Prepared to Teach TIMSS Mathematics Topics			
	Overall Mathematics (18 Topics)	Number (8 Topics)	Geometric Shapes and Measures (7 Topics)	Data Display (3 Topics)
England	90 (1.5)	91 (1.6)	89 (1.9)	93 (1.8)
International Avg.	83 (0.3)	87 (0.3)	82 (0.3)	74 (0.4)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

TIMSS science topics

Reported by Teachers

Country	Per cent of Students Whose Teachers Feel "Very Well" Prepared to Teach TIMSS Science Topics			
	Overall Science (20 Topics)	Life Science (6 Topics)	Physical Science (8 Topics)	Earth Science (6 Topics)
England	69 (2.4)	71 (3.1)	77 (2.9)	57 (2.9)
International Avg.	62 (0.3)	70 (0.4)	62 (0.4)	53 (0.4)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

M12

How well prepared do you feel you are to teach the following mathematics topics?
If a topic is not in the Year 5 curriculum or you are not responsible for teaching this topic, you may tick "Not applicable."

*Tick **one** circle for each row.*

	Not applicable	Very well prepared	Somewhat prepared	Not well prepared
A. Number				
a) Concepts of whole numbers, including place value and ordering	○	○	○	○
b) Adding, subtracting, multiplying and/or dividing with whole numbers	○	○	○	○
c) Concepts of fractions (fractions as parts of a whole or of a collection, or as a location on a number line; comparing and ordering fractions)	○	○	○	○
d) Adding and subtracting with fractions	○	○	○	○
e) Concepts of decimals, including place value and ordering	○	○	○	○
f) Adding and subtracting with decimals	○	○	○	○
g) Number sentences (finding the missing number, modelling simple situations with number sentences)	○	○	○	○
h) Number patterns (extending number patterns and finding missing terms)	○	○	○	○
B. Geometric Shapes and Measures				
a) Lines: measuring, estimating length of; parallel and perpendicular lines	○	○	○	○
b) Comparing and drawing angles	○	○	○	○
c) Using informal coordinate systems to locate points in a plane (e.g. in square B4)	○	○	○	○
d) Elementary properties of common geometric shapes	○	○	○	○
e) Reflections and rotations	○	○	○	○
f) Relationships between two-dimensional and three-dimensional shapes	○	○	○	○
g) Finding and estimating areas, perimeters, and volumes	○	○	○	○
C. Data Display				
a) Reading data from tables, pictographs, bar graphs, or pie charts	○	○	○	○
b) Drawing conclusions from data displays	○	○	○	○
c) Displaying data using tables, pictographs, and bar graphs	○	○	○	○

S11

How well prepared do you feel you are to teach the following science topics?
If a topic is not in the Year 5 curriculum or you are not responsible for teaching this topic, you may tick "Not applicable."

*Tick **one** circle for each row.*

	Not applicable	Very well prepared	Somewhat prepared	Not well prepared
A. Life Science				
a) Major body structures and their functions in humans and other organisms (plants and animals)	○	○	○	○
b) Life cycles and reproduction in plants and animals	○	○	○	○
c) Physical features, behaviour, and survival of organisms living in different environments	○	○	○	○
d) Relationships in a given community (e.g. simple food chains, predator-prey relationships)	○	○	○	○
e) Changes in environments (effects of human activity, pollution and its prevention)	○	○	○	○
f) Human health (e.g. transmission/prevention of communicable diseases, signs of health/illness, diet, exercise)	○	○	○	○
B. Physical Science				
a) States of matter (solids, liquids, gases) and differences in their physical properties (shape, volume), including changes in state of matter by heating and cooling	○	○	○	○
b) Classification of objects/materials based on physical properties (e.g. weight/mass, volume, magnetic attraction)	○	○	○	○
c) Forming and separating mixtures	○	○	○	○
d) Familiar changes in materials (e.g. decaying, burning, rusting, cooking)	○	○	○	○
e) Common energy sources/forms and their practical uses (e.g. the Sun, electricity, water, wind)	○	○	○	○
f) Light (e.g. sources, behaviour)	○	○	○	○
g) Electrical circuits and properties of magnets	○	○	○	○
h) Forces that cause objects to move (e.g. gravity, push/pull forces)	○	○	○	○
C. Earth Science				
a) Water on Earth (location, types, and movement) and air (composition, proof of its existence, uses)	○	○	○	○
b) Common features of Earth's landscape (e.g. mountains, plains, rivers, deserts) and relationship to human use (e.g. farming, irrigation, land development)	○	○	○	○
c) Weather conditions from day to day or over the seasons	○	○	○	○
d) Fossils of animals and plants (age, location, formation)	○	○	○	○
e) Earth's solar system (planets, Sun, moon)	○	○	○	○
f) Day, night, and shadows due to Earth's rotation and its relationship to the Sun	○	○	○	○

Source: Exhibit 7.9 mathematics and science reports

Teachers' responses about how well prepared they feel to teach the TIMSS mathematics topics were averaged across all 18 topics to give a perspective on mathematics overall as well as separately by content domain (Number, Geometric Shapes and Measures, and Data Display).

In England, 90 per cent of Y5 pupils were taught by teachers who feel *very well prepared* to teach the TIMSS mathematics topics. This compares favourably with the high performing countries where the percentage of pupils taught by teachers who feel very well prepared was similar to or lower than that in England, for example Northern Ireland (91 per cent), Singapore (89 per cent), Hong Kong (77 per cent) and Korea (73 per cent). In terms of the three mathematics content domains, there was little difference in the percentage of Y5 pupils in England whose teachers feel *very well prepared* to teach the topics within each domain (see Table 7.2). This was not the case in all participating countries. Notably, in a number of the high performing countries (e.g. Singapore, Japan and Korea) a smaller percentage of pupils were taught by teachers who feel *very well prepared* to teach Geometric Shapes and Measures and Data Display compared with Number. This may indicate that there is a greater focus on Number in the curricula of these countries, a conjecture which is borne out by data in chapter 8 of the international mathematics report.[83]

Compared to the mathematics topics, a lower percentage of Y5 pupils in England (69 per cent) were taught by teachers who feel *very well prepared* to teach the TIMSS science topics. However, in terms of the international picture, the percentage of pupils in England who were taught by teachers who feel *very well prepared* to teach the TIMSS science topics was higher than in a number of the highest performing countries, for example: Singapore (58 per cent), Korea (56 per cent) and Finland (51 per cent). As for the three content domains, there were big differences in the percentages of Y5 pupils in England whose teachers feel *well prepared* to teach Earth Science compared with Physical Science and Life Science (see Table 7.2). Across participating countries the domains that teachers feel *very well prepared* to teach varied. This may indicate that within these countries the focus of curricula is different (see Chapter 8 of the international report for science for more information about curricula).

7.1.3 Teachers' reports of collaboration to improve teaching

Teachers were asked how often they had five different types of interactions with other teachers (details of these interactions can be found below in Table 7.3). Their responses were used to create the *Collaborate to Improve Teaching* scale, which categorised the level of collaboration into three bands: *Very Collaborative*, *Collaborative* and *Somewhat Collaborative* (details of how pupils were assigned to each band is provided in Table 7.3). In England, the average scale score for mathematics was 10.5, and for science it was10.3; both scores were within the *Collaborative* category overall.

83 See Exhibit 8.8 in the international mathematics report.

Interpreting the data: indices and scales

In order to summarise data from a questionnaire, responses to several related items are sometimes combined to form an index or scale. The respondents to the questionnaire items are grouped according to their responses and the way in which responses have been categorised is shown for each index or scale. The data in an index or scale is often considered to be more valid and reliable than the responses to individual items.

Table 7.3 Collaborate to improve teaching

Mathematics

Reported by Teachers

Students were scored according to their teachers' responses to how often they interacted with other teachers in each of five teaching areas on the *Collaborate to Improve Teaching* scale. Students with **Very Collaborative** teachers had a score on the scale of at least 11.0, which corresponds to their teachers having interactions with other teachers at least "one to three times per week" in each of three of the five areas and "two or three times per month" in each of the other two, on average. Students with **Somewhat Collaborative** teachers had a score no higher than 7.3, which corresponds to their teachers interacting with other teachers "never or almost never" in each of three of the five areas and "two or three times per month" in each of the other two, on average. All other students had **Collaborative** teachers.

Country	Very Collaborative		Collaborative		Somewhat Collaborative		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	47 (4.0)	541 (6.0)	44 (4.0)	550 (5.4)	9 (1.9)	538 (13.3)	10.5 (0.14)
International Avg.	36 (0.5)	493 (0.9)	53 (0.5)	491 (0.7)	11 (0.3)	488 (2.0)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

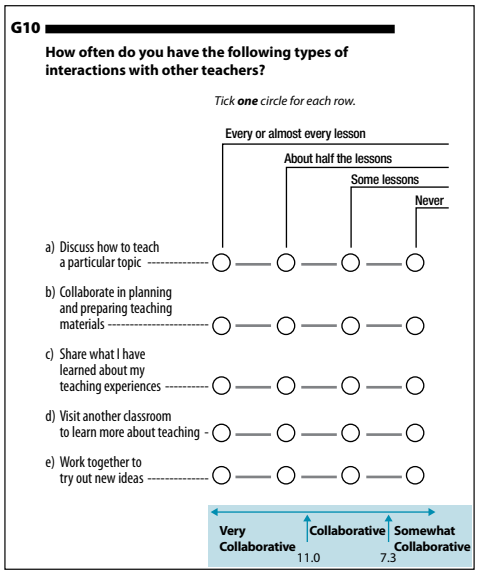
Science

Reported by Teachers

Students were scored according to their teachers' responses to how often they interacted with other teachers in each of five teaching areas on the *Collaborate to Improve Teaching* scale. Students with **Very Collaborative** teachers had a score on the scale of at least 11.0, which corresponds to their teachers having interactions with other teachers at least "one to three times per week" in each of three of the five areas and "two or three times per month" in each of the other two, on average. Students with **Somewhat Collaborative** teachers had a score no higher than 7.3, which corresponds to their teachers interacting with other teachers "never or almost never" in each of three of the five areas and "two or three times per month" in each of the other two, on average. All other students had **Collaborative** teachers.

Country	Very Collaborative		Collaborative		Somewhat Collaborative		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	42 (3.7)	523 (5.8)	47 (3.9)	534 (4.4)	11 (2.0)	537 (13.8)	10.3 (0.14)
International Avg.	35 (0.5)	487 (1.0)	53 (0.5)	487 (0.7)	12 (0.3)	479 (2.1)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Source: Exhibit 8.12, international mathematics and science reports; question adapted from the international version of the TIMSS 2011 Teacher Questionnaire[84]

In England, over 40 per cent of Y5 pupils were taught by teachers who had *Very Collaborative* practice. As shown in Table 7.3, the percentage for science was slightly lower than the equivalent percentage for mathematics for this age group (42 per cent and 47 per cent respectively). The majority of participants with similar average achievement to England, for mathematics and/or science, had a lower percentage of pupils taught by teachers whose practice was categorised as *Very Collaborative*. A number of countries, with significantly better performance than England at this level, also had a smaller percentage of pupils taught by teachers whose practice was in the *Very Collaborative* category. For example, in Northern Ireland only 22 per cent of pupils were taught mathematics by teachers whose practice was *Very Collaborative* and in Finland only 25 per cent of pupils had science teachers whose practice was *Very Collaborative*. However, there was not a clear association between average achievement scores for pupils in mathematics and science and the extent to which teachers reported collaboration with colleagues. The average achievement scores (both in England and internationally) were similar whether teachers' practice was categorised as *Very Collaborative*, *Collaborative* or *Somewhat Collaborative*.[85]

7.1.4 Teachers' reported career satisfaction

Teachers were asked about the degree to which they agreed with six statements about their career as a teacher (these statements can be found in Table 7.4). Their responses were used to create the *Teacher Career Satisfaction* scale, which has three bands: pupils taught by teachers who were *Satisfied*, *Somewhat Satisfied* and *Less Than Satisfied* (details of how pupils were assigned to each band is provided in Table 7.4). It is important to recognise that this section does not report the percentage of teachers who were *Satisfied, Somewhat Satisfied* and *Less Than Satisfied* with their careers. It reports the percentage of pupils taught by teachers who were *Satisfied*, *Somewhat Satisfied* and *Less Than Satisfied* with their careers.

84 http://timssandpirls.bc.edu/timss2011/index.html

85 Tests of statistical significance were not carried out in this international analysis. Based on the size of the standard errors, it is likely that most of the apparent differences are not statistically significant.

In England, the average scale score was 9.9 for both mathematics and science, placing England in the *Somewhat Satisfied* category of the scale overall. As this is a new scale for TIMSS 2011 there is no trend data available.

Table 7.4 Teacher career satisfaction

Mathematics

Reported by Teachers

Students were scored according to their teachers' degree of agreement with six statements on the *Teacher Career Satisfaction* scale. Students with **Satisfied** teachers had a score on the scale of at least 10.1, which corresponds to their teachers "agreeing a lot" with three of the six statements and "agreeing a little" with the other three, on average. Students with **Less Than Satisfied** teachers had a score no higher than 6.6, which corresponds to their teachers "disagreeing a little" with three of the six statements and "agreeing a little" with the other three, on average. All other students had **Somewhat Satisfied** teachers.

Country	Satisfied		Somewhat Satisfied		Less Than Satisfied		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	53 (3.9)	549 (4.8)	36 (3.6)	543 (7.0)	11 (2.8)	527 (12.6)	9.9 (0.19)
International Avg.	54 (0.5)	494 (0.7)	41 (0.5)	487 (0.8)	5 (0.2)	486 (2.1)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

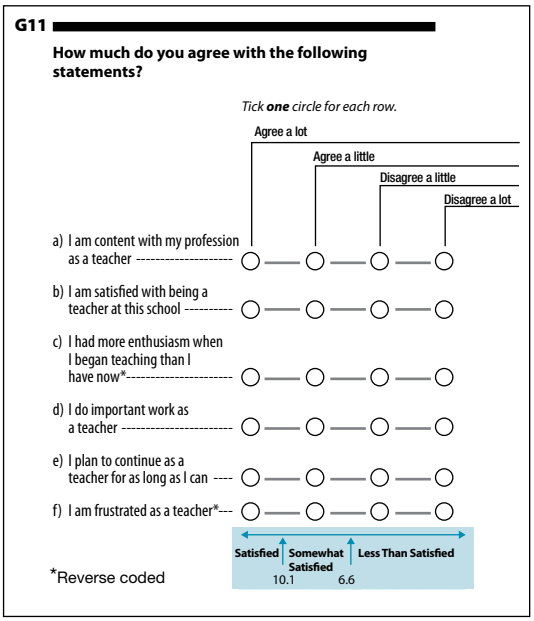
Science

Reported by Teachers

Students were scored according to their teachers' degree of agreement with six statements on the *Teacher Career Satisfaction* scale. Students with **Satisfied** teachers had a score on the scale of at least 10.1, which corresponds to their teachers "agreeing a lot" with three of the six statements and "agreeing a little" with the other three, on average. Students with **Less Than Satisfied** teachers had a score no higher than 6.6, which corresponds to their teachers "disagreeing a little" with three of the six statements and "agreeing a little" with the other three, on average. All other students had **Somewhat Satisfied** teachers.

Country	Satisfied		Somewhat Satisfied		Less Than Satisfied		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	52 (3.9)	534 (4.3)	37 (3.8)	531 (7.1)	11 (2.7)	507 (8.9)	9.9 (0.18)
International Avg.	54 (0.5)	490 (0.7)	41 (0.5)	483 (0.9)	5 (0.2)	483 (2.1)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Source: Exhibit 7.15, international mathematics and science report; question adapted from the international version of the TIMSS 2011 Teacher Questionnaire [86]

86 http://timssandpirls.bc.edu/timss2011/index.html

Just over half of Y5 pupils in England (53 per cent for mathematics and 52 per cent for science) were taught by teachers who reported being *Satisfied* with their careers. This was very similar to the percentage in Northern Ireland (56 per cent for mathematics and 55 per cent for science). Teacher career satisfaction in the five high performing Pacific Rim countries was lower than in England for both subjects. For example, the percentage of pupils in Singapore taught by teachers who reported being *Satisfied* with their careers was 29 per cent for mathematics and 32 per cent for science. However, there were a number of countries with average achievement in the subjects similar to England's, where a greater percentage of pupils were taught by teachers who were *Satisfied* with their careers. Notably, in Denmark only 3 per cent of pupils were taught by teachers who were *Less Than Satisfied* (this was the case for mathematics and science).

Across TIMSS participants on average, mathematics and science achievement for pupils aged 9 – 10 years appeared to be slightly higher for those pupils taught by a teacher who reported being *Satisfied* with their career. In England, however, this did not appear to apply. Although the score differences for both subjects have not been tested for statistical significance, the size of the standard errors is likely to mean that the differences are not statistically significant across the three categories.

7.1.5 Schools' emphasis on academic success

Headteachers and teachers were asked separately to rate the emphasis placed on academic success within their school, based on their perceptions of the attitudes of teachers, parents and pupils. Emphasis on academic success was measured by responses to five statements about teachers' understanding of the school's goals, parent support and pupil expectations (the statements can be seen below Table 7.5). The international analysis used the responses to these statements to create the *School Emphasis on Academic Success* scale for each group of respondents. Pupils were categorised into three bands according to their teachers' and headteachers' responses: *Very High Emphasis, High Emphasis* and *Medium Emphasis* (details of how pupils were assigned to each band is provided in Table 7.5). In England, the average scale score for headteachers was 10.8 for both subjects, and for teachers it was 11.1; both scores were within the *High Emphasis* category.

It should be noted that the data provided for this scale comes from the school and teacher questionnaires and is therefore based on headteacher and teacher perceptions of the emphasis on academic success within the school. The majority of the questions were not subject specific and therefore the overall proportions were broadly the same for mathematics and science. Differences in achievement scores, however, were subject specific and have been reported separately. Table 7.5 reports the findings from headteachers' and teachers' perspectives.

Table 7.5 School emphasis on academic success – headteacher and teacher reports

Mathematics

Reported by Principals/teachers

Students were scored according to their principals'/teachers' responses characterising five aspects on the *School Emphasis on Academic Success* scale. Students in schools where their principals/teachers reported a **Very High Emphasis** on academic success had a score on the scale of at least 13.1, which corresponds to their principals/teachers characterising three of the five aspects as "very high" and the other two as "high," on average. Students in schools with a **Medium Emphasis** on academic success had a score no higher than 8.9, which corresponds to their principals/teachers characterising three of the five aspects as "medium" and the other two as "high," on average. All other students attended schools with a **High Emphasis** on academic success.

Country		Very High Emphasis						Average Scale Score
		Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	*Principals*	10 (2.9)	554 (6.0)	72 (4.7)	546 (4.9)	17 (3.8)	517 (9.9)	10.8 (0.18)
	Teachers	16 (3.0)	563 (7.5)	67 (4.5)	546 (4.7)	17 (3.4)	522 (9.0)	11.1 (0.16)
International Avg.	*Principals*	8 (0.3)	511 (2.2)	58 (0.5)	496 (0.7)	34 (0.5)	477 (0.9)	
	Teachers	7 (0.3)	503 (3.3)	60 (0.5)	496 (0.7)	33 (0.5)	477 (0.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

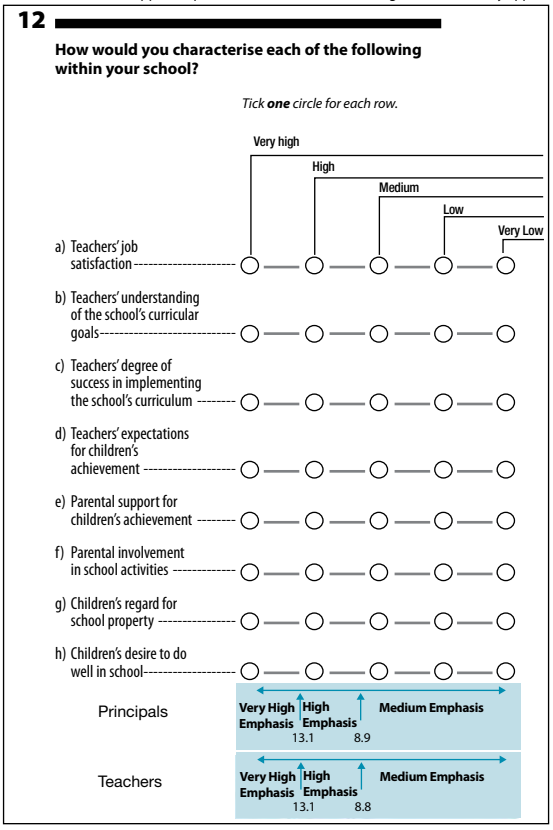
Science

Reported by Principals/teachers

Students were scored according to their principals'/teachers' responses characterizing five aspects on the *School Emphasis on Academic Success* scale. Students in schools where their principals/teachers reported a **Very High Emphasis** on academic success had a score on the scale of at least 13.1, which corresponds to their principals characterizing three of the five aspects as "very high" and the other two as "high," on average. Students in schools with a **Medium Emphasis** on academic success had a score no higher than 8.9 (principals)/ 8.8 (teachers), which corresponds to their principals/teachers characterizing three of the five aspects as "medium" and the other two as "high," on average. All other students attended schools with a **High Emphasis** on academic success.

Country		Very High Emphasis		High Emphasis		Medium Emphasis		Average Scale Score
		Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	*Principals*	10 (2.9)	539 (7.0)	72 (4.7)	531 (4.3)	17 (3.8)	508 (8.5)	10.8 (0.18)
	Teachers	17 (2.9)	554 (8.0)	67 (4.4)	529 (4.1)	16 (3.4)	504 (7.6)	11.1 (0.14)
International Avg.	*Principals*	8 (0.3)	508 (2.3)	58 (0.5)	492 (0.7)	34 (0.5)	471 (1.0)	
	Teachers	8 (0.3)	499 (2.2)	60 (0.5)	492 (0.7)	33 (0.5)	472 (1.0)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Items a,f and g did not contribute to this scale.

Source: Exhibit 6.1 and 6.3, international mathematics and science reports; question adapted from the international version of the TIMSS 2011 School and Teacher Questionnaires[87]

87 http://timssandpirls.bc.edu/timss2011/index.html

In England, over 80 per cent of Y5 pupils attend schools categorised as placing a *High* or *Very High* emphasis on academic success according to the data from headteachers and class teachers.

As can be seen in Table 7.5, according to headteachers' responses, the percentage of pupils in England in the highest category of the scale was very close to the international average. However, the picture was slightly different for the teacher responses, where the percentage of pupils in the highest category of the scale in England was more than double the international average.

Based on the responses from headteachers and teachers, Northern Ireland had a high percentage of pupils in schools categorised as placing a high level of emphasis on academic success. In contrast, according to headteachers and teachers, in Singapore, Hong Kong and Japan less than 10 per cent of pupils were in this category.

The international averages indicated an association between the extent of *Emphasis on Academic Success* and average pupil achievement. That is, the higher the category of emphasis on academic success, the higher the average achievement of pupils in that category. However, in England, only the data from teachers indicated a similar trend that was likely to be significant across the three categories. The data cannot identify the direction of causality: it is not clear whether an emphasis on success causes high achievement, whether high achievement breeds a culture of success, or whether a third related variable is implicated.

7.1.6 Teachers' ratings of the extent to which their schools are safe and orderly

Teachers were asked about the degree to which they agreed with five statements about school safety, including the behaviour of pupils (the statements can be seen below in Table 7.6). The *Safe and Orderly School* scale was constructed based on the teachers' level of agreement with the statements. Pupils were categorised as being in schools that were: *Safe and Orderly, Somewhat Safe and Orderly* or *Not Safe and Orderly* (details of how pupils were assigned to each band is provided in Table 7.6). While the section reports teacher perceptions of school safety, it is important to recognise that findings are presented as the percentage of the pupils taught by these teachers. In England, the average scale score for mathematics was 10.7, and for science it was 10.8; both scores were within the *Safe and Orderly* category overall.

Table 7.6 Safe and orderly school

Mathematics

Reported by Teachers

Students were scored according to their teachers' degree of agreement with five statements on the **Safe and Orderly** School scale. Students in **Safe and Orderly** schools had a score on the scale of at least 10.2, which corresponds to their teachers "agreeing a lot" with three of the five qualities of a safe and orderly school and "agreeing a little" with the other two, on average. Students in **Not Safe and Orderly** schools had a score no higher than 6.3, which corresponds to their teachers "disagreeing a little" with three of the five qualities and "agreeing a little" with the other two, on average. All other students attended **Somewhat Safe and Orderly** schools.

Country	Safe and Orderly		Somewhat Safe and Orderly		Not Safe and Orderly		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	67 (4.3)	557 (3.8)	31 (4.1)	519 (7.9)	2 (1.3)	~ ~	10.7 (0.18)
International Avg.	53 (0.5)	498 (0.7)	43 (0.5)	483 (0.8)	4 (0.2)	470 (2.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.

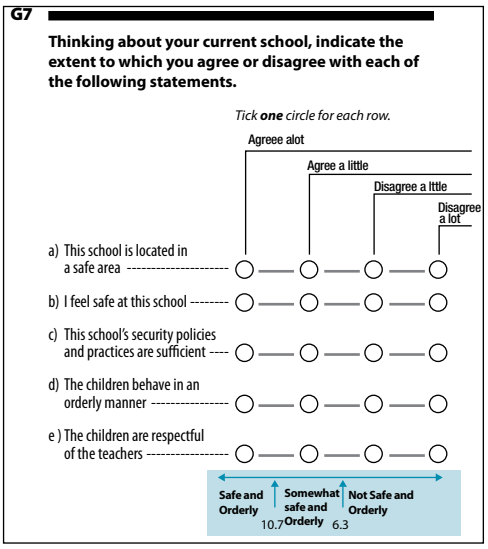
Science

Reported by Teachers

Students were scored according to their teachers' degree of agreement with five statements on the *Safe and Orderly School* scale. Students in **Safe and Orderly** schools had a score on the scale of at least 10.2, which corresponds to their teachers "agreeing a lot" with three of the five qualities of a safe and orderly school and "agreeing a little" with the other two, on average. Students in **Not Safe and Orderly** schools had a score no higher than 6.3, which corresponds to their teachers "disagreeing a little" with three of the five qualities and "agreeing a little" with the other two, on average. All other students attended **Somewhat Safe and Orderly** schools.

Country	Safe and Orderly		Somewhat Safe and Orderly		Not Safe and Orderly		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	68 (4.0)	541 (3.8)	30 (3.9)	504 (7.0)	2 (1.2)	~ ~	10.8 (0.16)
International Avg.	53 (0.5)	493 (0.7)	43 (0.5)	480 (0.9)	4 (0.2)	449 (4.0)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.



Source: Exhibit 6.7, international mathematics and science reports; question adapted from the international version of the TIMSS 2011 Teacher Questionnaire[88]

Table 7.6 shows that nearly 70 per cent of Y5 pupils in England were taught by teachers who judged their school to be *Safe and Orderly* (67 per cent for mathematics and 68 per cent for science). As may be expected, there was a lot of variation across countries in terms of the percentage of pupils in each of the three categories of this scale. However, of the participants that performed better than England in mathematics at this level only Northern Ireland had a higher proportion of pupils (85 per cent) taught by teachers who judged their schools as *Safe and Orderly.* This was not the case for science, where none of the countries that performed better than England had a higher proportion of pupils in schools perceived to be *Safe and Orderly* and only the benchmarking participant of Alberta in this case had a higher percentage, at 81 per cent.

In England there appeared to be an association between whether pupils attended a school that their teachers judged to be *Safe and Orderly* and their average achievement scores, as can be seen in Table 7.6. This is likely to be a significant difference for mathematics and science achievement. This corresponds to the pattern for the international averages but this relationship was not seen in all participating countries.

88 http://timssandpirls.bc.edu/timss2011/index.html

7.1.7 Teachers' ratings of the extent of school discipline and safety

This section reports headteacher perceptions of school discipline and safety. Headteachers were asked separately about the extent to which 10 discipline and safety issues were a problem in their school (these questions can be found in Table 7.7). The headteachers' responses to these questions were used to create the *School Discipline and Safety* scale. Pupils were categorised into three bands on this scale: *Hardly Any Problems*, *Minor Problems* and *Moderate Problems* (details of how pupils were assigned to each band is provided in Table 7.7). In England, the average scale score was 10.6 for mathematics and science. This score was within the *Hardly Any Problems* category overall.

Table 7.7 School discipline and safety

Mathematics

Reported by Principals

Students were scored according to their principals' responses concerning ten potential school problems on the *School Discipline and Safety* scale. Students in schools with **Hardly Any Problems** had a score on the scale of at least 9.7, which corresponds to their principals reporting "not a problem" for five of the ten discipline and safety issues and "minor problem" for the other five, on average. Students in schools with **Moderate Problems** had a score no higher than 7.6, which corresponds to their principals reporting "moderate problem" for five of the ten issues and "minor problem" for the other five, on average. All other students attended schools with **Minor Problems**.

Country	Hardly Any Problems		Minor Problems		Moderate Problems		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	77 (4.1)	551 (4.2)	20 (4.2)	515 (11.0)	3 (1.6)	495 (10.9)	10.6 (0.11)
International Avg.	61 (0.5)	496 (0.7)	29 (0.5)	482 (1.1)	11 (0.3)	451 (2.2)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

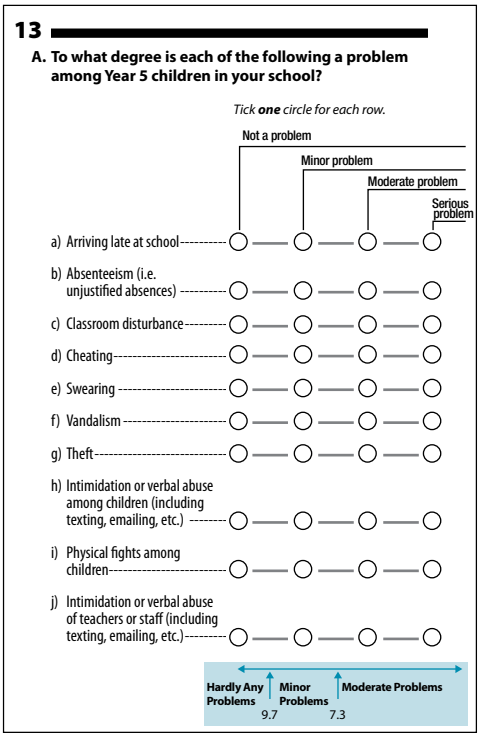
Science

Reported by Principals

Students were scored according to their principals' responses concerning ten potential school problems on the *School Discipline and Safety* scale. Students in schools with **Hardly Any Problems** had a score on the scale of at least 9.7, which corresponds to their principals reporting "not a problem" for five of the ten discipline and safety issues and "minor problem" for the other five, on average. Students in schools with **Moderate Problems** had a score no higher than 7.6, which corresponds to their principals reporting "moderate problem" for five of the ten issues and "minor problem" for the other five, on average. All other students attended schools with **Minor Problems**.

Country	Hardly Any Problems		Minor Problems		Moderate Problems		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	77 (4.1)	537 (3.5)	20 (4.2)	500 (10.0)	3 (1.6)	486 (7.3)	10.6 (0.11)
International Avg.	61 (0.5)	492 (0.7)	29 (0.5)	477 (1.2)	11 (0.3)	448 (2.2)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Source: Exhibit 6.9, international mathematics and science reports; question adapted from the international version of the TIMSS 2011 School Questionnaire[89]

Levels of discipline and safety appeared to be high in England, where 77 per cent of Y5 pupils attended schools that headteachers judged to have *Hardly Any Problems*. This was above the international average of 61 per cent and only nine other participating countries had a higher percentage of pupils in this category. However, 3 per cent of Y5 pupils in England were in schools where the headteacher judged that there were *Moderate Problems* with school discipline and safety. Some of the countries that performed better than England, or had similar performance to England in mathematics and science at this level, had an even smaller percentage of pupils in this category. For example, the Netherlands, Singapore, Chinese Taipei and the Russian Federation had no pupils in the category of schools that were judged to have *Moderate Problems.*

The international averages for mathematics and science show that as schools were judged as having more problems with discipline and safety, the average achievement score decreased. Despite this, across participating countries, there did not appear to be a consistent relationship between the perceived level of discipline and safety in a school and the relative achievement of pupils across the levels. In England, for both mathematics and science, there appeared to be a difference of more than 50 scale points in achievement scores between pupils in schools perceived to have *Hardly Any Problems* and pupils in schools perceived to have *Moderate Problems*. However, only a small proportion of pupils were in the lowest category of the scale in England, which may affect the reliability of this finding. It is likely that the differences are not statistically significant across the three categories.[90]

89 http://timssandpirls.bc.edu/timss2011/index.html

90 Although the score differences have not been tested for statistical significance, the size of the standard errors suggests that the differences are unlikely to be statistically significant across the three categories.

7.1.8 Teachers' reports of the extent to which their teaching is limited by disruptive or uninterested pupils

Y5 teachers were asked about the extent to which disruptive or uninterested pupils limited their ability to teach the class sampled for TIMSS 2011. As shown in Table 7.8 their responses were grouped into two categories: *Some or Not At All* or *A Lot*. These questions were also included in TIMSS 2007 so we are able to examine whether the extent to which teachers in England were limited by disruptive or uninterested pupils had changed over time. However, the response categories for this item had changed since 2007 and therefore we can only reliably compare those teachers who reported that their teaching was limited *a lot*.

Table 7.8 Teaching limited by disruptive or uninterested students

Mathematics

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Disruptive Students				Students in Classrooms Where Teachers Report Instruction Is Limited by Uninterested Students			
	Some or Not At All		A Lot		Some or Not At All		A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	93 (2.1)	547 (3.9)	7 (2.1)	508 (10.0)	95 (1.8)	546 (3.9)	5 (1.8)	512 (12.2)
International Avg.	87 (0.3)	493 (0.5)	13 (0.3)	479 (1.6)	89 (0.3)	494 (0.5)	11 (0.3)	468 (1.9)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Science

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Disruptive Students				Students in Classrooms Where Teachers Report Instruction Is Limited by Uninterested Students			
	Some or Not At All		A Lot		Some or Not At All		A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	94 (1.9)	532 (3.6)	6 (1.9)	494 (10.2)	96 (1.7)	532 (3.5)	4 (1.7)	491 (9.6)
International Avg.	87 (0.3)	488 (0.6)	13 (0.3)	472 (1.6)	89 (0.3)	489 (0.6)	11 (0.3)	463 (1.9)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 8.23, international mathematics and science reports

As can be seen in Table 7.8, less than 10 per cent of Y5 pupils in England were taught by teachers who reported that their teaching is limited *a lot* by disruptive pupils (7 per cent for mathematics and 6 per cent for science). An even smaller percentage of pupils were taught by teachers who reported that their teaching is limited *a lot* by uninterested pupils for mathematics and science (5 and 4 per cent respectively). In 2007 the equivalent percentages were around 7 per cent for both disruptive pupils and uninterested pupils (for both mathematics and science). This shows that the extent to which teachers of Y5 pupils in England perceived their teaching to be limited *a lot* by disruptive or uninterested pupils in 2011 was comparable with the findings from 2007.

In 2011, across both subjects, the percentages of pupils in England taught by teachers who reported that their teaching is limited *a lot* by disruptive and uninterested pupils were lower than the international averages of 13 per cent and 11 per cent respectively. Compared with England, some of the high performing countries

had similar percentages of pupils whose teachers reported that their teaching is limited by disruptive and uninterested pupils, while in others (e.g. Korea) these percentages were larger.[91]

As can be seen in Table 7.8, average mathematics and science achievement in England was higher for those pupils whose teachers reported being limited *some or not at all* by disruptive pupils, compared with the achievement of those whose teachers reported being limited *a lot* (547 and 508 respectively for mathematics; 532 and 494 for science). This difference was likely to be significant for both subjects. A similar size of difference in achievement was also seen for uninterested pupils and, as was the case for disruptive pupils, the difference was likely to be significant for mathematics and science. However, this size of difference was not seen in other participating countries, on average.

7.1.9 Pupils' reports of bullying in school

Y5 pupils were asked how often they had experienced each of six behaviours which were considered to demonstrate bullying (this list of behaviours can be seen below Table 7.9). The international analysis used responses to these questions to create the *Students Bullied at School* scale. Pupils were categorised into three bands which described the frequency with which they had experienced the six bullying behaviours in their school during the last year: *Almost Never, About Monthly* and *About Weekly* (details of how pupils were categorised is provided in Table 7.9). In England, the average scale score was 9.8. This score was within the *About Monthly* category for the bullying scale overall.

Table 7.9 Pupils bullied at school

Mathematics

Reported by Students

Students were scored according to their responses to how often they experienced six bullying behaviors on the *Students Bullied at School* scale. Students bullied **Almost Never** had a score on the scale of at least 10.1, which corresponds to "never" experiencing three of the six bullying behaviors and each of the other three behaviors "a few times a year," on average. Students bullied **About Weekly** had a score no higher than 8.3, which corresponds to their experiencing each of three of the six behaviors "once or twice a month" and each of the other three "a few times a year," on average. All other students were bullied **About Monthly.**

Country	Almost Never		About Monthly		About Weekly		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	45 (1.3)	549 (4.2)	36 (1.0)	548 (4.5)	20 (0.8)	519 (5.3)	9.8 (0.05)
International Avg.	48 (0.2)	501 (0.5)	32 (0.1)	493 (0.6)	20 (0.1)	469 (0.7)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Science

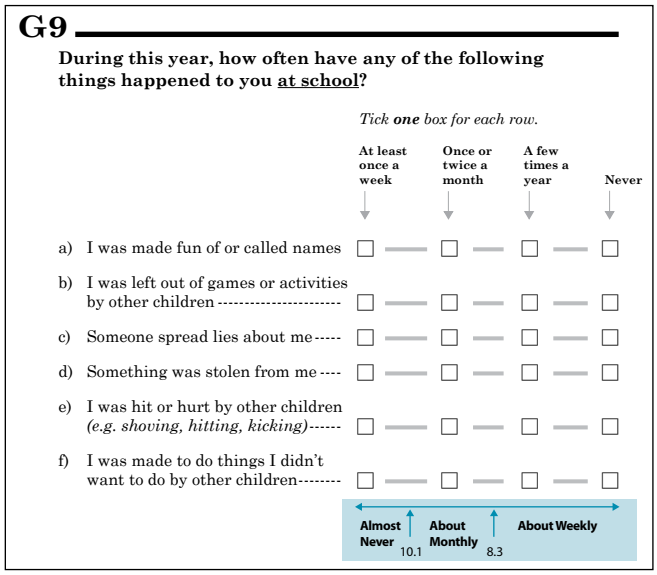
Reported by Students

Students were scored according to their responses to how often they experienced six bullying behaviors on the *Students Bullied at School* scale. Students bullied **Almost Never** had a score on the scale of at least 10.1, which corresponds to "never" experiencing three of the six bullying behaviors and each of the other three behaviors "a few times a year," on average. Students bullied **About Weekly** had a score no higher than 8.3, which corresponds to their experiencing each of three of the six behaviors "once or twice a month" and each of the other three "a few times a year," on average. All other students were bullied **About Monthly.**

Country	Almost Never		About Monthly		About Weekly		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	45 (1.3)	537 (3.6)	36 (1.0)	533 (3.8)	20 (0.8)	505 (5.1)	9.8 (0.05)
International Avg.	48 (0.2)	497 (0.6)	32 (0.1)	489 (0.6)	20 (0.1)	464 (0.8)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

91 See Exhibit 8.23 in the international science and mathematics reports.



Source: Exhibit 6.11 international mathematics and science report; question adapted from the international version of the TIMSS 2011 Student Questionnaire[92]

Nearly half of Y5 pupils in England (45 per cent) were categorised as experiencing these six bullying behaviours *Almost Never*. Over half of the TIMSS participants had a higher percentage of pupils in this category. In addition, England had quite a high percentage (20 per cent) of pupils categorised as experiencing bullying behaviours *About Weekly*. Although this was the same as the international average, many countries that performed better than or similarly to England in Y5 mathematics and/or science had a smaller percentage of pupils in this category.

Pupils' reports about the frequency with which they experienced the six bullying behaviours were associated with their average mathematics and science achievement in TIMSS 2011, as indicated by the international averages. Increased bullying (as described by the categories of the *Students Bullied at School* scale) was related to a decrease in average achievement in both subjects. However, in England this association was not likely to be significant across all three categories.

As the percentage of Y5 pupils categorised as experiencing bullying behaviours *About Weekly* was higher in England than for over half of the other participants, it is important to establish if this was the case in 2007 or whether there had been an increase in the frequency of bullying reported by pupils since the last survey. However, the scale and the response categories have changed since TIMSS 2007. As a result we can only reliably compare the three statements about bullying behaviours that were unchanged since 2007 (statements a, e and f shown in Table 7.9 above). In 2007 pupils were asked whether each of the bullying behaviours had happened to them during the last month, whereas in 2011, pupils had to indicate how often each event had happened using the following response categories: *at least once a week, once or twice a month, a few times a year* or *never*. Therefore, in order to make a reasonably valid comparison over time, the percentages of pupils in the 2011 survey who responded *at least once a week* and *once or twice a month* were aggregated so that they could be compared with the percentage of pupils in the 2007 survey who reported that these bullying behaviours had happened to them during the last month. Table 7.10 shows the findings for the two surveys.

12 http://timssandpirls.bc.edu/timss2011/index.html

Table 7.10 Trends in Pupils Bullied at School

Questionnaire item	2007 percentage of pupils	2011 percentage of pupils
I was made fun of or called names	36	32
I was hit or hurt by other children (*e.g. shoving, hitting, kicking*)	43	27
I was made to do things I didn't want to do by other children	20	16

Note: standard errors are not available for this data.

Source: derived from national dataset for TIMSS 2011[93] and weighted almanacs for TIMSS 2007 (Foy and Olson, 2009)

As Table 7.10 shows, since the 2007 survey there was a reduction in the percentage of pupils who reported that they had experienced these specific bullying behaviours during the last month.[94] Notably, the percentage of pupils reporting they had been hit or hurt by other children had fallen by 16 percentage points.

7.2 Year 9 (Y9)

7.2.1 Teacher's major area of study during training

As was the case for teachers of 9-10 year olds, teachers of Y9 pupils were asked to report their main area of study and whether they had specialised in any specific subjects during their post-secondary education (the findings for teachers in England are shown in Table 7.11). As was the case for Y5, in this context a 'subject specialist' is defined as likely to have an academic qualification in the subject taught, whereas a teacher who has studied mathematics or science education may have studied the pedagogy of mathematics or science but may not have an academic qualification in the subject. It is important to recognise that this section reports the percentages of the pupils taught by teachers who undertook specific forms of post-secondary education (not the percentages of teachers who undertook specific forms of post-secondary education).

Table 7.11 Teachers' major area of study during training

Mathematics

Reported by Teachers

Country	Major in Mathematics and Mathematics Education		Major in Mathematics Education but No Major in Mathematics		Major in Mathematics but No Major in Mathematics Education		All Other Majors		No Formal Education Beyond Upper-secondary*	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	41 (3.9)	502 (10.4)	5 (1.9)	470 (25.6)	35 (4.0)	517 (7.6)	18 (2.6)	503 (13.6)	0 (0.0)	~ ~
International Avg.	32 (0.5)	471 (1.3)	12 (0.3)	470 (3.0)	41 (0.5)	468 (1.1)	12 (0.4)	462 (2.4)	3 (0.1)	418 (7.0)

*Countries have been increasing their certification requirements and providing professional development to teachers certified under earlier guidelines.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.

93 See the TIMSS 2011 international database at http://timssandpirls.bc.edu/timss2011/index.html

94 In the context that pupils were not asked exactly the same question. In 2011 there were additional response categories and pupils were not specifically asked about the last month. In addition, the differences have not been tested to ascertain whether or not they are statistically significant

Science

Reported by Teachers

Country		Major in Science and Science Education		Major in Science Education but No Major in Science		Major in Science but No Major in Science Education		All Other Majors		No Formal Education Beyond Upper-secondary*	
		Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	r	54 (3.1)	535 (6.8)	3 (0.9)	502 (17.0)	39 (3.1)	537 (6.7)	3 (1.1)	506 (16.1)	0 (0.3)	~ ~
International Avg.		28 (0.5)	480 (1.2)	11 (0.3)	470 (2.2)	51 (0.5)	478 (1.0)	8 (0.3)	476 (2.7)	2 (0.1)	~ ~

*Countries have been increasing their certification requirements and providing professional development to teachers certified under earlier guidelines.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Source: Exhibit 7.4, international mathematics and science reports

Mathematics

Forty-one per cent of Y9 pupils were taught mathematics by teachers who had a specialism in mathematics and mathematics education and a further 35 per cent were taught by teachers who had a specialism in mathematics but not mathematics education (as shown in Table 7.11). The percentage of teachers with specialisms in both mathematics and mathematics education was higher than the international average (32 per cent), and similar to some of the high performing countries, for example, Hong Kong and Japan (both at 46 per cent). There was not a clear association between a teacher specialising in mathematics during training and the average achievement of pupils, either in England[95] or internationally.

Science

In England, over half of Y9 pupils (54 per cent) were taught science by teachers whose main areas of study were science and science education. A further 39 per cent of pupils were taught by teachers who had specialised in science but not science education in their training (as shown in Table 7.11). This was quite a different picture to Y5 science where less than a third of pupils (32 per cent) were taught science by teachers who were science specialists. For most of the higher performing participants in science at this level, the vast majority of pupils (over 90 per cent) were taught by teachers in the two categories of specialising in science during their training. Notably, in Finland, Massachusetts and Alberta this was not the case with only 80 per cent, 69 per cent and 56 per cent of pupils respectively taught by science specialists. As was the case with pupils aged 9-10, there was not a clear pattern within individual countries between a teacher specialisation during training and average achievement in science.[96]

7.2.2 Teacher reports of how well prepared they feel to teach mathematics and science

As for Y5, teachers of Y9 were asked how prepared they feel to teach the mathematics and science content topics assessed by TIMSS (the content topics are listed in Table 7.12). For each topic, teachers had to indicate whether they feel *Very Well Prepared, Somewhat Prepared* or *Not Well Prepared*.

95 No tests of statistical significance were carried out in this international analysis, but the sizes of the standard errors suggest that the observed differences are unlikely to be significant across all categories.

96 As was the case for mathematics, the sizes of the standard errors suggest that the observed differences in England would not be significant across all categories.

Table 7.12 Teachers feel "very well" prepared to teach

TIMSS Mathematics Topics

Reported by Teachers

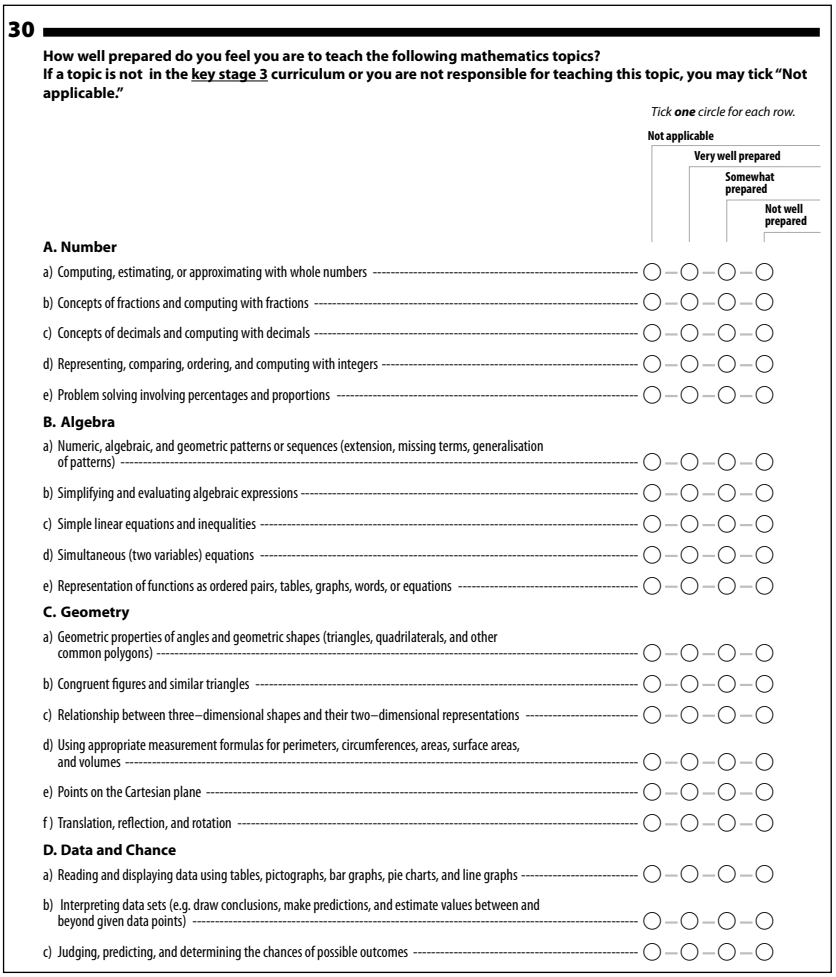
Country	Per cent of Students Whose Teachers Feel "Very Well" Prepared to Teach TIMSS Mathematics Topics				
	Overall Mathematics (19 Topics)	Number (5 Topics)	Algebra (5 Topics)	Geometry (6 Topics)	Data and Chance (3 Topics)
England	94 (1.4)	97 (1.3)	94 (1.7)	94 (1.5)	92 (2.0)
International Avg.	84 (0.3)	92 (0.3)	87 (0.3)	85 (0.3)	62 (0.4)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Reported by Teachers

Country	Per cent of Students Whose Teachers Feel "Very Well" Prepared to Teach TIMSS Science Topics				
	Overall Science (20 Topics)	Biology (7 Topics)	Chemistry (4 Topics)	Physics (5 Topics)	Earth Science (4 Topics)
England	r 84 (1.2)	r 89 (1.5)	r 91 (1.5)	r 84 (1.8)	r 70 (2.3)
International Avg.	72 (0.3)	77 (0.4)	82 (0.4)	78 (0.4)	47 (0.5)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.



30

How well prepared do you feel you are to teach the following mathematics topics?
If a topic is not in the key stage 3 curriculum or you are not responsible for teaching this topic, you may tick "Not applicable."

*Tick **one** circle for each row.*

Not applicable | Very well prepared | Somewhat prepared | Not well prepared

A. Number

a) Computing, estimating, or approximating with whole numbers
b) Concepts of fractions and computing with fractions
c) Concepts of decimals and computing with decimals
d) Representing, comparing, ordering, and computing with integers
e) Problem solving involving percentages and proportions

B. Algebra

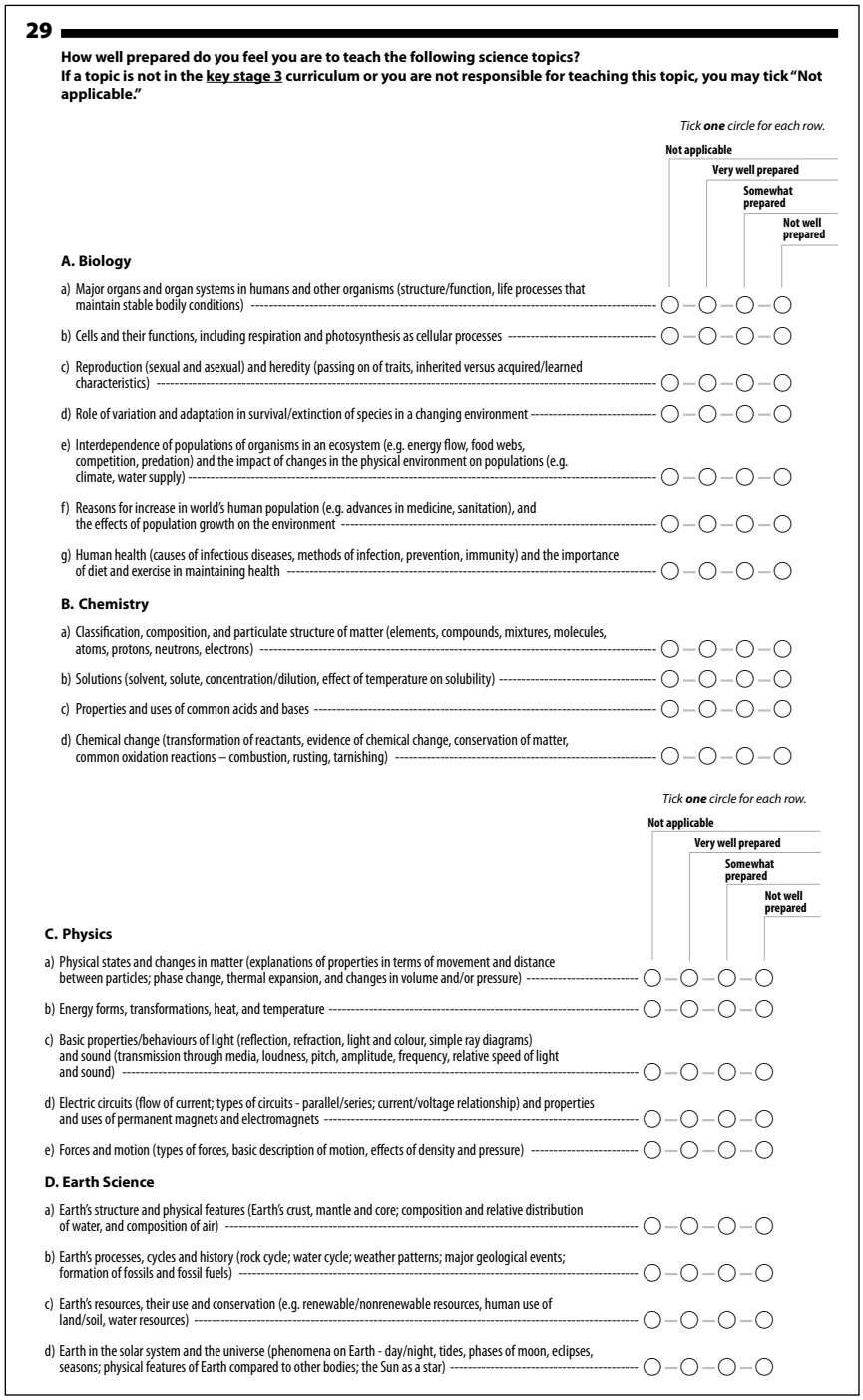
a) Numeric, algebraic, and geometric patterns or sequences (extension, missing terms, generalisation of patterns)
b) Simplifying and evaluating algebraic expressions
c) Simple linear equations and inequalities
d) Simultaneous (two variables) equations
e) Representation of functions as ordered pairs, tables, graphs, words, or equations

C. Geometry

a) Geometric properties of angles and geometric shapes (triangles, quadrilaterals, and other common polygons)
b) Congruent figures and similar triangles
c) Relationship between three–dimensional shapes and their two–dimensional representations
d) Using appropriate measurement formulas for perimeters, circumferences, areas, surface areas, and volumes
e) Points on the Cartesian plane
f) Translation, reflection, and rotation

D. Data and Chance

a) Reading and displaying data using tables, pictographs, bar graphs, pie charts, and line graphs
b) Interpreting data sets (e.g. draw conclusions, make predictions, and estimate values between and beyond given data points)
c) Judging, predicting, and determining the chances of possible outcomes



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How well prepared do you feel you are to teach the following science topics?
If a topic is not in the key stage 3 curriculum or you are not responsible for teaching this topic, you may tick "Not applicable."

*Tick **one** circle for each row.*

	Not applicable	Very well prepared	Somewhat prepared	Not well prepared
A. Biology				
a) Major organs and organ systems in humans and other organisms (structure/function, life processes that maintain stable bodily conditions)	○	○	○	○
b) Cells and their functions, including respiration and photosynthesis as cellular processes	○	○	○	○
c) Reproduction (sexual and asexual) and heredity (passing on of traits, inherited versus acquired/learned characteristics)	○	○	○	○
d) Role of variation and adaptation in survival/extinction of species in a changing environment	○	○	○	○
e) Interdependence of populations of organisms in an ecosystem (e.g. energy flow, food webs, competition, predation) and the impact of changes in the physical environment on populations (e.g. climate, water supply)	○	○	○	○
f) Reasons for increase in world's human population (e.g. advances in medicine, sanitation), and the effects of population growth on the environment	○	○	○	○
g) Human health (causes of infectious diseases, methods of infection, prevention, immunity) and the importance of diet and exercise in maintaining health	○	○	○	○
B. Chemistry				
a) Classification, composition, and particulate structure of matter (elements, compounds, mixtures, molecules, atoms, protons, neutrons, electrons)	○	○	○	○
b) Solutions (solvent, solute, concentration/dilution, effect of temperature on solubility)	○	○	○	○
c) Properties and uses of common acids and bases	○	○	○	○
d) Chemical change (transformation of reactants, evidence of chemical change, conservation of matter, common oxidation reactions – combustion, rusting, tarnishing)	○	○	○	○

*Tick **one** circle for each row.*

	Not applicable	Very well prepared	Somewhat prepared	Not well prepared
C. Physics				
a) Physical states and changes in matter (explanations of properties in terms of movement and distance between particles; phase change, thermal expansion, and changes in volume and/or pressure)	○	○	○	○
b) Energy forms, transformations, heat, and temperature	○	○	○	○
c) Basic properties/behaviours of light (reflection, refraction, light and colour, simple ray diagrams) and sound (transmission through media, loudness, pitch, amplitude, frequency, relative speed of light and sound)	○	○	○	○
d) Electric circuits (flow of current; types of circuits - parallel/series; current/voltage relationship) and properties and uses of permanent magnets and electromagnets	○	○	○	○
e) Forces and motion (types of forces, basic description of motion, effects of density and pressure)	○	○	○	○
D. Earth Science				
a) Earth's structure and physical features (Earth's crust, mantle and core; composition and relative distribution of water, and composition of air)	○	○	○	○
b) Earth's processes, cycles and history (rock cycle; water cycle; weather patterns; major geological events; formation of fossils and fossil fuels)	○	○	○	○
c) Earth's resources, their use and conservation (e.g. renewable/nonrenewable resources, human use of land/soil, water resources)	○	○	○	○
d) Earth in the solar system and the universe (phenomena on Earth - day/night, tides, phases of moon, eclipses, seasons; physical features of Earth compared to other bodies; the Sun as a star)	○	○	○	○

Source: Exhibit 7.10, international mathematics and science reports

Mathematics

Table 7.12 shows the percentage of pupils in England taught by teachers who feel *very well prepared* to teach the topics. The responses were averaged across all 19 topics to give a perspective on mathematics overall as well as separately by content domain (Number, Algebra, Geometry and Data and Chance). The topics used to test pupils aged 13-14 were not the same as those used in the tests for 9-10 year olds so a direct comparison cannot be made with the findings for Y5 pupils.

Ninety-four per cent of Y9 pupils in England were taught by teachers who feel *very well prepared* to teach the TIMSS topics. This was a larger percentage of pupils than seen for the majority of participants with average achievement scores significantly higher than England's. Only North Carolina and Massachusetts had a higher percentage of pupils taught by teacher who feel *very well prepared* to teach the TIMSS topics (95 per cent and 97 per cent respectively).

Across participating countries a lower percentage of teachers feel *very well prepared* to teach the Data and Chance topic, compared with the other topics. For example, in Finland the percentage of pupils taught by teachers who feel *very well prepared* to teach Data and Chance was 33 per cent. The equivalent figures for Number, Algebra and Geometry were at or above 90 per cent for Finland. This, however, was not the case in England where teacher responses resulted in similar percentages across all four content domains. This may well reflect differences in the focus of the mathematics curriculum for pupils aged 13-14 across countries (see Chapter 8 of the international report[97] and Chapter 6 of this report for further discussion of curricula).

Science

As was the case for mathematics, Y9 science teachers were asked how prepared they feel to teach the science content topics assessed by TIMSS (the content topics can be found below Table 7.12). Table 7.12 shows the percentage of pupils in England taught by teachers who feel *very well prepared* to teach the topics (the findings for all countries can be seen in Exhibit 7.10 in the international science report). The responses were averaged across all 20 topics to give a perspective on science overall as well as separately by content domain (Biology, Chemistry, Physics and Earth Science).

In England, 84 per cent of students were taught by teachers who feel *very well prepared* to teach the TIMSS science topics. This was higher than the equivalent percentage for pupils aged 9 -10, where only 69 per cent of pupils were taught by teachers who feel *very well prepared* to teach the TIMSS science topics. This may well reflect the fact that fewer pupils in the younger age group were taught by teachers who had specialised in science during their training. In addition, when compared with the majority of high achieving participants, there was a higher percentage of Y9 pupils in England with teachers who feel *very well prepared* to teach the TIMSS science topics. In terms of the four content domains there was a big difference in the percentage of Y9 pupils in England whose teachers feel *very well prepared* to teach Earth Science compared with Biology, Chemistry and Physics (shown in Table 7.12). This mirrors the findings for Earth Science at Y5. This pattern was also reflected in the findings for the majority of participants, with Earth Science the TIMSS content domain in which fewest pupils were taught by teachers who feel well prepared to teach it.[98]

7.2.3 Teachers' reports of collaboration to improve teaching in each subject

Teachers were asked how often they engaged in a number of collaborative teaching practices. These were the same statements given to the Y5 teachers (the collaborative practices and details of how pupils were assigned to each band of the *Collaborate to Improve Learning* scale are detailed below in Table 7.13). For Y9 there was a separate questionnaire for mathematics teachers and science teachers and, therefore, there may be more variation in the responses for each subject compared with the findings for Y5. While this section is based on teacher reports of the extent to

97 See Exhibit 8.9 in the international mathematics report.

98 This may be because the Earth Science topics would be covered in the geography curriculum and therefore science teachers would not be responsible for teaching these.

which they collaborate with colleagues, it is important to recognise that findings are presented as the percentage of the pupils taught by these teachers. In England, the average scale score for mathematics was 9.7, and for science it was 9.9; both scores were within the *Collaborative* category overall.

Table 7.13 Collaborate to improve teaching

Mathematics

Reported by Teachers

Students were scored according to their teachers' responses to how often they interacted with other teachers in each of five teaching areas on the *Collaborate to Improve Teaching* scale. Students with **Very Collaborative** teachers had a score on the scale of at least 11.4, which corresponds to their teachers having interactions with other teachers at least "one to three times per week" in each of three of the five areas and "two or three times per month" in each of the other two, on average. Students with **Somewhat Collaborative** teachers had a score no higher than 7.5, which corresponds to their teachers interacting with other teachers "never or almost never" in each of three of the five areas and "two or three times per month" in the other two, on average. All other students had **Collaborative** teachers.

Country	Very Collaborative		Collaborative		Somewhat Collaborative		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	24 (3.8)	502 (12.4)	57 (4.2)	505 (7.9)	20 (3.1)	512 (16.5)	9.7 (0.15)
International Avg.	28 (0.5)	467 (1.2)	57 (0.6)	468 (0.8)	15 (0.4)	465 (1.9)	

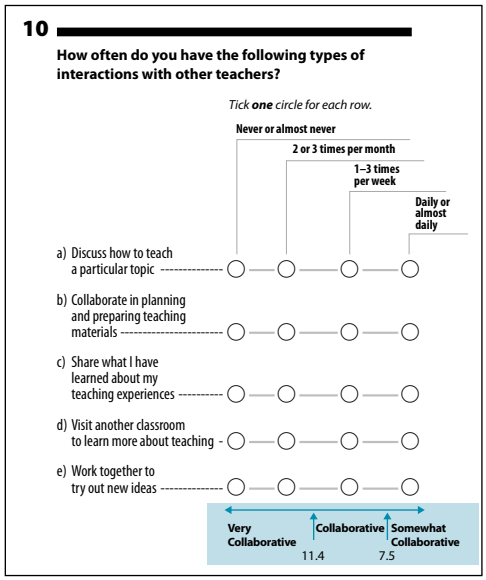
Science

Reported by Teachers

Students were scored according to their teachers' responses to how often they interacted with other teachers in each of five teaching areas on the *Collaborate to Improve Teaching* scale. Students with **Very Collaborative** teachers had a score on the scale of at least 11.4, which corresponds to their teachers having interactions with other teachers at least "one to three times per week" in each of three of the five areas and "two or three times per month" in each of the other two, on average. Students with **Somewhat Collaborative** teachers had a score no higher than 7.5, which corresponds to their teachers interacting with other teachers "never or almost never" in each of three of the five areas and "two or three times per month" in each of the other two, on average. All other students had **Collaborative** teachers.

Country	Very Collaborative		Collaborative		Somewhat Collaborative		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England r	27 (3.4)	521 (12.6)	57 (3.0)	536 (5.7)	16 (2.6)	535 (8.2)	9.9 (0.16)
International Avg.	29 (0.5)	476 (1.1)	58 (0.5)	479 (0.8)	13 (0.4)	472 (2.1)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.



Source: Exhibit 8.13, international mathematics and science reports; question adapted from the international version of the TIMSS 2011 Mathematics and Science Teacher Questionnaires[99]

99 http://timssandpirls.bc.edu/timss2011/index.html.

In contrast to the findings for Y5 mathematics and science, a smaller percentage of Y9 pupils were taught by teachers classified as having *Very Collaborative* practice (24 per cent for mathematics and 27 per cent for science). However, a number of countries, with significantly better performance than England in mathematics at this level, had an even smaller percentage of pupils in this category. For example, in Singapore, Chinese Taipei, Japan, Hong Kong and Korea the percentages of pupils taught by teachers whose practice was categorised as *Very Collaborative* were between 11 and 17 per cent inclusive for mathematics.

For the majority of countries, most pupils were taught by teachers whose practice was categorised as *Collaborative*. In England, for both subjects, this accounted for 57 per cent of Y9 pupils. As was seen in the Y5 findings, the average achievement scores for Y9 pupils in England and internationally were relatively similar regardless of levels of collaborative practice.[100] The differences observed for Y9 mathematics and science in England are unlikely to be significant.

7.2.4 Teachers' reported career satisfaction

Teachers of pupils in Y9 responded to six statements about their career as a teacher. These were the same statements used for the Y5 teachers (these statements can be found in Table 7.14). Their responses were used to create the *Teacher Career Satisfaction* scale.

In England, the average scale score for mathematics was 10.1, and for science it was 9.5; both scores were within the *Somewhat Satisfied* category of the *Teacher Career Satisfaction* scale overall. This is a new scale for TIMSS 2011 and therefore no trend data is available (details of how the scale is created can be found in Table 7.14).

Table 7.14 Teacher career satisfaction

Mathematics

Reported by Teachers

Students were scored according to their teachers' degree of agreement with six statements on the *Teacher Career Satisfaction* scale. Students with **Satisfied** teachers had a score on the scale of at least 10.4, which corresponds to their teachers "agreeing a lot" with three of the six statements and "agreeing a little" with the other three, on average. Students with **Less Than Satisfied** teachers had a score no higher than 7.0, which corresponds to their teachers "disagreeing a little" with three of the six statements and "agreeing a little" with the other three, on average. All other students had **Somewhat Satisfied** teachers.

Country	Satisfied		Somewhat Satisfied		Less Than Satisfied		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	46 (4.0)	513 (8.0)	44 (3.9)	507 (9.1)	10 (2.8)	466 (20.3)	10.1 (0.19)
International Avg.	47 (0.6)	473 (0.9)	45 (0.6)	464 (1.0)	7 (0.3)	462 (2.4)	

Science

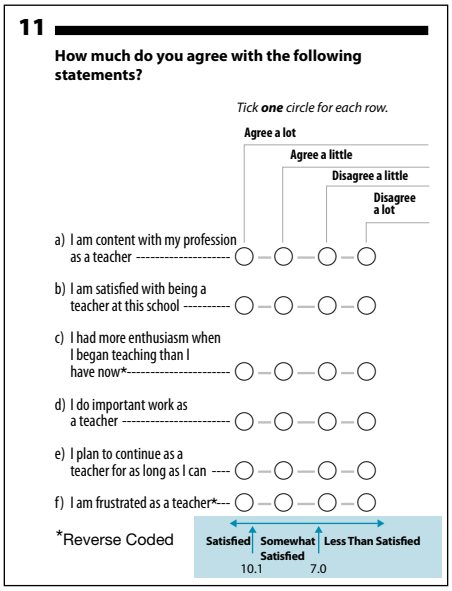
Reported by Teachers

Students were scored according to their teachers' degree of agreement with six statements on the *Teacher Career Satisfaction* scale. Students with **Satisfied** teachers had a score on the scale of at least 10.4, which corresponds to their teachers "agreeing a lot" with three of the six statements and "agreeing a little" with the other three, on average. Students with **Less Than Satisfied** teachers had a score no higher than 7.0, which corresponds to their teachers "disagreeing a little" with three of the six statements and "agreeing a little" with the other three, on average. All other students had **Somewhat Satisfied** teachers.

Country	Satisfied		Somewhat Satisfied		Less Than Satisfied		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	39 (2.8)	526 (8.6)	46 (3.1)	533 (6.7)	15 (2.4)	542 (8.4)	9.5 (0.13)
International Avg.	47 (0.5)	481 (0.8)	45 (0.5)	474 (0.8)	8 (0.3)	473 (2.3)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

100 Tests of statistical significance were not carried out in this international analysis but, based on the size of the standard errors, it is unlikely that the apparent differences are statistically significant.



Source: Exhibit 7.16, international mathematics report and Exhibit 715 international science report; question adapted from the international version of the TIMSS 2011 Mathematics and Science Teacher Questionnaires[101]

In England, there was a difference between the responses of teachers of Y9 mathematics and science. Forty-six per cent of Y9 pupils were taught by mathematics teachers who reported being *Satisfied* with their careers. The equivalent percentage for science was 39 per cent. Although this was lower than in a number of other participating countries, it compared favourably with levels of teacher satisfaction in the highest performing countries in mathematics and science: notably, the percentage of pupils in England whose teachers were *Satisfied* with their careers was higher than in Singapore, Chinese Taipei and Korea for both subjects.

For mathematics and science at this level, the international averages appeared to show higher pupil achievement for those pupils taught by teachers who reported being more satisfied with their careers, but the observed differences were unlikely be significant. The comparative data for England showed apparent differences that were also unlikely to be significant.

7.2.5 Schools' emphasis on academic success

As with Y5, headteachers and teachers were asked about teachers' understanding of the school's goals, based on their perceptions of the attitudes of teachers, parents and pupils (the statements can be seen in Table 7.15). The responses to these statements were used to create a scale for measuring the emphasis on academic success in the school (the way in which responses were categorised on the scale is detailed in Table 7.15). In England, the average scale score for headteachers was 11.6 for both subjects, and for teachers it was 11.2 for mathematics and 11.1 for science. All three scores were within the *High Emphasis* category overall.

While this section reports headteacher and teacher perceptions of their schools' emphasis on academic success, it is important to recognise that findings are presented as the percentage of the TIMSS pupils who attend these schools. As with Y5, the majority of the questions were not subject specific and therefore the overall proportions were broadly the same for mathematics and science. Differences in achievement scores, however, are subject specific and have been reported separately.

101 http://timssandpirls.bc.edu/timss2011/index.html.

Table 7.15 School emphasis on academic success – headteacher and teacher reports

Mathematics

Reported by principals/teachers

Students were scored according to their principals'/teachers' responses characterising five aspects on the *School Emphasis on Academic Success* scale. Students in schools where their principals'/teachers' reported a **Very High Emphasis** on academic success had a score on the scale of at least 13.3 (principals)/13.6 (teachers), which corresponds to their principals'/teachers' characterising three of the five aspects as "very high" and the other two as "high," on average. Students in schools with a **Medium Emphasis** on academic success had a score no higher than 9.2 (principals)/ 9.5 (teachers), which corresponds to their principals'/teachers' characterising three of the five aspects as "medium" and the other two as "high," on average. All other students attended schools with a **High Emphasis** on academic success.

Country		Very High Emphasis		High Emphasis		Medium Emphasis		Average Scale Score
		Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	***Principals***	26 (3.5)	525 (12.3)	56 (4.7)	509 (8.2)	19 (3.4)	477 (14.7)	11.6 (0.18)
	Teachers	16 (2.4)	526 (11.0)	59 (4.1)	508 (7.3)	24 (3.9)	488 (12.2)	11.2 (0.19)
International Avg.	***Principals***	7 (0.3)	495 (3.1)	53 (0.6)	477 (0.9)	41 (0.5)	449 (1.0)	
	Teachers	5 (0.3)	506 (3.4)	48 (0.6)	478 (0.9)	47 (0.5)	452 (0.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

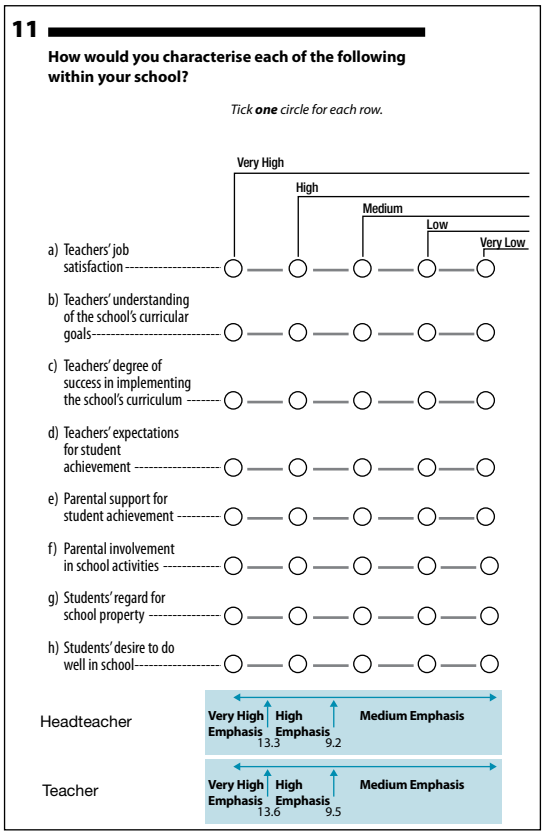
Science

Reported by principals/teachers

Students were scored according to their principals/teachers responses characterizing five aspects on the *School Emphasis on Academic Success* scale. Students in schools where their principals/teachers reported **Very High Emphasis** on academic success had a score on the scale of at least 13.3 (principals)/13.6 (teachers), which corresponds to their principals characterizing three of the five aspects as "very high" and the other two as "high," on average. Students in schools with a **Medium Emphasis** on academic success had a score no higher than 9.2 (principals)/9.5 (teachers), which corresponds to their principals/teachers characterizing three of the five aspects as "medium" and the other two as "high," on average. All other students attended schools with a **High Emphasis** on academic success.

Country		Very High Emphasis		High Emphasis		Medium Emphasis		Average Scale Score
		Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	***Principals***	26 (3.5)	553 (11.3)	56 (4.7)	534 (7.7)	19 (3.4)	506 (14.1)	11.6 (0.18)
	Teachers	16 (2.5)	554 (14.5)	60 (3.6)	533 (5.9)	24 (3.2)	514 (12.0)	11.1 (0.15)
International Avg.	***Principals***	7 (0.3)	504 (2.8)	53 (0.6)	486 (0.9)	41 (0.5)	460 (1.0)	
	Teachers	5 (0.2)	504 (3.2)	50 (0.5)	487 (0.8)	46 (0.5)	463 (0.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Items a, f and g did not contribute to this scale.

Source: Exhibit 6.2 and 6.4, international mathematics report and international science report; question adapted from the international version of the TIMSS 2011 School Questionnaire and Mathematics and Science Teacher Questionnaires[102]

Based on responses from headteachers, schools in England were categorised as placing more emphasis on academic success than other participating countries: in England 26 per cent of pupils were in schools categorised as placing a *Very High Emphasis* on academic success. Only one country (Qatar) and two benchmarking participants had a higher percentage of pupils in this category. This was a much higher percentage of pupils compared with the findings for Y5, where only 10 per cent of pupils were in schools categorised as placing a *Very High Emphasis* on academic success.

The pattern in the responses from teachers was very similar to those of headteachers. That is, compared with other participating countries, responses from England's teachers placed a relatively high percentage of pupils (16 per cent) in the *Very High Emphasis* category. However, this was lower than the percentage in this category based on the responses from headteachers. This was the case in some other countries, but the opposite of the situation at Y5. In the countries that performed significantly better than England in mathematics and/or science at Y9, there was substantial variation in the reported emphasis placed on academic success.[103]

Internationally, based on responses from headteachers and teachers, greater emphasis on academic success was associated with higher average achievement scores. However, in England, the size of the standard errors indicates that any differences are unlikely to be statistically significant.

102 http://timssandpirls.bc.edu/timss2011/index.html

103 See Exhibits 6.2 and 6.4 in the international mathematics and science reports.

7.2.6 Teachers' ratings of the extent to which their schools are safe and orderly

This section describes teachers' perceptions of school safety. The teachers of Y9 pupils were asked about the behaviour of pupils and safety in their school (the statements given can be seen in Table 7.16). Based on responses to these statements, a scale was constructed and pupils were categorised as being in schools that, according to their teachers' perceptions, were: *Safe and Orderly*, *Somewhat Safe and Orderly* or *Not Safe and Orderly* (details of how pupils were assigned to each band is provided in Table 7.16). As with the other teacher reported data, this section reports the percentages of the pupils taught by teachers who had particular views about safety in their school rather than the percentages of teachers who held these views. In England, the average scale score for mathematics was 10.6, and for science it was 10.2. Both scores were within the *Somewhat Safe and Orderly* category overall.

Table 7.16 Safe and orderly school

Mathematics

Reported by Teachers

Students were scored according to their teachers' degree of agreement with five statements on the *Safe and Orderly School* scale. Students in **Safe and Orderly** schools had a score on the scale of at least 10.7, which corresponds to their teachers "agreeing a lot" with three of the five qualities of a safe and orderly school and "agreeing a little" with the other two, on average. Students in **Not Safe and Orderly** schools had a score no higher than 6.8, which corresponds to their teachers "disagreeing a little" with three of the five qualities and "agreeing a little" with the other two, on average. All other students attended **Somewhat Safe and Orderly** schools.

Country	Safe and Orderly		Somewhat Safe and Orderly		Not Safe and Orderly		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	53 (4.5)	521 (7.2)	42 (4.2)	487 (10.3)	6 (1.9)	505 (19.1)	10.6 (0.19)
International Avg.	45 (0.5)	479 (1.0)	49 (0.6)	458 (0.9)	6 (0.3)	445 (3.1)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

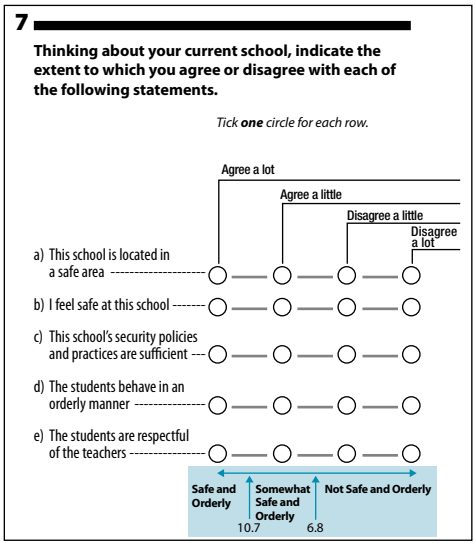
Science

Reported by Teachers

Students were scored according to their teachers' degree of agreement with five statements on the *Safe and Orderly School* scale. students in **Safe and Orderly** schools had a score on the scale of at least 10.7, which corresponds to their teachers "agreeing a lot" with three of the five qualities of a safe and orderly school and "agreeing a little" with the other two, on average. Students in **Not Safe and Orderly** schools had a score no higher than 6.8, which corresponds to their teachers "disagreeing a little" with three of the five qualities and "agreeing a little" with the other two, on average. All other students attended **Somewhat Safe and Orderly** schools.

Country	Safe and Orderly		Somewhat Safe and Orderly		Not Safe and Orderly		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	46 (3.0)	544 (7.3)	46 (3.0)	522 (7.1)	8 (1.6)	516 (15.1)	10.2 (0.13)
International Avg.	45 (0.5)	488 (0.9)	50 (0.5)	470 (0.8)	6 (0.3)	457 (2.3)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Source: Exhibit 6.8, international mathematics and science reports; question adapted from the international version of the TIMSS 2011 Mathematics and Science Teacher Questionnaires[104]

Compared with the Y5 pupils, a smaller percentage of Y9 pupils were taught by teachers who judged their school to be *Safe and Orderly*. This was the case for both mathematics and science (53 and 46 per cent of Y9 pupils were taught mathematics and science respectively by teachers who judged their schools to be *Safe and Orderly*. This compared with over 65 per cent for each subject at Y5). There was a lot of variation across countries in terms of the percentage of pupils in each of the three categories of this scale.

Across countries, being in a school perceived by teachers to be *Safe and Orderly* appeared to be associated with higher pupil achievement, as demonstrated in the international average achievement scores (Table 7.16). However, this relationship across the three categories was not seen in England.[105]

7.2.7 Teachers' ratings of the extent of school discipline and safety

Headteachers were asked about the degree to which a number of potential safety and discipline issues were a problem in their school (these questions and details of how the *School Discipline and Safety* scale was constructed can be found in Table 7.17). While this section reports headteachers' perceptions of school discipline and safety, it is important to recognise that findings are presented as the percentage of pupils whose headteachers hold these views. In England, the average scale score was 10.6 for both subjects: within the *Minor Problems* category overall.

104 http://timssandpirls.bc.edu/timss2011/index.html

105 Apparent differences are not likely to be significant across all three categories.

Table 7.17 School discipline and safety

Mathematics

Reported by Principals

Students were scored according to their principals' responses concerning eleven potential school problems on the *School Discipline and Safety* scale. Students in schools with **Hardly Any Problems** had a score on the scale of at least 12.0, which corresponds to their principals reporting "not a problem" for six of the eleven discipline and safety issues and "minor problem" for the other five, on average. Students in schools with **Moderate Problems** had a score no higher than 8.4, which corresponds to their principals reporting "moderate problem" for six of the eleven issues and "minor problem" for the other five, on average. All other students attended schools with **Minor Problems**.

Country	Hardly Any Problems		Minor Problems		Moderate Problems		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	19 (3.9)	519 (13.0)	76 (4.3)	508 (7.4)	5 (2.3)	456 (31.6)	10.6 (0.14)
International Avg.	16 (0.4)	483 (1.7)	66 (0.5)	467 (0.7)	18 (0.4)	437 (1.8)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

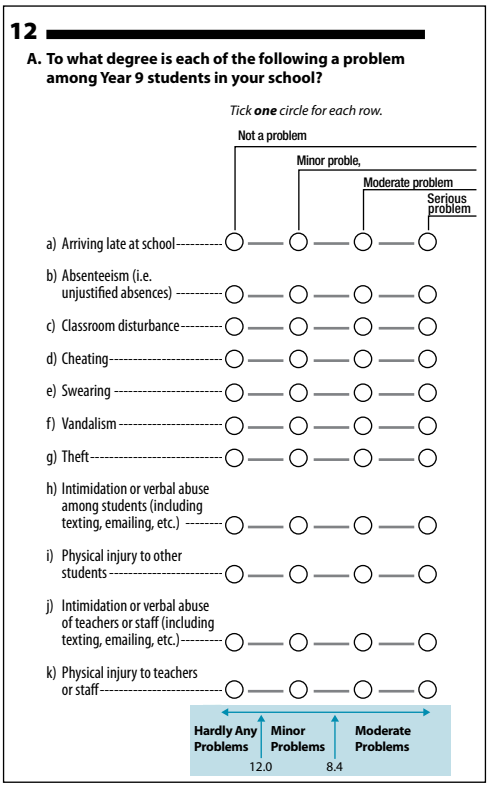
Science

Reported by Principals

Students were scored according to their principals' responses concerning eleven potential school problems on the *School Discipline and Safety* scale. Students in schools with **Hardly Any Problems** had a score on the scale of at least 12.0, which corresponds to their principals reporting "not a problem" for six of the eleven discipline and safety issues and "minor problem" for the other five, on average. Students in schools with **Moderate Problems** had a score no higher than 8.4, which corresponds to their principals reporting "moderate problem" for six of the eleven issues and "minor problem" for the other five, on average. All other students attended schools with **Minor Problems**.

Country	Hardly Any Problems		Minor Problems		Moderate Problems		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	19 (3.9)	548 (12.2)	76 (4.3)	534 (6.8)	5 (2.3)	484 (42.6)	10.6 (0.14)
International Avg.	16 (0.4)	492 (1.7)	66 (0.5)	477 (0.7)	18 (0.4)	452 (2.0)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Source: Exhibit 6.10, international mathematics and science reports; question adapted from the international version of the TIMSS 2011 School Questionnaire[106]

106 http://timssandpirls.bc.edu/timss2011/index.html

As can be seen in Table 7.17, 19 per cent of Y9 pupils were in schools where headteachers' responses indicated that there were *Hardly Any Problems* with safety or discipline. This compared with 77 per cent of Y5 pupils. However, this lower figure for pupils aged 13-14 was in line with the international average of 16 per cent (61 per cent for pupils aged 9 -10). Notably, two participants that performed significantly better than England in mathematics and/or science had a smaller percentage of pupils in this category (Minnesota and North Carolina).

In England, there was not a clear association between the perceived level of discipline and safety in a school and the average achievement of pupils in mathematics and science.[107]

7.2.8 Teachers' reports of the extent to which their teaching is limited by disruptive or uninterested pupils

The teachers of Y9 pupils were also asked about the extent to which disruptive or uninterested pupils limited their ability to teach. Their responses were grouped into the following two categories: *some or not at all* or *a lot*. As these questions were used in the 2007 TIMSS cycle we are able to explore trends over time. However, as noted in section 7.1.8, the response categories changed in 2011 and therefore we can only reliably compare those teachers who used the response category *a lot*.

Table 7.18 Teaching limited by disruptive or uninterested students

Mathematics

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Disruptive Students				Students in Classrooms Where Teachers Report Instruction Is Limited by Uninterested Students			
	Some or Not At All		A Lot		Some or Not At All		A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	83 (3.1)	518 (6.1)	17 (3.1)	448 (12.8)	88 (2.6)	516 (6.0)	12 (2.6)	436 (13.1)
International Avg.	83 (0.4)	472 (0.6)	17 (0.4)	444 (1.8)	76 (0.5)	475 (0.7)	24 (0.5)	441 (1.5)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Science

Reported by Teachers

Country	Pupils in Classrooms Where Teachers Report Instruction Is Limited by Disruptive Students				Pupils in Classrooms Where Teachers Report Instruction Is Limited by Uninterested Students			
	Some or Not At All		A Lot		Some or Not At All		A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	r 83 (2.7)	538 (5.9)	17 (2.7)	506 (11.1)	r 90 (2.0)	534 (5.7)	10 (2.0)	511 (10.9)
International Avg.	83 (0.4)	481 (0.6)	17 (0.4)	462 (1.8)	79 (0.4)	482 (0.6)	21 (0.4)	456 (1.7)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

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

Source: Exhibit 8.24 international mathematics and science reports

107 Based on the size of the standard errors, the apparent differences are unlikely to be statistically significant.

Table 7.18 shows that, for both mathematics and science, 17 per cent of pupils in Y9 were taught by teachers who reported that their teaching is limited *a lot* by disruptive pupils. The percentage of pupils taught by teachers reporting *a lot* of limitations due to uninterested pupils was slightly lower for both mathematics (12 per cent) and science (10 per cent). All these percentages were higher than the equivalent percentages for Y5. In 2007 the equivalent percentages for Y9 pupils for mathematics were: 16 per cent for disruptive pupils and 11 per cent for uninterested pupils. The equivalent 2007 percentages for science were: 18 per cent for disruptive pupils and 15 per cent for uninterested pupils. This shows that the findings in 2011 were broadly comparable with those for 2007 but slightly lower for pupils uninterested in science in 2011.

Internationally there was a varied picture: some of the higher achieving countries had a large percentage of pupils taught by teachers who reported that their teaching is limited *a lot* by disruptive or uninterested pupils. A few TIMSS participants, with performance significantly higher than England, had a smaller percentage of pupils taught by teachers who reported that their teaching is limited *a lot* by disruptive or uninterested pupils. However, compared with England, Chinese Taipei and Korea had larger percentages of pupils taught by teachers who reported that their teaching is limited to a greater extent by disruptive and/or uninterested pupils, and this was the case for both mathematics and science.

At Y5 in England, large differences were observed for both mathematics and science in the achievement scores of those pupils whose teachers reported being limited *some or not at all* by uninterested or disruptive pupils and those whose teachers reported being limited *a lot* by these pupils. A similar difference was seen at Y9 for mathematics but the apparent differences for science are not likely to be significant.[108]

7.2.9 Pupils' reports of bullying in school

Pupils in Y9 were asked how often they had experienced six specific 'bullying' behaviours in their school. This was the same question that Y5 pupils answered (the list of behaviours can be seen below Table 7.19). Pupils were categorised according to the frequency with which they had experienced the behaviours *during this year* (details of how pupils were categorised is provided in Table 7.19). In England, the average scale score for mathematics and science was 10.4; this score was within the *Almost Never* category of the *Students Bullied at School* scale overall.

Table 7.19 Pupils bullied at school

Mathematics

Reported by Students

Students were scored according to their responses to how often they experienced six bullying behaviors on the *Students Bullied at School* scale. Students bullied **Almost Never** had a score on the scale of at least 9.6, which corresponds to "never" experiencing three of the six bullying behaviors and each of the other three behaviors "a few times a year," on average. Students bullied **About Weekly** had a score no higher than 7.7, which corresponds to their experiencing each of three of the six behaviors "once or twice a month" and each of the other three "a few times a year," on average. All other students were bullied **About Monthly**.

Country	Almost Never		About Monthly		About Weekly		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	68 (1.1)	509 (5.6)	24 (0.7)	511 (6.0)	7 (0.6)	486 (11.1)	10.4 (0.05)
International Avg.	59 (0.2)	473 (0.6)	29 (0.1)	467 (0.7)	12 (0.1)	441 (1.0)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

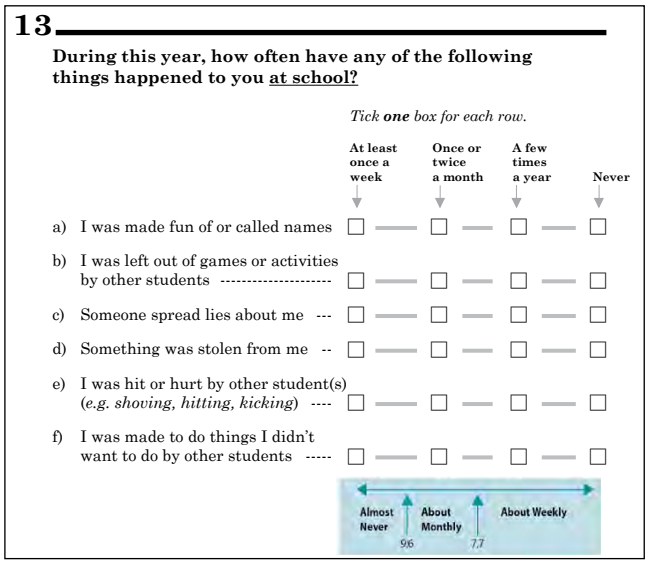
108 http://timssandpirls.bc.edu/timss2011/index.html

Reported by Students

Students were scored according to their responses to how often they experienced six bullying behaviors on the *Pupils Bullied at School* scale. Students bullied **Almost Never** had a score on the scale of at least 9.6, which corresponds to "never" experiencing three of the six bullying behaviors and each of the other three behaviors "a few times a year," on average. Students bullied **About Weekly** had a score no higher than 7.7, which corresponds to their experiencing each of three of the six behaviors "once or twice a month" and each of the other three "a few times a year," on average. All other students were bullied **About Monthly**.

Country	Almost Never		About Monthly		About Weekly		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	68 (1.1)	535 (5.1)	24 (0.7)	537 (5.5)	7 (0.6)	515 (10.9)	10.4 (0.05)
International Avg.	59 (0.2)	483 (0.6)	29 (0.1)	478 (0.7)	12 (0.1)	452 (1.1)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



13

During this year, how often have any of the following things happened to you at school?

*Tick **one** box for each row.*

	At least once a week	Once or twice a month	A few times a year	Never
a) I was made fun of or called names	☐	☐	☐	☐
b) I was left out of games or activities by other students	☐	☐	☐	☐
c) Someone spread lies about me	☐	☐	☐	☐
d) Something was stolen from me	☐	☐	☐	☐
e) I was hit or hurt by other student(s) (*e.g. shoving, hitting, kicking*)	☐	☐	☐	☐
f) I was made to do things I didn't want to do by other students	☐	☐	☐	☐

Source: Exhibit 6.12, international mathematics and science reports; question adapted from the international version of the TIMSS 2011 Student Questionnaire[109]

Sixty-eight per cent of Y9 pupils in England were categorised as experiencing these six bullying behaviours *Almost Never*. Pupils in Y9 reported experiencing these bullying behaviours less frequently than pupils in Y5, where the equivalent percentage of pupils was 45 per cent. This might reflect a real difference in experience or differences in perception or reporting. Only 11 participants had a higher percentage of pupils who reported experiencing the six bullying behaviours *Almost Never*.

Across countries, pupils' reports about the frequency with which they experienced the six bullying behaviours appeared to be associated with average achievement in mathematics and science, as demonstrated in the international average achievement scores (as shown in Table 7.19). That is, increased frequency of bullying (as described by the categories of the *Students Bullied at Schoo*l scale) was related to a decrease in average mathematics achievement in 13–14 year olds. In England, although there were apparent differences in achievement between the groups of pupils, the score differences were small relative to the size of the standard errors and are therefore unlikely to be statistically significant across the three categories.

109 http://timssandpirls.bc.edu/timss2011/index.html

As nearly a quarter of Y9 pupils' responses put them in the category of experiencing bullying behaviour *About Monthly*, it is important to establish whether there was a similar finding in TIMSS 2007 or whether there has been a change in the frequency of bullying reported by Y9 pupils since the last TIMSS survey. As was the case for Y5 pupils, the scale and the response categories have changed since 2007 and therefore a complete comparison is not possible (details of how comparisons were made is given in section 7.1.9). Table 7.20 shows the findings for the two surveys.

Table 7.20 Trends in pupils bullied at school

Questionnaire item	2007 percentage of Y9 pupils	2011 percentage of Y9 pupils
I was made fun of or called names	26	27
I was hit or hurt by other children (*e.g. shoving, hitting, kicking*)	18	10
I was made to do things I didn't want to do by other children	7	4

Note: standard errors are not available for this data.

Source: derived from national dataset for TIMSS 2011[110] and weighted almanacs for TIMSS 2007 (Foy and Olson, 2009)

Table 7.20 shows that the percentages of pupils in 2011 who reported that they had been made fun of or called names, or were made to do things they did not want to do by others were similar to the percentages for 2007. The biggest change (a reduction), as was the case for Y5 pupils, was the percentage of Y9 pupils reporting that they had been hit or hurt by other students.[111]

110 See the TIMSS 2011 international database at http://timssandpirls.bc.edu/timss2011/index.html

111 In the context that pupils were not asked exactly the same question, in 2011 there were additional response categories and pupils were not specifically asked about the last month. In addition, the differences have not been tested to ascertain whether or not they are statistically significant.

Chapter 8 School resources

Chapter outline

This chapter explores findings on teachers' working conditions; availability of computers for mathematics and science lessons; and views about limitations on teaching mathematics and science caused by resourcing. The chapter summarises findings for mathematics and science in Year 5 (Y5, ages 9 to 10) and Year 9 (Y9, ages 13 to 14) in 2011.

Findings for Y5 are presented first (for mathematics and science), followed by findings for Y9 (mathematics and science). Outcomes for England are compared with those of other countries where relevant.

Key findings

- Mathematics and science teachers in England rated their working conditions relatively positively compared to other countries.
- In England, all pupils had some level of computer availability.
- England had the highest computer availability of all participating countries in both mathematics and science. Other countries with high ratios of computer provision for pupils included the Slovak Republic, Northern Ireland, New Zealand and Australia.
- Internationally, in both subjects, at both age groups, pupils with no access to computers scored less well than those with computers available.
- Although the data for England appeared to show an association between the extent of computer availability and achievement for Year 5, this is unlikely to be significant.[112] Computer availability was too high for a similar comparison to be made at Year 9.
- According to their headteachers, no pupils in England attended schools in which Y5 or Y9 mathematics or science teaching was perceived as *Affected A Lot* by resource shortages.

112 Throughout this report, findings listed as 'significant' are statistically significant.

Interpreting the data: scaled data from teachers and headteachers

Most of the data presented in this chapter is reported by teachers and headteachers. Reported percentages refer to pupils and can usually (unless otherwise indicated) be interpreted as the percentage of pupils whose teacher or headteacher reported a particular practice or gave a particular response to a questionnaire item.

When interpreting the data from pupils, headteachers and teachers it is important to take account of the relative sample sizes. Participants are expected to sample a minimum of 150 schools in each year group and a minimum of 4,000 students for each target year group (these figures represent the numbers *drawn* in the sample; the achieved sample numbers may be less). The *achieved* ranges for participating schools internationally were 96 to 459 for Y5, and 95 to 501 for Y9[113]. These wide ranges reflected the fact that some participants had fewer than 150 schools available and some participants chose to over-sample schools. Just over half of participants sampled between 150 and 200 schools for each age group.

For TIMSS 2011 in England, the number of participating schools was 125 at Y5 and 118 at Y9. Numbers of participants within these schools were:

- 3,397 Y5 and 3,482 Y9 pupils.
- 125 and 118 headteachers respectively answered the Y5 and Y9 School Questionnaire.
- 194 Y5 class teachers completed a Teacher Questionnaire for mathematics and 199 for science.
- 213 Y9 teachers completed the Mathematics Teacher Questionnaire.
- 757 Y9 teachers completed the Science Teacher Questionnaire (the number of science teachers was greater as the Y9 pupils were sampled by mathematics class).

See Appendix A for more information about numbers of participants and sampling method.

8.1 Year 5

8.1.1 Teacher working conditions

Teachers were asked to rate the working conditions in their current school in terms of several potential problem areas. Pupils were scored according to their teachers' responses concerning five problem areas on the *Teacher Working Conditions* scale: buildings, workspace, hours, classrooms and materials. The questions and details of the scoring are shown in Table 8.1. In England, the average scale score for mathematics was 10.9, and for science it was 11.0; both scores were within the *Minor Problems* category overall.

113 These figures refer to countries and exclude benchmarking participants

Interpreting the data: indices and scales

In order to summarise data from a questionnaire, responses to several related items are sometimes combined to form an index or scale. The respondents to the questionnaire items are grouped according to their responses and the way in which responses have been categorised is shown for each index or scale. The data in an index or scale is often considered to be more valid and reliable than the responses to individual items.

Table 8.1 Teacher Working Conditions

Mathematics

Reported by Teachers

Students were scored according to their teachers' responses concerning five potential problem areas on the *Teacher Working Conditions* scale. Students whose teachers had **Hardly Any Problems** with their working conditions had a score on the scale of at least 11.3, which corresponds to their teachers reporting "not a problem" for three of five areas and "minor problem" for the other two, on average. Students whose teachers had **Moderate Problems** had a score no higher than 8.7, which corresponds to their teachers reporting "moderate problem" for three of five conditions and "minor problem" for the other two, on average. All other students had teachers that reported **Minor Problems** with their working conditions.

Country	Hardly Any Problems		Minor Problems		Moderate Problems		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	40 (4.3)	541 (5.7)	51 (4.6)	548 (5.7)	9 (2.4)	540 (11.6)	10.9 (0.14)
International Avg.	26 (0.5)	498 (1.1)	47 (0.5)	491 (0.7)	27 (0.5)	487 (1.0)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

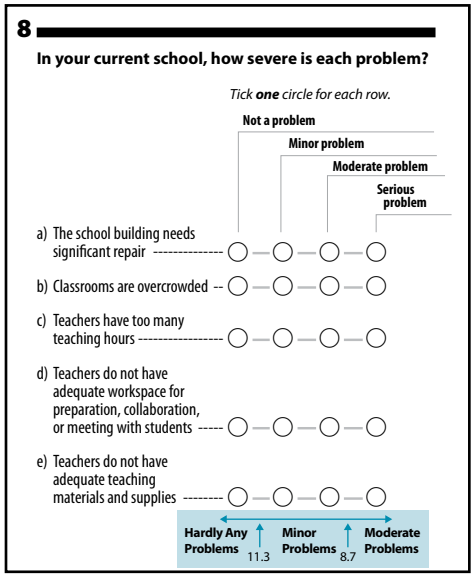
Science

Reported by Teachers

Students were scored according to their teachers' responses concerning five potential problem areas on the *Teacher Working Conditions* scale. Students whose teachers had **Hardly Any Problems** with their working conditions had a score on the scale of at least 11.7, which corresponds to their teachers reporting "not a problem" for three of five areas and "minor problem" for the other two, on average. Students whose teachers had **Moderate Problems** had a score no higher than 8.9, which corresponds to their teachers reporting "moderate problem" for three of five conditions and "minor problem" for the other two, on average. All other students had teachers that reported **Minor Problems** with their working conditions.

Country	Hardly Any Problems		Minor Problems		Moderate Problems		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England r	23 (3.0)	536 (9.5)	48 (3.5)	531 (7.3)	28 (3.3)	529 (9.9)	10.2 (0.14)
International Avg.	20 (0.4)	489 (1.5)	48 (0.5)	477 (0.8)	32 (0.5)	473 (1.1)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.



Sources: Exhibit 5.10, international mathematics report, and Exhibit 5.9, international science report; question adapted from the international version of the TIMSS 2011 Teacher Questionnaire[114]

Teachers of Y5 mathematics and science in England gave relatively high overall ratings about their working conditions. Around 40 per cent of pupils were taught by teachers who were categorised as having *Hardly Any Problems* with their working conditions (40 per cent for mathematics, and 41 per cent for science). Around half of Y5 pupils (51, and 52 per cent for mathematics and science respectively) were taught by teachers categorised as having *Minor Problems* with their working conditions, and fewer than 10 per cent of pupils (9, and 7 per cent for mathematics and science respectively) had teachers categorised as having *Moderate Problems* with their working conditions (see Table 8.1).

Several of the highest performing countries had relatively high percentages of pupils taught mathematics and/or science by teachers who were classified as having *Moderate Problems* with their working conditions. These countries included Chinese Taipei (23 per cent for mathematics, 22 per cent for science), Japan (40 per cent for mathematics, 43 per cent for science), Korea (36 per cent for mathematics, 33 per cent for science) and Hong Kong (33 per cent for mathematics, 34 per cent for science). These countries also had lower percentages than England of pupils in the highest category (being taught by teachers categorised as having *Hardly Any Problems* with their working conditions); for these countries the percentages of pupils in this high category ranged from 23 per cent to 14 per cent across the mathematics and science findings.

The TIMSS countries with the highest percentages of pupils taught mathematics or science by teachers who were classified as having *Hardly Any Problems* were Poland and the United States, both with around 50 per cent of pupils being taught by teachers who were classified as having *Hardly Any Problems* with their working conditions.

The international averages show that pupil achievement in mathematics and science at Y5 was highest among pupils taught by teachers who were classified as having *Hardly Any Problems* with their working conditions. However, although this is seen internationally, it does not necessarily apply in all individual countries. There is no clear trend for England, and based on the size of the standard errors, the differences seen for England are unlikely to be significant.

8.1.2 Availability of computers for lessons

In order to calculate the availability of computers for lessons, headteachers were asked to indicate the number of pupils in Y5 and the total number of computers available for teaching. The calculated ratios for England are shown in Table 8.2.

The data shows that in England, according to headteachers, the majority of Y5 pupils (90 per cent) were in schools providing one computer for every one to two pupils. The equivalent international average was 38 per cent. For the remaining 10 per cent of pupils in England, computers were reportedly available for every three to five pupils.

Table 8.2 Schools with computers available for teaching

Mathematics

Reported by Principals

Country	1 Computer for 1–2 Students		1 Computer for 3–5 Students		1 Computer for 6 or More Students		No Computers Available	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England r	90 (2.8)	543 (4.2)	10 (2.8)	549 (16.6)	0 (0.0)	~ ~	0 (0.0)	~ ~
International Avg.	38 (0.5)	491 (1.1)	30 (0.5)	493 (1.2)	24 (0.5)	493 (1.3)	8 (0.3)	452 (2.9)

Science

Reported by Principals

Country	1 Computer for 1–2 Students		1 Computer for 3–5 Students		1 Computer for 6 or More Students		No Computers Available	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England r	90 (2.8)	528 (3.6)	10 (2.8)	533 (15.2)	0 (0.0)	~ ~	0 (0.0)	~ ~
International Avg.	38 (0.5)	486 (1.2)	30 (0.5)	487 (1.3)	24 (0.5)	491 (1.4)	8 (0.3)	450 (2.8)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Mathematics

The number of students per computer was calculated by dividing the number of students by the number of computers.

1) **What is the total enrollment of fourth grade students in your school as of the first day of the month TIMSS 2011 testing begins?**

_____

2) **What is the number of computers that can be used for instructional purposes by fourth grade students?**

_____

Sources: Exhibit 5.14, international mathematics report, and Exhibit 5.13 international science report; question adapted from the international version of the TIMSS 2011 School Questionnaire[115]

England had the highest level of reported computer availability among all participating countries, followed by the Slovak Republic and Northern Ireland.

Internationally, there was considerable variation from country to country. Chinese Taipei and Korea both had much lower percentages of pupils in schools where a computer was available for every one to two pupils; these figures were 23 per cent in Chinese Taipei, and 22 per cent in Korea. Some of the other highest-achieving countries also had lower levels of computer availability.

Table 8.2 appears to show an association between achievement and extent of computer availability (in England and internationally), but based on the size of the standard errors, most of these observed differences are unlikely to be significant. The main exception is that pupils internationally with no access to computers scored less well in both subjects than those with computers available.[116]

It is important to note that the relationship between computer availability and average attainment is complex. In some countries computer availability is highly interrelated with socio-economic levels, in others computers are used widely for remedial purposes. In addition, teaching practice and the quality of software programs varies greatly between, and within, countries. Any association, or lack of association, between computer availability and achievement might be affected by these varying reasons for levels of computer availability and varying reasons for computer use.

115 http://timssandpirls.bc.edu/timss2011/index.html

116 It is likely that this difference is significant. There are some other potentially significant differences for science, but these are very small borderline differences.

8.1.3 Views about limitations on teaching caused by resourcing

In order to measure views about limitations on teaching caused by resourcing, headteachers were asked to rate the extent to which their school's capacity to teach mathematics and science was limited by a shortage of resources.

Questions were asked about general school resources (such as supplies, materials, teaching space and buildings), and questions were also asked about specific resources for teaching mathematics and science. These questions are shown in Table 8.3.[117]

Pupils were scored according to their headteachers' responses concerning the seven general school and classroom resources and five subject specific resources. In each case, the scale contained the general resources and the relevant subject-specific resources. The question was analysed as two separate scales, one for each subject. This resulted in the parallel *Mathematics Resource Shortages* and *Science Resource Shortages scales*; an explanation of how each scale was calculated is shown in Table 8.3.

In England, the average scale score was 11.1 for both mathematics and science; on the border of the *Not Affected* and *Somewhat Affected* categories for mathematics, and in the *Somewhat Affected* category for science overall.

Table 8.3 Teaching affected by resource shortages

Mathematics

Reported by Principals

Students were scored according to their principals' responses concerning twelve school and classroom resources on the *Mathematics Resource Shortages* scale. Students in schools where instruction was **Not Affected** by resource shortages had a score on the scale of at least 11.1, which corresponds to their principals reporting that shortages affected instruction "not at all" for six of the twelve resources and "a little" for the other six, on average. Students in schools where instruction was **Affected A Lot** had a score no higher than 6.8, which corresponds to their principals reporting that shortages affected instruction "a lot" for six of the twelve resources and "some" for the other six, on average. All other students attended schools where instruction was **Somewhat Affected** by resource shortages.

Country	Not Affected		Somewhat Affected		Affected A Lot		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	42 (4.8)	545 (6.5)	58 (4.8)	540 (5.5)	0 (0.0)	~ ~	11.1 (0.18)
International Avg.	25 (0.5)	497 (1.2)	70 (0.5)	488 (0.6)	5 (0.2)	462 (3.5)	

Centerpoint of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.

Science

Reported by Principals

Students were scored according to their headteachers' responses concerning twelve school and classroom resources on the *Science Resource Shortages* scale. Students in schools where instruction was **Not Affected** by resource shortages had a score on the scale of at least 11.3, which corresponds to their headteachers reporting that shortages affected instruction "not at all" for six of the twelve resources and "a little" for the other six, on average. Students in schools where instruction was **Affected A Lot** had a score no higher than 7.1, which corresponds to their headteachers reporting that shortages affected instruction "a lot" for six of the twelve resources and "some" for the other six, on average. All other students attended schools where instruction was **Somewhat Affected** by resource shortages.

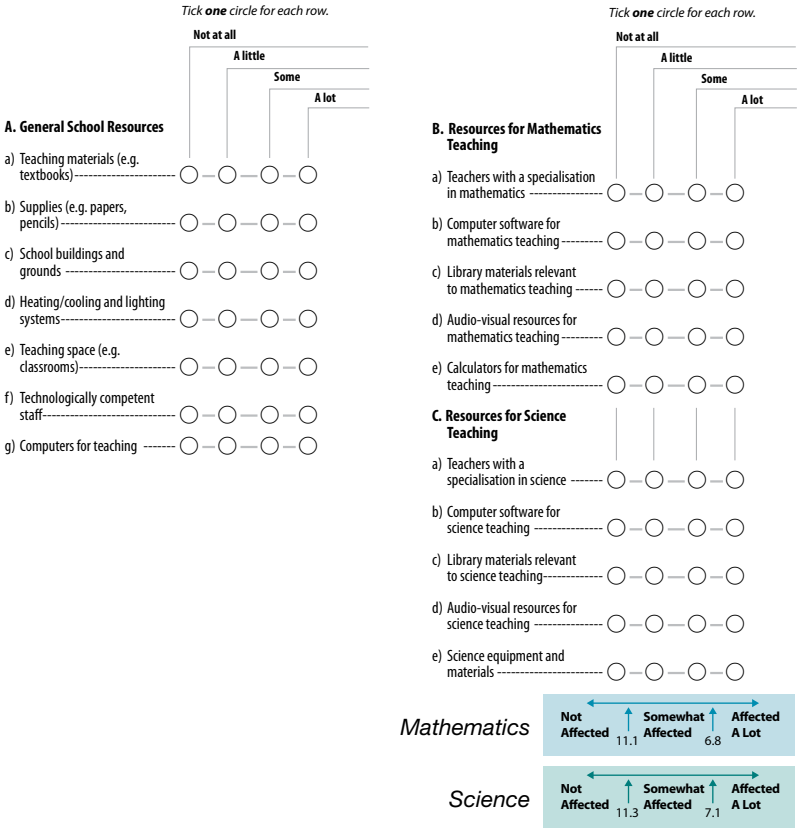
Country	Not Affected		Somewhat Affected		Affected A Lot		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	37 (4.7)	527 (6.4)	63 (4.7)	529 (4.4)	0 (0.0)	~ ~	11.1 (0.17)
International Avg.	22 (0.4)	495 (1.3)	72 (0.5)	485 (0.6)	7 (0.3)	460 (4.0)	

Centrepoint of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.

117 As this is a new scale, the international analysis does not include trend data.

10

How much is your school's capacity to provide teaching affected by a shortage or inadequacy of the following?



Section B did not contribute to these scales.

Sources: Exhibit 5.8, international mathematics report, and Exhibit 5.7, international science report; questions adapted from the international version of the TIMSS 2011 School Questionnaire[118]

According to their headteachers' responses, over half of Y5 pupils in England (58 and 63 per cent respectively for mathematics and science) were in schools where mathematics and science teaching were perceived as *Somewhat Affected* by resource shortages. No pupils were in schools where teaching was perceived as *Affected A Lot* by resource shortages, and the remainder (42 and 37 per cent respectively) were in schools where teaching was perceived as *Not Affected* by resource shortages (see Table 8.3).

There are several examples of high performing countries which reported relatively small percentages of pupils attending schools where teaching was perceived as *Not Affected* by resource shortages. For example, the percentages of Y5 pupils in schools where teaching was perceived as *Not Affected* by resource shortages (as reported by headteachers) in Japan, Finland, and Chinese Taipei were relatively low (compared to England), at 28 and 23 per cent for mathematics and science respectively in Japan, 24 and 19 per cent in Finland, and 9 per cent for both subjects in Chinese Taipei. The percentages in Singapore were similar to England, at 37 and 36 per cent respectively.

118 http://timssandpirls.bc.edu/timss2011/index.html

In Hong Kong, a high performing country in mathematics at this age group, the vast majority of pupils were in schools where mathematics and science teaching were perceived as *Somewhat Affected* by resource shortages (over 90 per cent), with no pupils in schools where teaching was perceived as being *Not Affected* by resource shortages.

This illustrates the great variability among the highest performing countries in headteachers' perceptions of resource shortages affecting teaching in their schools.

Internationally, there was an association between resourcing and achievement for both subjects: as the perceived effect of resource shortages increases, achievement decreases on average. However, based on the size of the standard errors, the differences in England are unlikely to be statistically significant for either mathematics or science.

8.2 Year 9

8.2.1 Teacher working conditions

As for Y5, teachers were asked to rate the working conditions in their current school in terms of several potential problem areas. Pupils were scored according to their teachers' responses concerning five potential problem areas on the *Teacher Working Conditions* scale: buildings, workspace, hours, classrooms and materials. The questions and details of the scoring are shown in Table 8.4. In England, the average scale score for mathematics was 10.9, and for science it was 10.2; both scores were within the *Minor Problems* category overall.

Table 8.4 Teacher working conditions

Mathematics

Reported by Teachers

Students were scored according to their teachers' responses concerning five potential problem areas on the *Teacher Working Conditions* scale. Students whose teachers had **Hardly Any Problems** with their working conditions had a score on the scale of at least 11.7, which corresponds to their teachers reporting "not a problem" for three of five areas and "minor problem" for the other two, on average. Students whose teachers had **Moderate Problems** had a score no higher than 8.9, which corresponds to their teachers reporting "moderate problem" for three of five conditions and "minor problem" for the other two, on average. All other students had teachers that reported **Minor Problems** with their working conditions.

Country	Hardly Any Problems		Minor Problems		Moderate Problems		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	30 (4.4)	500 (8.2)	55 (4.4)	516 (8.5)	14 (2.9)	479 (13.7)	10.9 (0.18)
International Avg.	21 (0.5)	479 (1.6)	49 (0.6)	467 (0.9)	31 (0.5)	464 (1.2)	

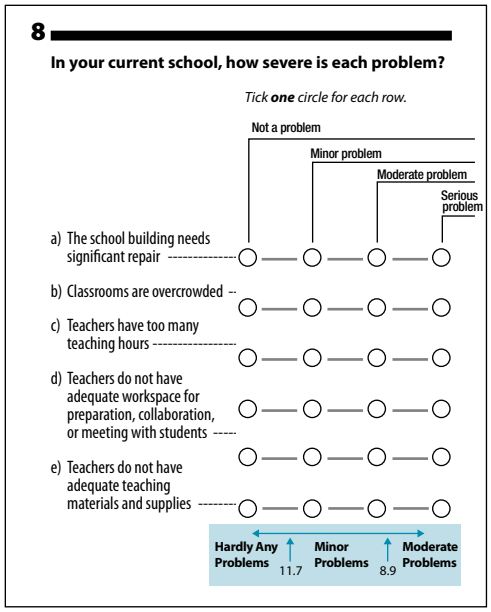
Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Reported by Teachers

Students were scored according to their teachers' responses concerning five potential problem areas on the *Teacher Working Conditions* scale. Students whose teachers had **Hardly Any Problems** with their working conditions had a score on the scale of at least 11.7, which corresponds to their teachers reporting "not a problem" for three of five areas and "minor problem" for the other two, on average. Students whose teachers had **Moderate Problems** had a score no higher than 8.9, which corresponds to their teachers reporting "moderate problem" for three of five conditions and "minor problem" for the other two, on average. All other students had teachers that reported **Minor Problems** with their working conditions.

Country		Hardly Any Problems		Minor Problems		Moderate Problems		Average Scale Score
		Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	r	23 (3.0)	536 (9.5)	48 (3.5)	531 (7.3)	28 (3.3)	529 (9.9)	10.2 (0.14)
International Avg.		20 (0.4)	489 (1.5)	48 (0.5)	477 (0.8)	32 (0.5)	473 (1.1)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.



Sources: Exhibit 5.11, international mathematics report, and Exhibit 5.10, international science report; questions adapted from the international version of the TIMSS 2011 Mathematics Teacher and Science Teacher Questionnaires[119]

119 http://timssandpirls.bc.edu/timss2011/index.html

Mathematics

In England, 30 per cent of pupils were taught by teachers who were classified as having *Hardly Any Problems* with their working conditions, 55 per cent were taught by teachers classified as having *Minor Problems*, and 14 per cent had teachers classified as having *Moderate Problems* with their working conditions (see Table 8.4). Teacher ratings of their working conditions were more positive among the Y5 teachers than the Y9 teachers.

Several of the highest performing countries had relatively high percentages of pupils with teachers who were placed in the lowest category of the *Teacher Working Conditions* scale (those whose teachers were classified as having *Moderate Problems* with their working conditions). These countries included Japan (38 per cent), Chinese Taipei (26 per cent), Hong Kong (23 per cent), and Korea (56 per cent). These countries also had lower percentages than England of pupils in the highest category (being taught by teachers classified as having *Hardly Any Problems*); for these countries the percentages of pupils in this high category ranged from 22 per cent to 8 per cent.

The TIMSS participants with the highest percentages of Y9 pupils taught mathematics by teachers who were classified as having *Hardly Any Problems* were the United States and Qatar, with 48 per cent and 47 per cent of pupils respectively.

Internationally, pupils taught by teachers classified as having *Hardly Any Problems* with their working conditions achieved higher average scores than their peers; while this international association is likely to be statistically significant, it does not necessarily apply in all individual countries. The apparent differences in achievement in England are unlikely to be significant across the three categories.

Science

At Y9 the teacher responses to questions about working conditions were less positive for science than for mathematics. In England, 23 per cent of Y9 pupils were taught by science teachers who were categorised as having *Hardly Any Problems* in their working conditions, 48 per cent were taught by teachers categorised as having *Minor Problems*, and 28 per cent of pupils had teachers classified as having *Moderate Problems* with their working conditions (see Table 8.4).

Several of the highest performing countries had relatively high percentages of pupils with teachers who were in the lowest category of the *Teacher Working Conditions scale* (classified as having *Moderate Problems* with their working conditions). These countries included Japan (40 per cent), Finland (24 per cent), Chinese Taipei (21 per cent), and Korea (53 per cent). These countries also had lower percentages than England of pupils in the highest category (being taught by teachers classified as having *Hardly Any Problems*); for these countries the percentages of pupils in this high category ranged from 18 per cent to 7 per cent.

The TIMSS countries with the highest percentages of Y9 pupils taught by teachers classified as having *Hardly Any Problems* were the same as for mathematics (Qatar and the United States, with 51 per cent and 40 per cent respectively).

For science, as for mathematics, there was an association internationally between perceptions of working conditions and pupil achievement. However, the differences in achievement in England are unlikely to be significant.

8.2.2 Availability of computers for lessons

As at Y5, in order to calculate the availability of computers for lessons, headteachers were asked to indicate the number of pupils in Y9 and the total number of computers available for teaching. The calculated ratios for England are shown in Table 8.5.

Table 8.5 Schools with Computers Available for Teaching

Mathematics

Reported by Principals

Country	1 Computer for 1–2 Students		1 Computer for 3–5 Students		1 Computer for 6 or More Students		No Computers Available	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	99 (0.9)	510 (5.8)	1 (0.9)	~ ~	0 (0.0)	~ ~	0 (0.0)	~ ~
International Avg.	40 (0.5)	472 (1.4)	28 (0.5)	472 (1.5)	28 (0.4)	467 (1.8)	4 (0.2)	396 (4.7)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.

Science

Reported by Principals

Country	1 Computer for 1–2 Students		1 Computer for 3–5 Students		1 Computer for 6 or More Students		No Computers Available	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	99 (0.9)	537 (5.2)	1 (0.9)	~ ~	0 (0.0)	~ ~	0 (0.0)	~ ~
International Avg.	40 (0.5)	481 (1.2)	28 (0.5)	480 (1.4)	28 (0.4)	474 (1.7)	4 (0.2)	408 (5.6)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.

The number of students per computer was calculated by dividing the number of students by the number of computers.

1) **What is the total enrollment of fourth grade students in your school as of the first day of the month TIMSS 2011 testing begins?**

_____

2) **What is the number of computers that can be used for instructional purposes by fourth grade students?**

_____

Sources: Exhibit 5.15, international mathematics report, and Exhibit 5.14, international science report; question adapted from the international version of the TIMSS 2011 School Questionnaire[120]

Again, at this age group, England had the highest level of reported computer provision among all participating countries; nearly all pupils in England (99 per cent) were in schools where a computer was available for every one to two pupils. The equivalent international average was 40 per cent (see Table 8.5), although there was considerable variation from country to country.

Other TIMSS countries with a particularly high percentage of pupils in schools where a computer was available for every one to two pupils included Australia at 89 per cent, and New Zealand at 88 per cent.

Three of the highest scoring countries (Japan, Chinese Taipei and Korea) each had lower percentages of pupils in schools where a computer was available for every

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one to two pupils; these figures were 31 per cent in Japan, and 6 per cent in each of Chinese Taipei and Korea.

Internationally, the differences in achievement scores between those pupils in schools with *No Computers Available*, and pupils in any one of the categories of some computer availability, are likely to be statistically significant for both subjects. This is also true of the differences in achievement related to having one computer for six or more pupils, compared with each category of higher computer availability.[121] Other comparisons across the categories of computer availability are unlikely to be statistically significant (based on the size of the standard errors).

Differences in achievement could not be calculated for England because of the high level of computer provision in Y9. As noted for Y5, the relationship between computer availability and achievement is complex. See section 8.1.2 for more information.

8.2.3 Views about limitations on teaching caused by resourcing

As with Y5, headteachers of Y9 pupils were asked to rate the extent to which their school's capacity to teach mathematics and science was limited by a shortage of resources. Headteachers were asked about general school resources as well as specific resources for teaching mathematics and science; the questions can be seen in Table 8.6.

Pupils were scored according to their headteachers' responses concerning the seven general school and classroom resources and five subject specific resources. In each case, the scale contained the general resources and the relevant subject-specific resources. The question was analysed as two separate scales, one for each subject. This resulted in the parallel *Mathematics Resource Shortages* and *Science Resource Shortages scales*; an explanation of how each scale was calculated is shown in Table 8.3.[122]

In England, the average scale score was 11.3 for both mathematics and science; within the *Not Affected* category overall for each subject.

121 Although the findings for both subjects are likely to be significant, the difference is potentially borderline for mathematics and very small.

122 As this is a new scale, the international analysis does not include trend data.

Table 8.6 Teaching Affected by Resource Shortages

Mathematics

Reported by Principals

Students were scored according to their headteachers' responses concerning twelve school and classroom resources on the *Mathematics Resource Shortages* scale. Students in schools where instruction was **Not Affected** by resource shortages had a score on the scale of at least 11.1, which corresponds to their headteachers reporting that shortages affected instruction "not at all" for six of the twelve resources and "a little" for the other six, on average. Students in schools where instruction was **Affected A Lot** had a score no higher than 7.3, which corresponds to their headteachers reporting that shortages affected instruction "a lot" for six of the twelve resources and "some" for the other six, on average. All other students attended schools where instruction was **Somewhat Affected** by resource shortages.

Country	Not Affected		Somewhat Affected		Affected A Lot		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	48 (4.2)	498 (8.1)	52 (4.2)	516 (8.2)	0 (0.0)	~ ~	11.3 (0.16)
International Avg.	25 (0.5)	488 (2.2)	69 (0.5)	464 (0.7)	6 (0.3)	453 (2.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.

Science

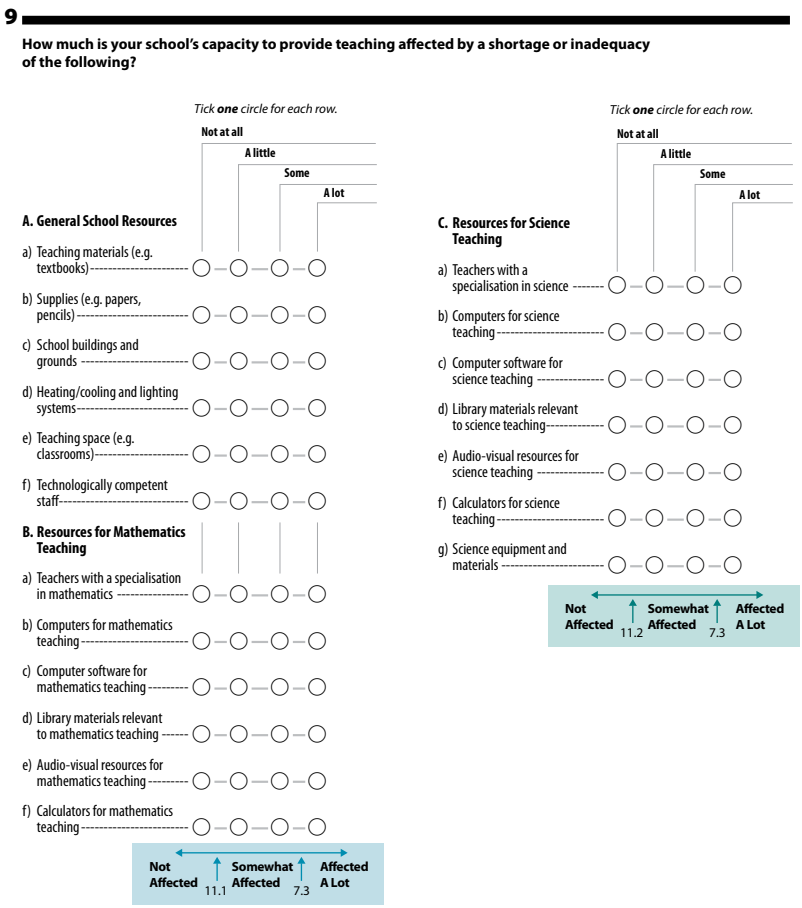
Reported by headteachers

Students were scored according to their principals' responses concerning thirteen school and classroom resources on the *Science Resource Shortages* scale. Students in schools where instruction was **Not Affected** by resource shortages had a score on the scale of at least 11.2, which corresponds to their principals reporting that shortages affected instruction "not at all" for seven of the thirteen resources and "a little" for the other six, on average. Students in schools where instruction was **Affected A Lot** had a score no higher than 7.3, which corresponds to their principals reporting that shortages affected instruction "a lot" for seven of the thirteen resources and "some" for the other six, on average. All other students attended schools where instruction was **Somewhat Affected** by resource shortages.

Country	Not Affected		Somewhat Affected		Affected A Lot		Average Scale Score
	Per cent of pupils	Average Achievement	Per cent of pupils	Average Achievement	Per cent of pupils	Average Achievement	
England	47 (4.0)	525 (7.8)	53 (4.0)	542 (7.3)	0 (0.0)	~ ~	11.3 (0.16)
International Avg.	22 (0.4)	494 (1.9)	71 (0.5)	474 (0.7)	7 (0.3)	464 (3.3)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.

Source: Exhibit 5.9, international mathematics report, and Exhibit 5.8, international science report



Source: question adapted from the international version of the TIMSS 2011 School Questionnaire[123]

Mathematics

The data show that just over half of Y9 pupils studying mathematics in England (52 per cent) were in schools where mathematics teaching was perceived by their headteachers as *Somewhat Affected* by resource shortages. No pupils were in schools where teaching was perceived as *Affected A Lot* by resource shortages, and 48 per cent of pupils were in schools where teaching was perceived as *Not Affected* by resource shortages (see Table 8.6).

The three countries with the highest percentages of pupils in schools where teaching was perceived to be *Not Affected* by resource shortages, based on their headteachers' responses, were Slovenia, Singapore and Korea, with between 71 and 58 per cent respectively.

The pattern seen in Hong Kong for Y5 mathematics is not mirrored for Y9 mathematics. In Hong Kong (one of the highest performing countries in mathematics), none of the 9–10 year old pupils were in schools where the teaching of mathematics was perceived as *Not Affected* by resource shortages, but at ages 13–14 a higher percentage of 41 per cent of pupils in Hong Kong attended schools where teaching was perceived as *Not Affected* by resource shortages.

Internationally, there is an association between perceived resource shortages and pupils' mathematics achievement. However, the differences in achievement in England are unlikely to be significant.

123 http://timssandpirls.bc.edu/timss2011/index.html

Science

Just over half of Y9 pupils in England (53 per cent) were in schools where science teaching was perceived as *Somewhat Affected* by resource shortages. No pupils were in schools where teaching was perceived as *Affected A Lot* by resource shortages, and 47 per cent of pupils were in schools where teaching was perceived as *Not Affected* by resource shortages. These findings are very similar to the findings for Y9 mathematics (see Table 8.6), despite being based on a set of parallel-but-different questions answered by headteachers.

The countries with the highest percentages of pupils in schools where teaching science was perceived as *Not Affected* by resource shortages were similar to those for mathematics: Singapore, Slovenia and Korea, with percentages between 64 and 57 per cent respectively.

As for mathematics, there is an international association between headteachers' perceptions of resource shortages and pupils' science achievement. However, the observed differences in science achievement in England are unlikely to be significant.

Chapter 9 The home environment

Chapter summary

This chapter presents findings relating to pupils' home background in Year 5 (Y5) and Year 9 (Y9), reported by pupils, teachers and headteachers. The chapter first describes pupils' home educational resources and, for Y9, pupils' use of social networking sites. Data is then presented on teachers' reports of the extent to which a number of pupil-level factors (namely lack of prerequisite knowledge or skills, lack of basic nutrition and of sufficient sleep) limit their teaching. Comparison with the findings for other TIMSS participants is made where relevant. Where associations between aspects of the home environment and average achievement in TIMSS 2011 are apparent, these are reported. Findings for Y5 are presented, followed by findings for Y9.

Key findings

- The proportion of Y5 pupils reporting having *more than 100 books* at home was lower than in 2007, while internet access was higher in 2011.
- Y9 pupils with access to more educational resources at home achieved higher average scores in TIMSS 2011 in both subjects[124]. This was the case in England and for the majority of TIMSS participants. However, in England, the difference in average attainment according to resources was greater than the difference on average internationally.
- The extent to which teachers perceived that pupils' lack of prerequisite knowledge or skills limits teaching was similar across age groups and subjects. The majority of pupils (close to 60 per cent in both age groups and subjects) were taught by teachers who reported that this limits their teaching to some extent.
- In England, according to teachers' reports, teaching was more commonly limited by pupils' lack of sleep than by pupils' lack of basic nutrition. This was the case for both age groups and subjects.
- At Y9, in several of the highest performing countries, teachers reported that their teaching was limited by pupils' lack of sleep to a greater extent than in England.
- Just over half of Y9 pupils[125] reported spending up to 2 hours on a normal school day using social networking sites, with the highest proportion reporting *from 1 to 2 hours per day*. Sixteen per cent of pupils reported spending no time at all using such sites.
- For both mathematics and science, increases in reported use of social networking sites up to six hours a day appeared to have no association with average achievement. However, pupils who reported using social networking sites for more than six hours a day had lower average scores than those who reported using them for less time or not at all.

124 Comparable data is not available for Y5.

125 There was no equivalent question at Year 5.

Interpreting the data: scaled data from teachers and headteachers

Most of the data presented in this chapter is reported by teachers and headteachers. Reported percentages refer to pupils and can usually (unless otherwise indicated) be interpreted as the percentage of pupils whose teacher or headteacher reported a particular practice or gave a particular response to a questionnaire item.

When interpreting the data from pupils, headteachers and teachers it is important to take account of the relative sample sizes. Participants are expected to sample a minimum of 150 schools in each year group and a minimum of 4,000 students for each target year group (these figures represent the numbers *drawn* in the sample; the achieved sample numbers may be less). The achieved ranges for participating schools internationally were 96 to 459 for Y5, and 95 to 501 for Y9.[126] These wide ranges reflected the fact that some participants had fewer than 150 schools available and some participants chose to over-sample schools. Just over half of participants sampled between 150 and 200 schools for each age group.

For TIMSS 2011 in England, the number of participating schools was 125 at Y5 and 118 at Y9. Numbers of participants within these schools were:

- 3,397 Y5 and 3,482 Y9 pupils.
- 125 and 118 headteachers respectively answered the Y5 and Y9 School Questionnaire.
- 194 Y5 class teachers completed a Teacher Questionnaire for mathematics and 199 for science.
- 213 Y9 teachers completed the Mathematics Teacher Questionnaire.
- 757 Y9 teachers completed the Science Teacher Questionnaire (the number of science teachers was greater as the Y9 pupils were sampled by mathematics class).

See Appendix A for more information about numbers of participants and sampling method.

Year 5

9.1 Home resources for learning

Y5 pupils and their parents were asked to report the availability of resources considered important in relation to educational attainment. The responses from both parents and pupils were used to construct the *Home Resources for Learning scale*. In some countries, including England, parents did not complete a questionnaire,[127] so data for England is only available for the two components of the scale that were

126 These figures refer to countries and exclude benchmarking participants

127 At Y5, parent reports regarding home resources were only obtained for TIMSS in countries that administered the TIMSS and PIRLS assessments to the same Y5 pupils; in England, separate samples were drawn for TIMSS and PIRLS.

reported by pupils: number of books in the home, and number of home study supports.[128] More detail on the components used in the questionnaire is given below Table 9.1.

Table 9.1 shows that 34 per cent of Y5 pupils in England reported having more than 100 books in their home.[129] Seventy-five per cent of Y5 pupils had both their own room and an internet connection at home.[130] Across most of the high performing countries and those performing similarly to England, a higher proportion of pupils reported having their own room and an internet connection than reported having more than 100 books in their home. However, in Korea, the opposite was the case, with a higher proportion of pupils reporting having more than 100 books at home than having their own room and an internet connection. Since the questions relating to home resources are not subject-specific, and are reported by pupils, the percentages are the same for Y5 mathematics and Y5 science, for all countries.

Table 9.1 Home resources for learning in Y5

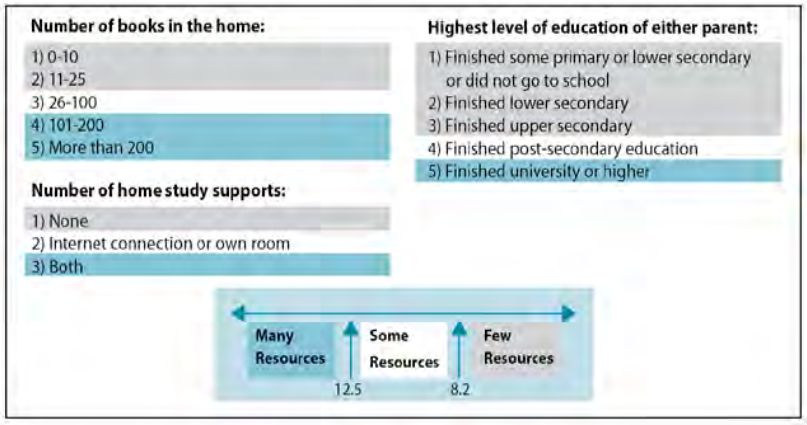
Columns 1-2 Reported by Students and Columns 3-5 Reported by Parents[131]

Country	Per cent of students with				
	More than 100 Books in Their Home	Own Room and Internet Connection in Home	At Least One Parent with a University Degree or Higher	At Least One Parent in a Professional Occupation**	More than 25 Children's Books in Their Home
England	34 (1.3)	75 (1.4)			
International Avg.	25 (0.2)	52 (0.2)	30 (0.2)	36 (0.2)	58 (0.2)

* Data reported in columns 3-5 were from the PIRLS Home Questionnaire completed by parents, so data are available only for countries that administered both TIMSS and PIRLS to the same fourth grade pupils.

** Includes corporate manager or senior official, professional, and technician or associate professional.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Source: Exhibits 4.1 and 4.2, international mathematics report

128 As a result, only data reported by pupils is shown for England and there are no associated average achievement figures available.

129 For Y5, the question included images of bookshelves, to help pupils visualise the number of books in each response category.

130 Data for these two items is combined in the international reports. Separate percentages are given later in this section.

131 Columns 3 to 5 are intentionally blank for England: see the note marked * on Table 9.1.

Table 9.2 shows the results for *own room* and *internet connection in the home* separately, as well as trends from 2007 for these variables and for *more than 100 books in the home*. The percentage of Y5 pupils with their own room was similar in 2007 and 2011, whereas the percentage of pupils with an internet connection in their home was higher in 2011, and the percentage of pupils with more than 100 books in their home was lower.

Table 9.2 Home resources for learning in Y5, with trends in England

Per cent of Y5 pupils with			
	More than 100 books in their home	**Their own room**	**An internet connection in the home**
2007	41	78	86
2011	34	79	94

Source: 2007 national report for England (Sturman et al, 2008)[132]

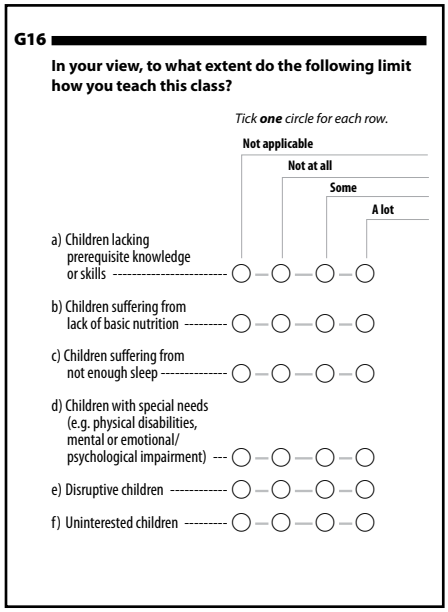
9.2 Pupil-level factors that limit Y5 teaching

Teachers were asked to report the extent to which a number of pupil factors limited their teaching. The question to which teachers responded is shown in Figure 9.1. The results relating to the first three statements in this question are spread across Tables 9.3 and 9.4. Table 9.3 presents teachers' reports on the extent to which pupils lacking prerequisite knowledge or skills limit teaching, and Table 9.4 presents the equivalent findings relating to limitations due to pupils suffering from a lack of basic nutrition and pupils suffering from not enough sleep.

It is important to note that, although reported at the pupil level, these figures are based on teachers' reports of the extent to which their teaching is limited by pupils who lack prerequisite skills, basic nutrition or enough sleep. The percentages therefore do not reflect the *proportion* of pupils who may lack prerequisite skills, basic nutrition or enough sleep. Rather, they simply reflect teachers' perceptions of any *impact on the teaching of classes* containing such pupils. The data does not indicate how many pupils might have caused that limitation, only the extent to which the presence of an unspecified number of such pupils is perceived to limit teaching. In relation to achievement, any association observed does not reflect a direct link between, for example, pupils' achievement and a lack of sleep. Instead, it would indicate an association between pupils' achievement and the perceived effect of the presence in their classes of an unspecified number of pupils lacking sufficient sleep.

132 The 2007 'own room' data is taken from the 2007 TIMSS national report (Sturman *et al*, 2008), as it was a national option in 2007 and therefore unavailable in international data. The wording was slightly different ('own bedroom' in 2007) and standard errors are not available. The percentages for 'number of books in the home' and 'internet connection' are also taken from the 2007 national report. Both measures are directly comparable since the question stem and response categories were identical in 2007 and 2011. For 'number of books in the home', the top two response categories were combined to create the category 'more than 100 books', in both 2007 and 2011. Standard errors are available for the individual categories only.

Figure 9.1 Pupil-level factors that limit teaching



Source: adapted from the international version of the TIMSS 2011 Teacher Questionnaire[133]

9.2.1 Limitations on teaching due to pupils lacking prerequisite knowledge or skills

Table 9.3 shows that in England, 65 per cent of Y5 pupils were taught mathematics by teachers who reported that their teaching was limited to *some* extent by pupils lacking prerequisite knowledge or skills. The equivalent percentage for science was similar at 62 per cent. In both subjects, England's percentages in each category were similar to the international averages.

For both subjects, 13 per cent of pupils were taught by teachers who reported that their teaching was limited *a lot* by such pupils. Among the high performing countries in one or both subjects, this percentage was similar in Singapore and Korea but lower in Chinese Taipei, Northern Ireland and Hong Kong. The percentage of pupils whose teachers reported that pupils' lack of prerequisite knowledge or skills limited their teaching *a lot* was particularly low in Finland (2 per cent), Japan (3 per cent) and the Czech Republic (3 and 4 per cent for mathematics and science respectively). In North Carolina, for mathematics and science, the percentage was particularly high at 32 per cent.

In England, the average mathematics achievement of Y5 pupils whose mathematics teachers reported that their teaching was limited *a lot* by pupils' lacking prerequisite knowledge or skills was 77 scale points lower than that of pupils whose teachers reported that their teaching was *not at all* limited by this. In science this difference was 67 scale points. Both differences are likely to be statistically significant.[134]

133 http://timssandpirls.bc.edu/timss2011/index.html

134 Throughout this report, the term 'significant' refers to statistical significance. Tests of statistical significance were not carried out in the international analysis. Based on the size of the standard errors, it is unlikely that any apparent differences are statistically significant.

Table 9.3 Y5 teaching limited by pupils lacking prerequisite knowledge or skills

Mathematics

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Students Lacking Prerequisite Knowledge or Skills					
	Not At All		Some		A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	23 (3.3)	578 (7.3)	65 (4.1)	541 (4.3)	13 (2.9)	501 (10.0)
International Avg.	27 (0.5)	506 (1.0)	61 (0.5)	489 (0.6)	12 (0.3)	467 (1.9)

Science

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Students Lacking Prerequisite Knowledge or Skills					
	Not At All		Some		A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	26 (3.4)	560 (5.8)	62 (4.2)	525 (4.6)	13 (3.0)	493 (9.2)
International Avg.	28 (0.5)	501 (1.1)	60 (0.5)	485 (0.7)	11 (0.3)	460 (2.1)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 8.19, international mathematics and science reports

9.2.2 Limitations on teaching due to pupils suffering from a lack of basic nutrition

Table 9.4 shows that in England, 22 per cent of pupils were taught mathematics and 21 per cent taught science by teachers who reported that their teaching was limited to *some* extent or *a lot*[135] by pupils suffering from a lack of basic nutrition. These proportions were lower than the equivalent proportions on average internationally, and were a little higher than the findings in Singapore and Korea. However, in the United States and Alberta, around 40 per cent of pupils were taught in classes by teachers who reported that a lack of basic nutrition limited their teaching to some extent or a lot. In Japan the equivalent figure was just 1 per cent.

In England, the average mathematics achievement of Y5 pupils whose teachers reported that their teaching was limited to *some* extent or *a lot* by pupils suffering from a lack of basic nutrition was 41 scale points lower than that of pupils whose teachers reported that their teaching was *not at all* limited by this; for science achievement the difference was slightly lower at 32 scale points. These differences are likely to be statistically significant.

135 In the international analysis (see Table 9.4), the response categories to some extent and a lot were combined, for both statements relating to nutrition and sleep (statements b) and c) in Figure 9.1).

Table 9.4 Y5 teaching limited by pupils suffering from lack of nutrition or sleep

Mathematics

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Students Suffering from Lack of Basic Nutrition				Students in Classrooms Where Teachers Report Instruction Is Limited by Students Suffering from Not Enough Sleep			
	Not at All		Some or A Lot		Not at All		Some or A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	78 (3.1)	554 (4.3)	22 (3.1)	513 (6.5)	36 (4.6)	569 (5.1)	64 (4.6)	531 (4.9)
International Avg.	71 (0.4)	498 (0.7)	29 (0.4)	472 (1.1)	53 (0.5)	497 (0.7)	47 (0.5)	486 (0.8)

Science

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Students Suffering from Lack of Basic Nutrition				Students in Classrooms Where Teachers Report Instruction Is Limited by Students Suffering from Not Enough Sleep			
	Not At All		Some or A Lot		Not At All		Some or A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	79 (3.0)	537 (4.4)	21 (3.0)	505 (5.0)	36 (4.3)	545 (6.1)	64 (4.3)	521 (4.4)
International Avg.	71 (0.4)	493 (0.8)	29 (0.4)	467 (1.1)	54 (0.5)	492 (0.7)	46 (0.5)	481 (0.9)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 8.21, international mathematics and science reports

9.2.3 Limitations on teaching due to pupils suffering from not enough sleep

Table 9.4 also shows that in England, 64 per cent of Y5 pupils were taught by teachers who reported that their teaching was limited to *some* extent or *a lot* by pupils suffering from not enough sleep, for both subjects. This is higher than the international average (47 per cent for mathematics, 46 per cent for science). In Chinese Taipei, the equivalent percentage for mathematics was similar to England, but for science it was lower. Among other high performing countries, in Japan, Korea, Singapore and Hong Kong, a lower proportion of pupils than in England were taught by teachers who reported limitations to their teaching due to pupils' lack of sleep to *some* extent or *a lot*, for both subjects. In the United States and North Carolina the proportion of pupils whose teachers reported this was higher than England at over 70 per cent for both subjects, while in the Czech Republic, a high performer in science, it was around half that in England (35 and 33 per cent for mathematics and science respectively).

In England, for both mathematics and science, the average achievement of Y5 pupils taught by teachers who reported that their teaching was limited to *some* extent or *a lot* by pupils suffering from not enough sleep was lower than that of pupils who were taught by teachers who reported that their teaching was *not at all* limited by this. For mathematics this difference was 38 points, while for science it was slightly lower at 24 points. Both these differences are likely to be statistically significant.

Year 9

9.3 Home educational resources in Y9

At Y9, all information relating to home background was provided by pupils themselves (whereas the comparable information at Y5 was designed to be derived from responses from parents as well as pupils). Pupils' responses to particular questions were used to create a Home Educational Resources scale, which included three of the items included in the Y5 Home Resources for Learning scale (number of books in the home, the availability of an own room and an internet connection) as well as parents' education level. Pupils were categorised into three bands based on their reports of the availability of the three resources and their parents' education level: *Many Resources, Few Resources* and *Some Resources* (details of how pupils are assigned to each band is provided in Table 9.5). The box beneath Table 9.5 provides detail about the questions forming the scale and the categorisation of responses. The percentages of pupils in each band, reported in Table 9.5, are based on pupil responses and are not subject-specific. Therefore, percentages are the same for mathematics and science.

Table 9.5 shows that England's average scale score was 10.8, which puts pupils in England in the *Some Resources* category overall (79 per cent of pupils in England were in this category). Compared with the international average, a notably lower proportion of pupils in England were categorised as having *Few Resources* (5 per cent in England compared with 21 per cent on average internationally).

Mathematics

The average mathematics achievement score for the 17 per cent of pupils in the *Many Resources* category was 137 scale points higher than the average achievement score of pupils in the *Few Resources* category. This difference was greater than the difference between the international averages for these categories (115 scale points) and is likely to be significant. The difference in England was also larger than that seen in some of the higher performing countries. However, there were also large differences in Chinese Taipei, Korea and the high performing US states.

Science

In England, the average achievement of Y9 pupils in the *Many Resources* category in the science assessment was 158 scale points higher than that of pupils in the *Few Resources* category. This difference is larger than for Y9 mathematics and also larger than the equivalent difference in the international average (116 scale points). There were achievement differences between these two groups of pupils in the majority of countries. The difference in England was larger than in the majority of the higher performing countries. However, there were also large differences in Chinese Taipei, Singapore and Korea, as well as similar differences in the US states performing in the same achievement band as England.

Table 9.5 *Home educational resources* in Y9

Mathematics

Reported by Students

Students were scored according to their responses concerning the availability of three home educational resources on the *Home Educational Resources* scale. Students with **Many Resources** had a score of at least 12.5, which is the point on the scale corresponding to students reporting that they had more than 100 books in the home and two home study supports, and that at least one parent had finished university, on average. Students with **Few Resources** had a score no higher than 8.2, which is the scale point corresponding to students reporting that they had 25 or fewer books in the home, neither of the two home study supports, and that neither parent had gone beyond upper-secondary education, on average. All other students were assigned to the **Some Resources** category.

Country	Many Resources		Some Resources		Few Resources		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	17 (1.1)	564 (6.7)	79 (1.1)	500 (5.1)	5 (0.5)	427 (14.9)	10.8 (0.05)
International Avg.	12 (0.1)	530 (1.2)	67 (0.2)	470 (0.6)	21 (0.2)	415 (1.0)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

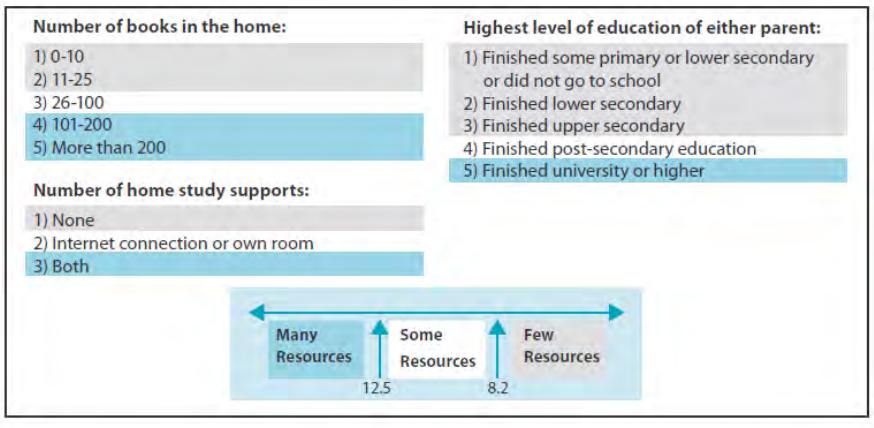
Science

Reported by Students

Students were scored according to their responses concerning the availability of three home educational resources on the *Home Educational Resources* scale. Students with **Many Resources** had a score of at least 12.5, which is the point on the scale corresponding to students reporting that they had more than 100 books in the home and two home study supports, and that at least one parent had finished university, on average. Students with **Few Resources** had a score no higher than 8.2, which is the scale point corresponding to students reporting that they had 25 or fewer books in the home, neither of the two home study supports, and that neither parent had gone beyond upper-secondary education, on average. All other students were assigned to the **Some Resources** category.

Country	Many Resources		Some Resources		Few Resources		Average Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
England	17 (1.1)	597 (5.9)	79 (1.1)	526 (4.5)	5 (0.5)	439 (13.5)	10.8 (0.05)
International Avg.	12 (0.1)	540 (1.1)	67 (0.2)	480 (0.6)	21 (0.2)	424 (1.0)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.



Source: Exhibit 4.3, international mathematics and science reports

Table 9.6 provides supporting detail about the availability of the specific home resources included in the *Home Educational Resources* scale. In England, 31 per cent of Y9 pupils had at least one parent with a university degree, similar to the international average. Percentages of pupils who reported that at least one parent had a university degree were higher in Korea, Japan, and Quebec, and were particularly high in all the US states with average achievement higher than England's in at least one subject. Thirty-three per cent of Y9 pupils in England reported having more than

100 books in their home, compared with a quarter on average internationally. The majority of pupils in England, 89 per cent, reported having both their own room and an internet connection at home, whereas on average internationally this was just over half (53 per cent).[136]

Table 9.6 Components of the *Home Educational Resources* scale

Reported by Students

Country	Per cent of Students with		
	More than 100 Books in Their Home	Own Room and Internet Connection in Home	At Least One Parent with a University Degree or Higher
England	33 (1.5)	89 (0.8)	31 (1.8)
International Avg.	25 (0.2)	53 (0.2)	32 (0.2)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 4.4, international mathematics and science reports

Table 9.7 shows the results for *their own room* and *internet connection* in the home separately, as well as trends from 2007 for these variables and for *more than 100 books in their home*. It shows that the percentages of Y9 pupils with more than 100 books in their home and with their own room were similar in 2007 and 2011. The percentage of Y9 pupils with an internet connection in the home is higher than in 2007.

Table 9.7 Components of the *Home Educational Resources* scale, with trends

Per cent of Y9 pupils in England with			
	More than 100 books in their home	**Their own room**	**An internet connection in the home**
2007	35	86	92
2011	33	89	98

Source: 2007 national report for England (Sturman et al, 2008)[137]

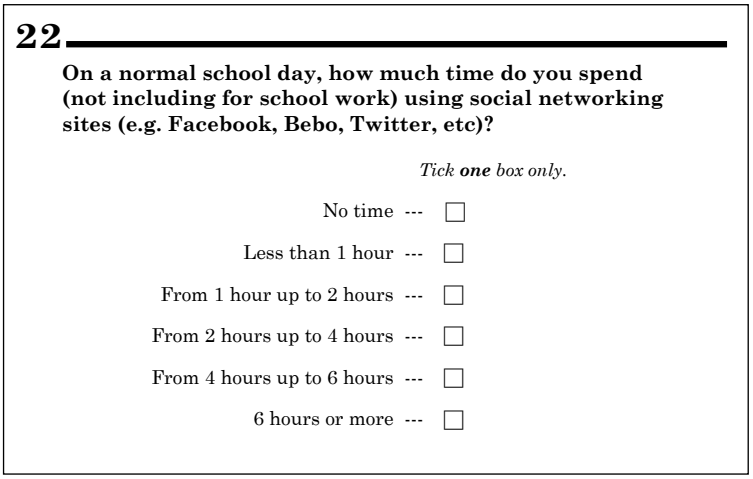
9.4 Pupils' use of social networking sites

Y9 pupils in England were asked about the amount of time they spend using social networking sites on a normal school day. The question asked is given in Figure 9.2, and pupils' responses, along with the average achievement associated with each group of responses, are summarised in Table 9.8.

136 Data for these two items is combined in the international reports. Separate percentages are given later in this section.

137 The 2007 'own room' data is taken from the 2007 TIMSS national report (Sturman *et al*, 2008), as it was a national option in 2007 and therefore unavailable in international data. The wording was slightly different ('own bedroom' in 2007) and standard errors are not available. The percentages for 'number of books in the home' and 'internet connection' are also taken from the 2007 national report. Both measures are directly comparable since the question stem and response categories were identical in 2007 and 2011. For 'number of books in the home', the top two response categories were combined to create the category 'more than 100 books', in both 2007 and 2011. Standard errors are available for the individual categories only. Trends for 'at least one parent with a university degree or higher' could not be reported because the question was not administered in the 2007 pupil questionnaire in England.

Figure 9.2 Social networking sites question



22

On a normal school day, how much time do you spend (not including for school work) using social networking sites (e.g. Facebook, Bebo, Twitter, etc)?

*Tick **one** box only.*

- No time ☐
- Less than 1 hour ☐
- From 1 hour up to 2 hours ☐
- From 2 hours up to 4 hours ☐
- From 4 hours up to 6 hours ☐
- 6 hours or more ☐

Source: national option in England's adapted version of the TIMSS 2011 Student Questionnaire[138]

Table 9.8 Y9 pupils' use of social networking sites

Time spent on social networking sites on a normal school day	Per cent of Y9 pupils	Mean score on TIMSS mathematics assessment	Mean score on TIMSS science assessment
No time	16 (0.9)	503 (8.0)	531 (8.4)
Less than 1 hour	25 (0.9)	525 (7.1)	549 (6.5)
From 1 hour up to 2 hours	27 (0.8)	511 (5.8)	537 (4.9)
From 2 hours up to 4 hours	18 (0.8)	504 (6.2)	529 (5.5)
From 4 hours up to 6 hours	7 (0.5)	494 (6.2)	526 (6.4)
6 hours or more	6 (0.5)	452 (8.6)	485 (7.4)

Source: derived from national dataset for TIMSS 2011

Just over half of Y9 pupils reported spending up to two hours on a normal school day using social networking sites, with the highest proportion reporting *from 1 to 2 hours per day.* Sixteen per cent of pupils reported spending *no time* at all on social networking sites, compared with 13 per cent of pupils who reported using social networking sites for four hours or more on a normal school day. It is likely that pupils' use of social networking sites is dependent on a number of contextual factors, for example socio-economic circumstances, access to relevant technology, personal or family choice. Further investigation of the characteristics of pupils in each category would be needed to establish the factors associated with the different levels of attainment observed.

138 http://timssandpirls.bc.edu/timss2011/index.html

Average achievement appears to be lower among pupils who reported spending *no time* on a normal school day using social networking sites than among pupils who reported spending *less than 1 hour* using them. This difference may be statistically significant for mathematics achievement, but is unlikely to be significant for science achievement.[139]

For both subjects, average achievement appears to decrease as the reported number of hours using social networking sites increases from *less than 1 hour* up to *from 4 to 6 hours*. However, these apparent differences are unlikely to be statistically significant.

For pupils who reported using social networking sites for more than six hours on a normal school day, there is a decrease in average achievement, compared with pupils who reported using them for less time or no time at all. These differences are likely to be statistically significant for both subjects.

9.5 Pupil-level factors that limit teaching in Y9

As for Y5, teachers of Y9 pupils were asked to report the extent to which a number of pupil-level factors limited their mathematics teaching. The content of the question to which teachers responded is the same as shown in section 9.2.[140] The findings relating to responses to the first three statements of this question are presented in Table 9.9 and Table 9.10. Table 9.9 presents teachers' reports on the extent to which pupils lacking prerequisite knowledge or skills limited teaching and Table 9.10 presents equivalent findings relating to pupils suffering from a lack of basic nutrition and from not enough sleep.

9.5.1 Limitations on teaching due to pupils lacking prerequisite knowledge or skills

Mathematics

Table 9.9 shows that in England, 24 per cent of pupils were taught mathematics by teachers who reported that their teaching was *not at all* limited by pupils' lack of prerequisite knowledge or skills; a higher proportion than on average internationally (15 per cent). A further 60 per cent of Y9 pupils were taught mathematics by teachers who reported that their teaching was limited to some *extent* by pupils' lacking prerequisite knowledge or skills. High performing participants with particularly high percentages of pupils taught by teachers whose teaching was limited *a lot* by pupils lacking prerequisite knowledge or skills included the Russian Federation, Chinese Taipei, Quebec and North Carolina.

In England, average achievement of Y9 pupils whose mathematics teachers reported that their teaching was limited *a lot* by pupils lacking prerequisite knowledge or skills was 124 scale points lower than that of pupils whose teachers reported that their teaching was *not at all* limited. This is likely to be a statistically significant difference, and is higher than in Y5, where the difference was 77 scale points for mathematics.

139 No tests of statistical significance have been carried out in the international analysis. Based on the size of the standard errors, this difference may be significant for mathematics, but further analysis would be needed in order to confirm this.

140 The only difference is that the Y9 mathematic teachers were asked about 'students' rather than 'children'.

Science

Table 9.9 shows that in England, 29 per cent of pupils were taught science by teachers who reported that their teaching was *not at all* limited by pupils' lack of prerequisite knowledge or skills, a higher proportion than on average internationally (20 per cent). A further 62 per cent of Y9 pupils were taught science by teachers who reported that their teaching was limited to *some* extent by pupils lacking prerequisite knowledge or skills. Among high performing participants, Chinese Taipei had a relatively high percentage of pupils who were taught by teachers who reported that their teaching was limited *a lot* by pupils' lacking prerequisite knowledge or skills (21 per cent, compared with 9 per cent in England), although this was not as high as the percentage in Chinese Taipei for mathematics (43 per cent).

In England, average achievement among Y9 pupils whose science teachers reported that their teaching was limited *a lot* by pupils lacking prerequisite knowledge or skills was 80 scale points lower than that of pupils whose teachers reported that their teaching was *not at all* limited by this. This is likely to be a statistically significant difference, but is smaller than the equivalent difference for Y9 mathematics. However, it is larger than the equivalent difference for Y5 science.

Table 9.9 Y9 teaching limited by pupils lacking prerequisite knowledge or skills

Mathematics

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Students Lacking Prerequisite Knowledge or Skills					
	Not At All		Some		A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	24 (3.3)	552 (9.0)	60 (4.4)	507 (6.3)	15 (3.1)	428 (13.6)
International Avg.	15 (0.4)	490 (1.9)	57 (0.6)	471 (0.8)	28 (0.5)	443 (1.2)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Science

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Students Lacking Prerequisite Knowledge or Skills					
	Not At All		Some		A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England r	29 (3.2)	562 (8.0)	62 (3.2)	526 (6.4)	9 (1.7)	482 (18.8)
International Avg.	20 (0.4)	496 (2.0)	61 (0.5)	478 (0.7)	19 (0.4)	455 (1.5)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Source: Exhibit 8.20, international mathematics and science reports

9.5.2 Limitations on teaching due to pupils suffering from a lack of basic nutrition

Mathematics

Table 9.10 shows that in England, 14 per cent of Y9 pupils were taught mathematics by teachers who reported that their teaching was limited to *some* extent or *a lot*[141] by pupils' suffering from a lack of basic nutrition. This is lower than the equivalent percentage reported by teachers of Y5 pupils in England, and is lower than the international average. Among high performing participants, this percentage was higher in Korea, Quebec and Minnesota, but much lower in Japan, where it was just 1 per cent.

In England, the average achievement of Y9 pupils taught mathematics by teachers whose teaching was limited to *some* extent or *a lot* by pupils suffering from a lack of basic nutrition was 70 scale points lower than that of pupils whose teachers reported that their teaching was *not at all* limited. This is likely to be a statistically significant difference.

Science

Table 9.10 shows that in England, 25 per cent of Y9 pupils were taught science by teachers who reported that their teaching was limited to *some* extent or *a lot* by pupils suffering from a lack of basic nutrition. This is higher than the equivalent percentage for Y9 mathematics, but lower than the international average. It was similar to Korea, but higher than most other high performing and similarly performing participants, apart from Alberta where it was 43 per cent, and the United States where it was 40 per cent (and 35 to 40 per cent within similarly performing individual states).

In England, average achievement among Y9 pupils who were taught science by teachers who reported that their teaching was limited to *some* extent or *a lot* by pupils suffering from a lack of basic nutrition was 25 scale points lower than that of pupils who were taught by teachers who reported that their teaching was *not at all* limited by this. This is likely to be a statistically significant difference, but is a smaller difference than for Y9 mathematics.

9.5.3 Limitations on teaching due to pupils suffering from not enough sleep

Mathematics

Table 9.10 also shows that in England, 56 per cent of Y9 pupils were taught by teachers who reported that their teaching was limited to *some* extent or *a lot* by pupils' suffering from not enough sleep. These results are similar to the international average. However, the equivalent percentage was higher for the high performing participants Chinese Taipei, Hong Kong, Singapore, Minnesota and Quebec, and in similarly performing Finland.

In England, the average achievement of Y9 pupils who were taught mathematics by teachers who reported that their teaching was limited to *some* extent or *a lot* by pupils suffering from a lack of enough sleep was 62 scale points lower than that of pupils whose teachers reported that their teaching was *not at all* limited by this. This is likely to be a statistically significant difference, and is larger than the equivalent difference at Y5 (38 scale points).

141 As for Y5, for this statement and for *Pupils suffering from not enough sleep*, the response categories *some* and a lot were combined in the international analysis.

Science

Table 9.10 also shows that in England, 63 per cent of pupils were taught by teachers who reported that their teaching was limited to *some* extent or *a lot* by pupils' suffering from not enough sleep. These results are just above the international average. This percentage was higher in most of the highest performing participants, apart from Japan and was particularly high in Finland (82 per cent), Alberta (84 per cent), Minnesota (85 per cent) and Massachusetts (84 per cent).

In England, average achievement among Y9 pupils whose science teachers reported that their teaching was limited to *some* extent or *a lot* by pupils' suffering from not enough sleep was 27 scale points lower than that of pupils who were taught by teachers who reported that their teaching was *not at all* limited by this. Though notably smaller than for mathematics, this is likely to be a statistically significant difference, and is similar to the equivalent difference at Y5 science.

Table 9.10 Y9 teaching limited by pupils suffering from lack of nutrition or sleep

Mathematics

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Students Suffering from Lack of Basic Nutrition				Students in Classrooms Where Teachers Report Instruction Is Limited by Students Suffering from Not Enough Sleep			
	Not At All		Some or A Lot		Not At All		Some or A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	86 (2.6)	516 (5.9)	14 (2.6)	446 (10.1)	44 (4.3)	540 (8.0)	56 (4.3)	478 (7.1)
International Avg.	63 (0.5)	477 (0.8)	37 (0.5)	449 (1.2)	43 (0.6)	477 (1.0)	57 (0.6)	461 (0.9)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Science

Reported by Teachers

Country	Students in Classrooms Where Teachers Report Instruction Is Limited by Students Suffering from Lack of Basic Nutrition				Students in Classrooms Where Teachers Report Instruction Is Limited by Students Suffering from Not Enough Sleep			
	Not At All		Some or A Lot		Not At All		Some or A Lot	
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement
England	r 75 (2.4)	538 (5.4)	25 (2.4)	513 (11.4)	r 37 (3.4)	549 (5.4)	63 (3.4)	522 (7.7)
International Avg.	64 (0.5)	485 (0.8)	36 (0.5)	461 (1.2)	42 (0.5)	484 (1.0)	58 (0.5)	473 (0.8)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

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

Source: Exhibit 8.22, international mathematics and science reports

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Appendix A Trends in International Mathematics and Science Study (TIMSS): Overview

A.1 TIMSS 2011: introduction

The TIMSS 2011 survey is the fifth in the IEA's[142] series of comparative international surveys of mathematics and science achievement. TIMSS is administered on a four-yearly cycle, so the 2011 survey updates the picture of performance from 2007. Earlier cycles took place in 2003, 1999 and 1995.[143] The next TIMSS cycle is planned for 2015.

A.2 TIMSS 2011 participants

TIMSS 2011 involved 74 participants: 60 countries and 14 benchmarking participants,[144] taking part at one or both of the target grades: 'fourth grade', ages 9-10 and 'eighth grade', ages 13-14 (Year 5 and Year 9 respectively in England). Participant numbers were:

- Fourth grade – 57 participants (50 countries and 7 benchmarking participants)
- Eighth grade – 56 participants (42 countries and 14 benchmarking participants).[145]

Table A.1 gives the list of participants at each grade, and Exhibit A.1 in the international mathematics and science reports indicates the previous cycles in which each participant was involved.

The TIMSS 2011 participants are varied, ranging from highly developed countries or regions through to developing ones. Their education systems also vary, differing for example in the age at which children start school.[146] More information about the educational system in each participating country and region can be found in the TIMSS encyclopaedia (Mullis *et al*, 2012).

142 International Association for the Evaluation of Educational Achievement (IEA): http://www.iea.nl

143 The 1995 TIMSS study was originally entitled the Third International Mathematics and Science Study, and followed earlier mathematics surveys in 1964 and 1980-1982 and science surveys in 1970 and 1984.

144 Countries participating in TIMSS follow guidelines and strict sampling targets to provide samples that are nationally representative. 'Benchmarking participants' are regional entities which follow the same guidelines and targets to provide samples that are representative at regional level.

144 Three participants tested only pupils older than the target age. Botswana and Honduras administered the 4th grade assessment to 6th grade pupils (Y7 equivalent); Yemen administered it to both 4th and 6th grade pupils. Botswana, South Africa and Honduras administered the 8th grade assessment to 9th grade pupils (Y10 equivalent). Out-of-grade result are not included in this national report.

145 See Appendix C.1 in the international mathematics and science reports for a summary of school starting ages in the participating countries/regions.

Table A1 TIMSS 2011 participants

Participant	4th grade, ages 9-10	8th grade, ages 13-14
Countries		
Armenia	✓	✓
Australia	✓	✓
Austria	✓	
Azerbaijan	✓	
Bahrain	✓	✓
Belgium (Flemish)	✓	
Chile	✓	✓
Chinese Taipei	✓	✓
Croatia	✓	
Czech Republic	✓	
Denmark	✓	
England	✓	✓
Finland	✓	✓
Georgia	✓	✓
Germany	✓	
Ghana		✓
Hong Kong SAR	✓	✓
Hungary	✓	✓
Indonesia		✓
Iran, Islamic Rep. of	✓	✓
Ireland, Rep. of	✓	
Israel		✓
Italy	✓	✓
Japan	✓	✓
Jordan		✓
Kazakhstan	✓	✓
Korea, Rep. of	✓	✓
Kuwait	✓	
Lebanon		✓
Lithuania	✓	✓
Benchmarking participants		
Alberta, Canada	✓	✓
Ontario, Canada	✓	✓
Quebec, Canada	✓	✓
Abu Dhabi, UAE	✓	✓
Dubai, UAE	✓	✓
Alabama, US		✓
California, US		✓

Participant	4th grade, ages 9-10	8th grade, ages 13-14
Countries		
Macedonia, Rep. of		✓
Malaysia		✓
Malta	✓	
Morocco	✓	✓
Netherlands	✓	
New Zealand	✓	✓
Northern Ireland	✓	
Norway	✓	✓
Oman	✓	✓
Palestinian Nat'l Auth.		✓
Poland	✓	
Portugal	✓	
Qatar	✓	✓
Romania	✓	✓
Russian Federation	✓	✓
Saudi Arabia	✓	✓
Serbia	✓	
Singapore	✓	✓
Slovak Republic	✓	
Slovenia	✓	✓
Spain	✓	
Sweden	✓	✓
Syrian Arab Republic		✓
Thailand	✓	✓
Tunisia	✓	✓
Turkey	✓	✓
Ukraine		✓
United Arab Emirates	✓	✓
United States	✓	✓
Yemen	✓	
Benchmarking participants		
Colorado, US		✓
Connecticut, US		✓
Florida, US	✓	✓
Indiana, US		✓
Massachusetts, US		✓
Minnesota, US		✓
North Carolina, US	✓	✓

Source: Exhibit A.1, international mathematics and science reports

A.3 TIMSS 2011 in the UK

The countries which comprise the United Kingdom are regarded separately by the IEA, and, of the four, England and Northern Ireland chose to participate in the 2011 survey. England has participated in all TIMSS cycles, so comparisons can be made with all earlier cycles where appropriate. The 2011 cycle represented Northern Ireland's first TIMSS participation. Scotland has also participated in previous cycles.

In all three participating UK nations, the TIMSS surveys were administered by NFER. Outcomes from previous cycles of TIMSS internationally and in the UK are available through the NFER website: www.nfer.ac.uk/timss

A.4 TIMSS 2011 sampling strategy

TIMSS samples are drawn based on internationally specified criteria, and are designed to be representative of the national population of pupils in the target age group (or regional population, for benchmarking participants). Each participant is therefore expected to provide a sampling pool that covers all or almost all of the target national population. Where exclusions are considered necessary, these must be within set limits. Exclusions may be for a variety of reasons, including:

- geographical (e.g. remote and/or very small schools may be excluded at sampling stage);
- linguistic (e.g. participants may exclude some language groups at sampling stage, if they opt to translate the assessment into majority languages only, not all languages spoken within the country/region); or
- special educational needs (e.g. special schools teaching pupils who cannot access the assessment may be excluded at sampling stage, or individual pupils who cannot access the assessment may be excluded at the administration stage).

TIMSS guidance stipulates that no more than five per cent of the population in total should be excluded across all stages of the survey. See the technical report (Martin and Mullis (Eds.), 2011) and Appendix C of the international reports for more information.

In TIMSS, each participating country has a 'main sample' and two matched 'replacement samples' which are used if the main sample schools decline to participate. The main sample is designed to be nationally representative of pupils in the target age group and so the sampling criteria ('stratifiers') for each country are designed to address key characteristics of the nation's school system.[147] Each main sample school is then assigned a 'first replacement' school and a 'second replacement' school, both of which share the same key sampling characteristics as the main sample school. This ensures that, if the main sample school declines to participate, its first replacement school can be used instead and the sample will still be nationally representative. If the first replacement school also declines to participate, the second replacement school will be invited to participate and, again, the sample will remain nationally representative. If the second replacement school declines to participate, then the country cannot include any other school, to avoid skewing the sample.

147 Schools are sampled using systematic, random sampling with probability proportional to their measures of size.

Classes of pupils of the target age are then randomly sampled within the participating schools and 95 per cent of these classes are expected to take part. Within each sampled class, at least 85 per cent of pupils are expected to take part. Samples are inspected and, if they meet the sampling criteria, accepted by the IEA's sampling referee.

In order to meet the stringent TIMSS participation targets, countries are expected to achieve participation of:

- At least 85 per cent of their main sample schools; OR
- At least 85 per cent of sampled schools of which at least 50 per cent must be from the main sample and the remainder matched replacement schools; OR
- A combined pupil/school rate of at least 75 per cent.

Participants achieving at least 85 per cent of the main sample schools or a combined pupil/school figure of at least 75 per cent are deemed to have met the sampling requirements fully. Those achieving at least 85 per cent with the use of replacement schools are deemed to have achieved a sample that is suitably representative at national level, but are 'annotated' in the report, to indicate that replacement schools were used.

A.5 England's TIMSS 2011 samples

England's sampling strategy

Samples for England were drawn by Statistics Canada, assisted by the NFER Research and Statistics teams. The sample was stratified by attainment band and school type (comprehensive school 11-16, comprehensive school 11-18, independent school, or other). Schools were recruited by the NFER Research Operations team. Once a school had agreed to participate, one or more classes from the target year group were randomly sampled, using the IEA's within-school sampling software. This selected the number of classes automatically. In primary schools, Y5 classes were sampled and in secondary schools, Y9 mathematics classes were used as the sampling unit.[148]

England's Y5 sample

The Y5 sample in England met the stringent sampling standards described above. Of 150 schools sampled, a total of 125 primary schools took part (122 main sample schools and just three replacement schools). Class participation was 100 per cent and pupil participation 94 per cent (see Table A.2). Overall participation was 78 per cent, exceeding the combined target of at least 75 per cent of pupils and schools. Total exclusions for England at Y5 were just 2 per cent.

Internationally, participation rates at this grade ranged from 70 per cent in Norway to 100 per cent in Azerbaijan. Overall exclusion rates ranged from 0.3 per cent in Kuwait to 12.1 per cent in Florida (a benchmarking participant). The highest exclusion rate among countries at Y5 was 9.4 per cent in Serbia.

148 The class sampling strategy had implications for the number of teachers completing questionnaires. The Y5 teacher questionnaire was generally completed by a class teacher but, where pupils had separate mathematics and science teachers, each teacher completed a questionnaire. At Y9 the mathematics teacher questionnaire was completed by the teacher of the sampled class and all science teachers teaching the sampled pupils completed a science teacher questionnaire. Therefore, each individual TIMSS pupil was linked to multiple teachers at Y9 and a greater number of science than mathematics teachers took part.

The average age of participating Y5 pupils in England was 10.2. The range internationally for those in the target grade was from 9.7 (in Italy, Kuwait and Norway) to 11.2 in Yemen.

Table A.2 Y5 sample information for England

The information in this table is taken from the international mathematics and science reports. The source of each element within the reports is indicated.

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
England	150	150	122	3	125

Source: Exhibit C.4, international mathematics and science reports

Country	Within-school Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
England	94%	3,689	49	13	3,627	230	3,397

Source: Exhibit C.6, international mathematics and science reports

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
England	81%	83%	100%	94%	76%	78%

Source: Exhibit C.8, international mathematics and science reports

Country	International Target Population		Exclusions from National Target Population		
	Coverage	Notes on Coverage	School-level Exclusions	Within-sample Exclusions	Overall Exclusions
England	100%	n/a	1.7%	0.4%	2.0%

Source: Exhibit C.2, international mathematics and science reports

England's Y9 sample

Of 150 schools sampled, a total of 118 secondary schools took part (113 main sample schools and just five replacement schools). Class participation was 100 per cent and pupil participation 89 per cent (see Table A.3). Overall participation was 70 per cent, just below the combined target of at least 75 per cent. Total exclusions for England at Y9 were just 2.2 per cent.

England's Y9 sample is annotated in the international report to indicate that the sample "nearly satisfied guidelines for sample participation rates after replacement schools were included". Further initial analysis of the achieved sample (comparing the 118 participating Y9 schools and the Y9 main sample schools that declined to take part) confirmed that there were no significant differences between the responding and non-responding schools, based on England's stratifying variables of attainment and school type. The Y9 achieved sample can, therefore, be regarded as nationally representative in terms of the stratifying variables.

England's overall participation rate at Y9 was the lowest internationally, followed by Hong Kong at 75 per cent. The highest was 99 per cent in Chinese Taipei, Iran, Korea, Qatar, Romania and Thailand. Overall exclusion rates ranged from 0.1 per cent in Malaysia and Morocco to 22.6 per cent in Israel. The next highest exclusion rate among countries was 7.2 per cent in the United States.

The average age of participating Y9 pupils in England was 14.2. The range internationally was from 13.7 in Norway to 15.8 in Ghana.

Table A.3 Y9 sample information for England

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
England	150	150	113	5	118

Source: Exhibit C.5, international mathematics and science reports

Country	Within-school Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
England	89%	4,382	88	3	4,291	449	3,842

Source: Exhibit C.7, international mathematics and science reports

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
‡ England	75%	79%	100%	89%	67%	70%

‡ Nearly satisfied guidelines for sample participation rates after replacement schools were included.

Source: Exhibit C.9, international mathematics and science reports

Country	International Target Population		Exclusions from National Target Population		
	Coverage	Notes on Coverage	School-level Exclusions	Within-sample Exclusions	Overall Exclusions
England	100%	n/a	2.2%	0.1%	2.2%

Source: Exhibit C.3, international mathematics and science reports

Appendix B Trend performance of England and selected countries

This appendix summarises the trend performance of the TIMSS participants performing similarly to England in 2011 and those which performed better than England in TIMSS 2011. A description of the trend is given in each case (where a participant has taken part in more than one cycle), with a graphic showing the trend. Rankings are given for TIMSS 2007 and 2011, where applicable. England is given in each table for comparison. Benchmarking participants are shown in square brackets.[149]

149 Rankings are not given for benchmarking participants as they are reported separately from countries in the international rankings.

Table B1 Trends among participants performing similarly to England in Y5 mathematics

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1995	Increased 1995-2003 and 2003-2007; stable 2007-2011	484		531	541	542
			Rank		2007: 7th		2011: 9th
Belgium (Flemish)	2011, 2003	No significant change over time			551		549
			Rank		2007: n/a		2011: 7th
Finland	2011	n/a	n/a				
			Rank		2007: n/a		2011: 5th
[Florida, US]	2011	n/a	n/a				
Russian Federation	2011, 2007, 2003	No significant change over time			532	544	542
			Rank		2007: 6th		2011: 10th
United States	2011, 2007, 2003, 1995	Stable 1995 - 2003, then significant increase in 2007 and again in 2011	518		518	529	541
			Rank		2007: 11th		2011: 11th
Netherlands	2011, 2007, 2003, 1995	Significant decrease 1995-2003; no significant differences thereafter	549		540	535	540
			Rank		2007: 9th		2011: 12th
Denmark	2011, 2007	Improved significantly 2007-2011				523	537
			Rank		2007: 13th		2011: 13th

Source: Exhibits 1.5 and 1.7, international mathematics report, TIMSS 2011; and Exhibit 1.1, international mathematics report, TIMSS 2007

Table B2 Trends among participants performing better than England in Y5 mathematics

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1995	Increased 1995-2003 and 2003-2007; stable 2007-2011	484		531	541	542
			Rank		2007: 7th		2011: 9th
Singapore	2011, 2007, 2003, 1995	2011 significantly higher than 1995; otherwise, no significant change	590		594	599	606
			Rank		2007: 2nd		2011: 1st
Korea	2011, 1995	Significant increase	581				605
			Rank		2007: n/a		2011: 2nd
Hong Kong	2011, 2007, 2003, 1995	Significant increases 1995-2003 and 2003-2007; stable thereafter	557		575	607	602
			Rank		2007: 1st		2011: 3rd
Chinese Taipei	2011, 2007, 2003	Significant increases in each cycle			564	576	591
			Rank		2007: 3rd		2011: 4th
Japan	2011, 2007, 2003, 1995	Increase in 2011	567		565	568	585
			Rank		2007: 4th		2011: 5th
Northern Ireland	2011	n/a					
			Rank		2007: n/a		2011: 6th
[North Carolina, US]	2011	n/a	n/a				

Source: Exhibits 1.5 and 1.7, international mathematics report, TIMSS 2011; and Exhibit 1.1, international mathematics report, TIMSS 2007.

Table B3 Trends among participants performing similarly to England in Y9 mathematics

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1999, 1995	Stable 1995-2003; increased 2003-2007; stable 2007-2011	498	496	498	513	507
			Rank	2007: 7th		2011: 10th	
[Indiana, US]	2011, 2003, 1999	No significant differences		515	508		522
[Colorado, US]	2011	n/a	n/a				
[Connecticut, US]	2011, 1999	No significant difference		512			518
Israel	2011, 2007, 2003, 1999	Trends not reported	n/a				
			Rank	2007: 24th		2011: 7th	
Finland[150]	2011, 1999	(7th grade scores) declined since 1999; no 8th grade (Y9) trends		520			482
			Rank (8th grade)	2007: n/a		2011: 8th	
[Florida, US]	2011	n/a	n/a				
[Ontario, Canada]	2011, 2007, 2003, 1999, 1995	Improved significantly 1995-1999; 2011 significantly lower than 2003	501	517	521	517	512

150 In 1999, Finland participated at 7th grade (pupils a year younger than the 8th grade (Y9) pupils tested in TIMSS 2011); in 2011, Finland tested both 7th and 8th graders (Y8 and Y9 equivalents). The trend data given here is, therefore, for 7th graders only. Ranking data is for 8th graders (Y9 equivalent).

Table B3 Trends among participants performing similarly to England in Y9 mathematics (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
United States	2011, 2007, 2003, 1999, 1995	2003 scores onwards significantly higher than 1995; otherwise, no significant changes	492	502	504	508	509
			Rank			2007: 9th	2011: 9th
[Alberta, Canada]	2011, 1999, 1995	2011 scores declined compared with 1995 and 1999	527	531			505
Hungary	2011, 2007, 2003, 1999, 1995	2007 and 2011 scores declined compared with all previous years	527	532	529	517	505
			Rank			2007: 6th	2011: 11th
Australia	2011, 2007, 2003, 1995	2007 scores lower than 1995; otherwise, no significant differences	509		505	496	505
			Rank			2007: 14th	2011: 12th
Slovenia	2011, 2007, 2003, 1995	Stable since 2007; recent scores improved on 2003 and 1995 performance	494		493	501	505
			Rank			2007: 12th	2011: 13th
Lithuania	2011, 2007, 2003, 1999, 1995	2003 increased on previous years; stable since then	472	482	502	506	502
			Rank			2007: 10th	2011: 14th
Italy	2011, 2007, 2003, 1999	2011 scores improved on all previous cycles		479	484	480	498
			Rank			2007: 19th	2011: 15th
[California, US]	2011	n/a	n/a				

Source: Exhibits 1.6 and 1.8, international mathematics report, TIMSS 2011; and Exhibit 1.1, international mathematics report, TIMSS 2007.

Table B4 Trends among participants performing better than England in Y9 mathematics

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1999, 1995	Stable 1995-2003; increased 2003-2007; stable 2007-2011	498	496	498	513	507
			Rank	2007: 7th		2011: 10th	
Korea	2011, 2007, 2003, 1999, 1995	Significant increase every cycle except 2003	581	587	589	597	613
			Rank	2007: 2nd		2011: 1st	
Singapore	2011, 2007, 2003, 1999, 1995	Declined in 2007 but a significant increase in 2011	609	604	605	593	611
			Rank	2007: 3rd		2011: 2nd	
Chinese Taipei	2011, 2007, 2003, 1999	Stable 1999-2003, with significant increases in each subsequent cycle		585	585	598	609
			Rank	2007: 1st		2011: 3rd	
Hong Kong	2011, 2007, 2003, 1999, 1995	A very mixed picture. Broadly, stable 1995-1999 and 1999-2003; declined 2003-2007; stable 2007-2011; but 2003 and 2011 scores significantly higher than 1995 score.[151]	569	582	586	572	586
			Rank	2007: 4th		2011: 4th	

151 See Exhibits 1.5 and 1.7 in the international mathematics report for more information.

Table B4 Trends among participants performing better than England in Y9 mathematics (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
Japan	2011, 2007, 2003, 1999, 1995	Stable scores since 2003; scores since then significantly higher than those of 1995/1999.	581	579	570	570	570
			Rank			2007: 5th	2011: 5th
[Massachusetts, US]	2011, 2007, 1999	No significant difference 2007-2011; these scores significantly higher than 1999 score.		513		547	561
[Minnesota, US]	2011, 2007, 1995	2011 score significantly higher than 1995 score.	518			532	545
Russian Federation	2011, 2007, 2003, 1999, 1995	Significant decline 1999-2003; significant increase 2007-2011	524	526	508	512	539
			Rank			2007: 8th	2011: 6th
[North Carolina, US]	2011, 1999	Significant increase		495			537
[Quebec, Canada]	2011, 2007, 2003, 1999, 1995	Significant decline in 2003 and 2007 compared with all previous years; stable 2007-2011.	556	566	543	528	532

Source: Exhibits 1.6 and 1.8, international mathematics report, TIMSS 2011; and Exhibit 1.1, international mathematics report, TIMSS 2007

Table B5 Trends among participants performing similarly to England in Y5 science

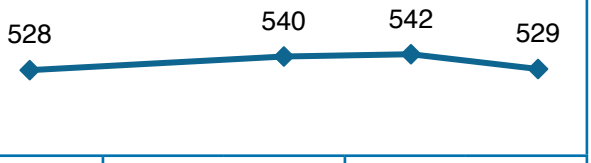
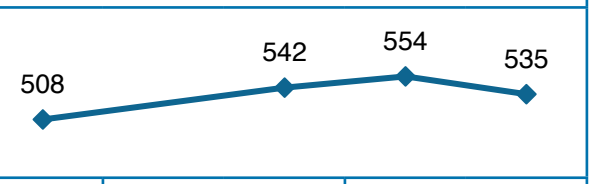
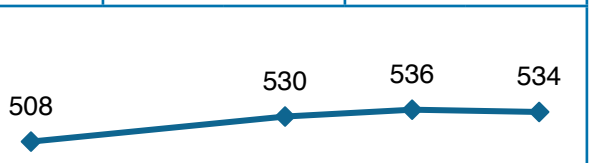
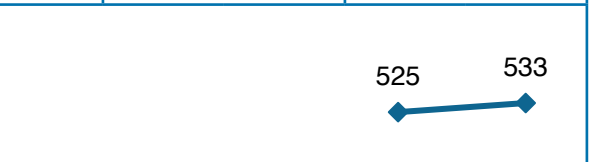
Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1995	Increased 1995-2003; stable 2003-2007; decreased 2007-2011					
			Rank		2007: 7th		2011: 15th
[North Carolina, US]	2011	n/a	n/a				
Hong Kong	2011, 2007, 2003, 1995	Increased from 1995-2003 and 2003-2007, decreased 2007-2011					
			Rank		2007: 3rd		2011: 9th
Hungary	2011, 2007, 2003, 1995	Increased 1995-2003; stable since					
			Rank		2007: 9th		2011: 10th
Sweden	2011, 2007	Increased 2007-2011					
			Rank		2007: 16th		2011: 11th
Slovak Republic	2011, 2007	No significant change					
			Rank		2007: 14th		2011: 12th

Table B5 Trends among participants performing similarly to England in Y5 science (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
Austria	2011, 2007, 1995	Stable since 1995; decreased 2003-2007	538			526	532
			Rank			2007: 15th	2011: 13th
Netherlands	2011, 2007, 2003, 1995	Stable since 1995; increased 2007-2011	530		525	523	531
			Rank			2007: 17th	2011: 14th
Denmark	2011, 2007	Increased 2007-2011				517	528
			Rank			2007: 19th	2011: 16th
Germany	2011, 2007	No significant change				528	528
			Rank			2007: 12th	2011: 17th
[Ontario, Canada]	2011, 2007, 2003, 1995	Increased 1995-2003; stable since	516		540	536	528
Italy	2011, 2007, 2003	Increased 2003-2007; decreased 2007-2011			516	535	524
			Rank			2007: 10th	2011: 18th
Portugal	2011, 1995	Increased 1995-2011	452				522
			Rank			2007: n/a	2011: 19th

Source: Exhibits 1.5 and 1.7, international science report, TIMSS 2011; and Exhibit 1.1, international science report, TIMSS 2007

Table B6 Trends among participants performing better than England in Y5 science

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1995	Increased 1995-2003; stable 2003-2007; decreased 2007-2011	528		540	542	529
			Rank		2007: 7th		2011: 15th
Korea	2011, 1995	Significant increase	576				587
			Rank		2007: n/a		2011: 1st
Singapore	2011, 2007, 2003, 1995	Increases each cycle, then stable 2007-2011	523		565	587	583
			Rank		2007: 1st		2011: 2nd
Finland	2011	n/a	n/a				
			Rank		2007: n/a		2011: 3rd
Japan	2011, 2007, 2003, 1995	Decrease 1995-2003; increase 2007-2011	553		543	548	559
			Rank		2007: 4th		2011: 4th
Russian Federation	2011, 2007, 2003	Increase 2003-2007; stable 2007-2011			526	546	552
			Rank		2007: 5th		2011: 5th

Table B6 Trends among participants performing better than England in Y5 science (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
Chinese Taipei	2011, 2007, 2003	Increase 2003-2007; stable 2007-2011			551	557	552
			Rank		2007: 2nd		2011: 6th
[Florida, US]	2011	n/a	n/a				
United States	2011, 2007, 2003, 1995	Significant increase 2003-2011; otherwise stable.	542		536	539	544
			Rank		2007: 8th		2011: 7th
[Alberta, Canada]	2011, 2007, 1995	No significant increases	555			543	541
Czech Republic	2011, 2007, 1995	Decrease 1995-2007; increase 2007-2011	532			515	536
			Rank		2007: 20th		2011: 8th

Source: Exhibits 1.5 and 1.7, international science report, TIMSS 2011; and Exhibit 1.1, international science report, TIMSS 2007

Table B7 Trends among participants performing similarly to England in Y9 science

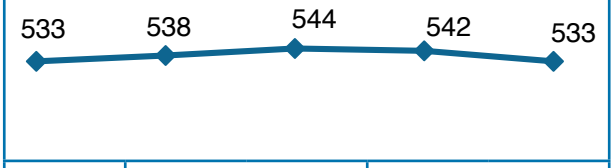
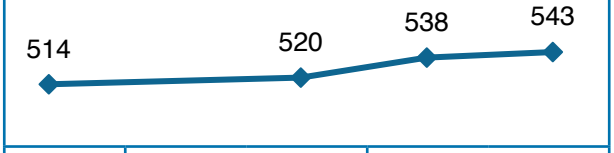
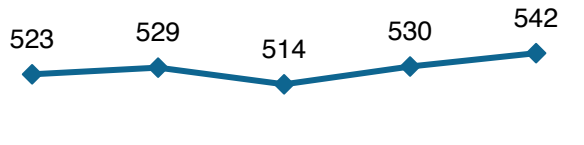
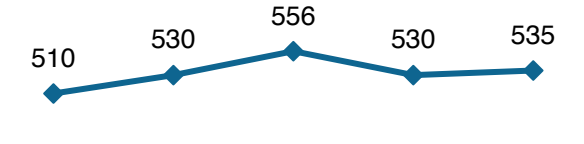
Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1999, 1995	No significant differences					
			Rank	2007: 5th		2011: 9th	
Slovenia	2011, 2007, 2003, 1995	Significant increases 1995-2003 and 2003-2007; stable 2007-2011					
			Rank	2007: 8th		2011: 6th	
Russian Federation	2011, 2007, 2003, 1999, 1995	Stable 1995-1999, significant decrease 1999-2003, increases 2003-2007 and 2007-2011					
			Rank	2007: 10th		2011: 7th	
[Colorado, US]	2011	n/a	n/a				
Hong Kong	2011, 2007, 2003, 1999, 1995	Increases 1995-1999 and 1999-2003; decreased 2003-2007; stable 2007-2011					
			Rank	2007: 9th		2011: 8th	

Table B7 Trends among participants performing similarly to England in Y9 science (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
[Indiana, US]	2011, 2003, 1999	No significant differences		534	531		533
[Connecticut, US]	2011, 1999	No significant differences		529			532
[North Carolina, US]	2011, 1999	Increased 1999-2011		508			532
[Florida, US]	2011	n/a	n/a				
United States	2011, 2007, 2003, 1999, 1995	Increased 1999-2003; 2011 score higher than 1995 score; no other significant differences		513	515	527	520 525
			Rank		2007: 11th		2011: 10th
Hungary	2011, 2007, 2003, 1999, 1995	Increased 1995-1999; decreased 1999-2003; stable 2003 -2007; decreased 2007-2011		537	552	543	539 522
			Rank		2007: 6th		2011: 11th

Source: Exhibits 1.6 and 1.8, international science report, TIMSS 2011; and Exhibit 1.1, international science report, TIMSS 2007

Table B8 Trends among participants performing better than England in Y9 science

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1999, 1995	No significant differences	533	538	544	542	533
			Rank	2007: 5th		2011: 9th	
Singapore	2011, 2007, 2003, 1999, 1995	2011 score higher than most previous cycles (2007, 2003, 1999)	580	568	578	567	590
			Rank	2007: 1st		2011: 1st	
[Massachusetts, US]	2011, 2007, 1999	2007 and 2011 scores higher than 1995; no other significant differences	533			556	567
Chinese Taipei	2011, 2007, 2003, 1999	Decreased 2003-2007; no other significant differences		569	571	561	564
			Rank	2007: 2nd		2011: 2nd	
Korea	2011, 2007, 2003, 1999, 1995	Increased 1999-2003; decreased 2003-2007; increased 2007-2011	546	549	558	553	560
			Rank	2007: 4th		2011: 3rd	

Table B8 Trends among participants performing better than England in Y9 science (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
Japan	2011, 2007, 2003, 1999, 1995	2011 score significantly higher than 1999 score; no other significant differences	554	550	552	554	558
			Rank	2007: 3rd		2011: 4th	
[Minnesota, US]	2011, 2007, 1995	Increased 2007-2011	544			539	553
Finland [152]	2011, 1999	No significant difference (7th grade)		535			529
			Rank (8th grade)	2007: n/a		2011: 5th	
[Alberta, Canada]	2011, 1999, 1995	No significant differences	550	559			546

Source: Exhibits 1.6 and 1.8, international science report, TIMSS 2011; and Exhibit 1.1, international science report, TIMSS 2007

152 In 1999, Finland participated at 7th grade (pupils a year younger than the Y9 pupils tested in TIMSS 2011); in 2011, Finland tested both 7th and 8th graders (Y8 and Y9 equivalents). The trend data given here is, therefore, for 7th graders only. Ranking data is for 8th graders (Y9 equivalent).

Appendix C Example mathematics and science items

Interpreting the data: example items

The items exemplify attainment at each of the benchmark levels. The figures accompanying each item show: the percentage answering each item correctly for England; the international average; and the highest percentage answering the item correctly. The items are the 'source version', provided for translation and/or adaptation in each country as required. Any translations and adaptations must be approved by the International Study Centre in order to verify that the changes made do not affect the demand or intent of the question.

Each item is classified by its content domain and by its cognitive domain. For mathematics, these are:

- Y5 – Number, Geometric Shapes and Measures, Data Display; Knowing, Applying and Reasoning
- Y9 - Number, Algebra, Geometry, Data and Chance; Knowing, Applying and Reasoning.

These areas map reasonably well onto the mathematics national curriculum in England.

For science, the content and cognitive domains are:

- Y5 – Life Science, Physical Science, Earth Science; Knowing, Applying and Reasoning
- Y9 – Biology, Chemistry, Physics, Earth Science; Knowing, Applying and Reasoning.

These areas map reasonably well onto the science national curriculum in England. For Y5, subject content related to Materials and their Properties is included within the TIMSS Physical Science category. Some elements of the TIMSS Earth Science category are covered by the Geography curriculum in England.

C.1 Y5 mathematics

Example item A **Low attainment benchmark, Y5 mathematics**

Content Domain: Number
Cognitive Domain: Applying

Description: Solves a word problem involving addition of three-digit whole numbers

There are 218 passengers and 191 crew members on a ship.
How many people are on the ship altogether?

Answer: 409

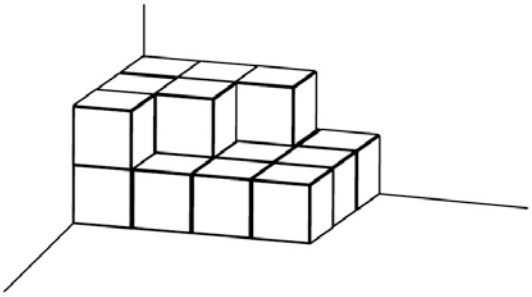
The answer shown illustrates the type of student response that was given 1 of 1 points.

England's score (and standard error)	78 (2.3) – above average
International average	73 (0.3)
Highest score	93 (0.8) - Singapore

Source: Exhibit 2.5, international mathematics report

Example item B **Intermediate attainment benchmark, Y5 mathematics**

Content Domain: Geometric Shapes and Measures
Cognitive Domain: Applying
Description: Determines the number of cubes in a stack with some hidden



Ann stacks these boxes in the corner of the room. All the boxes are the same size. How many boxes does she use?

Ⓐ 25
Ⓑ 19
● 18
Ⓓ 13

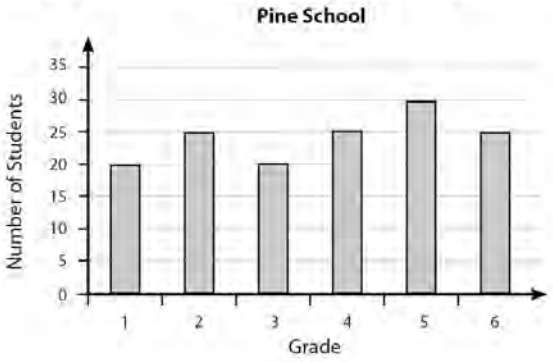
England's score (and standard error)	67 (2.5) – average
International average	63 (0.3)
Highest score	95 (0.8) – Chinese Taipei

Source: Exhibit 2.9, international mathematics report

Example item C **High attainment benchmark, Y5 mathematics**

Content Domain: Data Display
Cognitive Domain: Reasoning
Description: Solves a multi-step reasoning problem using data from a bar graph

The graph shows the number of students at each grade in the Pine School.



In the Pine School there is room in each grade for 30 students.
How many more students could be in the school?

Ⓐ 20
Ⓑ 25
Ⓒ 30
● 35

England's score (and standard error)	65 (2.5) – above average
International average	54 (0.3)
Highest score	79 (1.9) – Chinese Taipei

Source: Exhibit 2.14, international mathematics report

Example item D **Advanced attainment benchmark, Y5 mathematics**

Content Domain: Number
Cognitive Domain: Reasoning
Description: Solves a multi-step numerical reasoning problem

In a soccer tournament, teams get:

3 points for a win
1 point for a tie
0 points for a loss

Zedland has 11 points.

What is the **smallest** number of games Zedland could have played?

Answer: 5

The answer shown illustrates the type of student response that was given 1 of 1 points.

England's score (and standard error)	47 (2.3) – above average
International average	27 (0.3)
Highest score	59 (2.2) – Hong Kong

Source: Exhibit 2.16, international mathematics report

C.2 Y9 mathematics

Example item E **Low attainment benchmark, Y9 mathematics**

Content Domain: Algebra
Cognitive Domain: Knowing
Description: Evaluates a simple algebraic expression

$$y = \frac{a+b}{c}$$

$a = 8$, $b = 6$, and $c = 2$

What is the value of y?

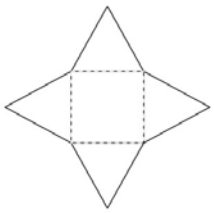
● 7
Ⓑ 10
Ⓒ 11
Ⓓ 14

England's score (and standard error)	73 (2.9) – average
International average	71 (0.3)
Highest score	94 (1.3) - Massachusetts

Source: Exhibit 2.23, international mathematics report

Example item F **Intermediate attainment benchmark, Y9 mathematics**

Content Domain: Geometry
Cognitive Domain: Knowing
Description: Given a net of a three-dimensional object, completes a two-dimensional drawing of it from a specific viewpoint



The shape shown above is cut out of cardboard. The triangle flaps are then folded up along the dotted lines until they touch the edges of the flaps next to them.

Complete the diagram below to show what the shape would look like when viewed from directly above.

The answer shown illustrates the type of student response that was given 1 of 1 points.

England's score (and standard error)	82 (2.1) – above average
International average	58 (0.3)
Highest score	90 (1.7) – Massachusetts

Source: Exhibit 2.26, international mathematics report

Example item G **High attainment benchmark, Y9 mathematics**

Content Domain: Number
Cognitive Domain: Knowing
Description: Given the part and the whole can express the part as a percentage and given the whole and the percentage can find the part

Peter, James, and Andrew each had 20 tries at throwing balls into a basket.

Complete the missing boxes below.

Name	Number of Successful Shots	Percentage of Successful Shots
Peter	10 out of 20	50 %
James	15 out of 20	75 %
Andrew	16 out of 20	80%

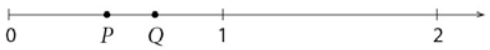
The answer shown illustrates the type of student response that was given 2 of 2 points.

England's score (and standard error)	48 (3.0) – above average
International average	37 (0.3)
Highest score	89 (1.2) - Singapore

Source: Exhibit 2.28, international mathematics report

Example item H **Advanced attainment benchmark, Y9 mathematics**

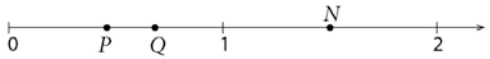
Content Domain: Number
Cognitive Domain: Reasoning
Description: Given two points on a number line representing unspecified fractions, identifies the point that represents their product

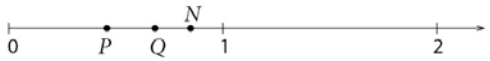


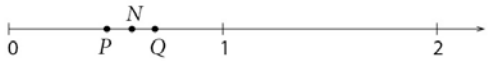
P and Q represent two fractions on the number line above.

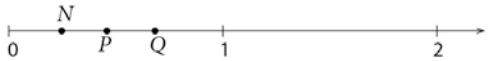
$P \times Q = N$.

Which of these shows the location of N on the number line?

Ⓐ 

Ⓑ 

Ⓒ 

● 

England's score (and standard error)	29 (3.0) – above average
International average	23 (0.3)
Highest score	53 (2.0) – Chinese Taipei

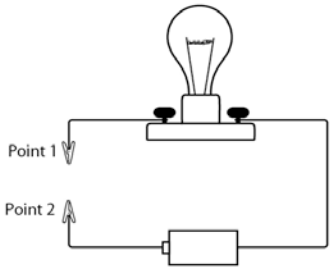
Source: Exhibit 2.32, international mathematics report

C.3 Y5 science

Example item I **Low attainment benchmark, Y5 science**

Content Domain: Physical Science
Cognitive Domain: Applying
Description: From a simple circuit diagram, recognizes that an iron nail can complete an electrical circuit

The following picture shows a lightbulb connected to a battery in an electrical circuit. Which of the following objects connected to Points 1 and 2 will allow the bulb to glow?



● iron nail
Ⓑ plastic spoon
Ⓒ rubber band
Ⓓ wooden stick

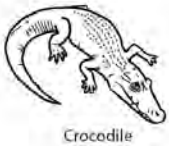
England's score (and standard error)	84 (1.7) – above average
International average	71 (0.3)
Highest score	94 (1.1) – Japan

Source: Exhibit 2.6, international science report

Example item J **Intermediate attainment benchmark, Y5 science**

Content Domain: Life Science
Cognitive Domain: Applying
Description: Pairs pictures of three animals with their distinguishing biological characteristics (skeleton, milk production, number of legs)


Monkey


Crocodile


Grasshopper


Octopus

Answer the following questions using the animals shown above. Write the name for the correct animal in the spaces below.

Which animal has an internal skeleton and produces milk for its young?

monkey

Which animal has an external skeleton and three pairs of legs?

grasshopper

Which animal has a soft body and no skeleton?

octopus

The answer shown illustrates the type of student response that was given 1 of 1 points.

England's score (and standard error)	67 (2.4) – above average
International average	58 (0.3)
Highest score	88 (1.4) – Korea

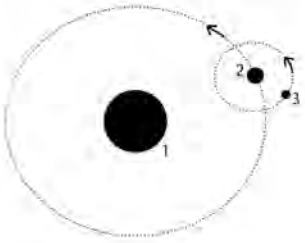
Source: Exhibit 2.8, international science report

Example item K **High attainment benchmark, Y5 science**

Content Domain: Earth Science
Cognitive Domain: Reasoning

Description: Identifies the Earth, Moon, and Sun from a diagram of their orbits

The figure below shows Earth, the Moon, and the Sun. Each body is labeled by a number. The arrows show the direction each body is moving.



Fill in the correct number next to each body (1, 2 or 3).

Earth is body number: 2

The Moon is body number: 3

The Sun is body number: 1

The answer shown illustrates the type of student response that was given 1 of 1 points.

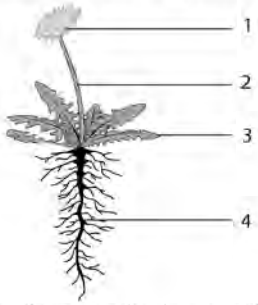
England's score (and standard error)	63 (2.5) – above average
International average	49 (0.3)
Highest score	78 (2.2) – Portugal

Source: Exhibit 2.12, international science report

Example item L **Advanced attainment benchmark, Y5 science**

Content Domain: Life Science
Cognitive Domain: Knowing
Description: From a diagram of a flowering plant, identifies numbered parts and states a function of most of these parts

The diagram shows a flowering plant. Four of its parts are numbered.



In the table below, write the name of each part, and state its function.

Part Number	Name of Part	Function of Part
1	flower	produces seeds
2	stem	transports water and food.
3	leaf	makes food for the plant
4	root	absorbs water, minerals, and nutrients into the plant

The answer shown illustrates the type of student response that was given 2 of 2 points.

England's score (and standard error)	21 (2.8) – average
International average	21 (0.3)
Highest score	80 (1.6) – Singapore

Source: Exhibit 2.14, international science report

C.4 Y9 science

Example item M **Low attainment benchmark, Y9 science**

Content Domain: Chemistry
Cognitive Domain: Knowing
Description: Recognizes the chemical formula of carbon dioxide

What is the chemical formula for carbon dioxide?

Ⓐ CO
● CO_2
Ⓒ C
Ⓓ O_2

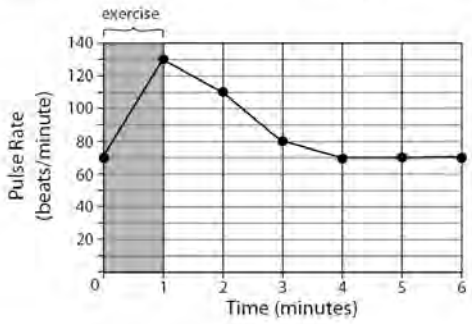
England's score (and standard error)	92 (1.3) – above average
International average	85 (0.2)
Highest score	99 (0.3) – Japan

Source: Exhibit 2.22, international science report

Example item N **Intermediate attainment benchmark, Y9 science**

Content Domain: Biology
Cognitive Domain: Reasoning
Description: Interprets a graph showing changes in pulse rates before, during, and after exercise and recognizes what can be concluded from the graph

John measures his pulse rate before he exercises. It is 70 beats per minute. He exercises for one minute and measures his pulse rate again. He then measures it every minute for several minutes. He draws a graph to show his results.



What can be concluded from his results?

Ⓐ His pulse rate increased by 50 beats per minute.
Ⓑ His pulse rate took less time to slow down than to increase.
Ⓒ His pulse rate after 4 minutes was 80 beats per minute.
● His pulse rate returned to normal in less than 6 minutes.

England's score (and standard error)	69 (2.6) – above average
International average	57 (0.3)
Highest score	82 (1.7) – Japan

Source: Exhibit 2.24, international science report

Example item O **High attainment benchmark, Y9 science**

Content Domain: Physics
Cognitive Domain: Knowing
Description: Recognizes what happens to molecules of a liquid as the liquid cools

What happens to the molecules of a liquid when the liquid cools?

- ● They slow down.
- Ⓑ They speed up.
- Ⓒ They decrease in number.
- Ⓓ They decrease in size.

England's score (and standard error)	65 (2.3) – above average
International average	58 (0.3)
Highest score	86 (1.6) – Alberta

Source: Exhibit 2.28, international science report

Example item P **Advanced attainment benchmark, Y9 science**

Content Domain: Physics
Cognitive Domain: Applying
Description: Recognizes that the force of gravity acts on a person regardless of position and movement

The figure shows a parachute jumper in four positions.

1. In the aircraft before the jump

2. In freefall immediately after jumping before parachute opens

3. Falling to the ground after the parachute opens

4. On the ground just after landing

In which of the positions does the force of gravity act on the jumper?

Ⓐ Position 2 only.
Ⓑ Positions 2 and 3 only.
Ⓒ Positions 1, 2 and 3 only.
● Positions 1, 2, 3, and 4.

England's score (and standard error)	43 (2.9) – above average
International average	32 (0.3)
Highest score	63 (2.0) – Korea

Source: Exhibit 2.32, international science report

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