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

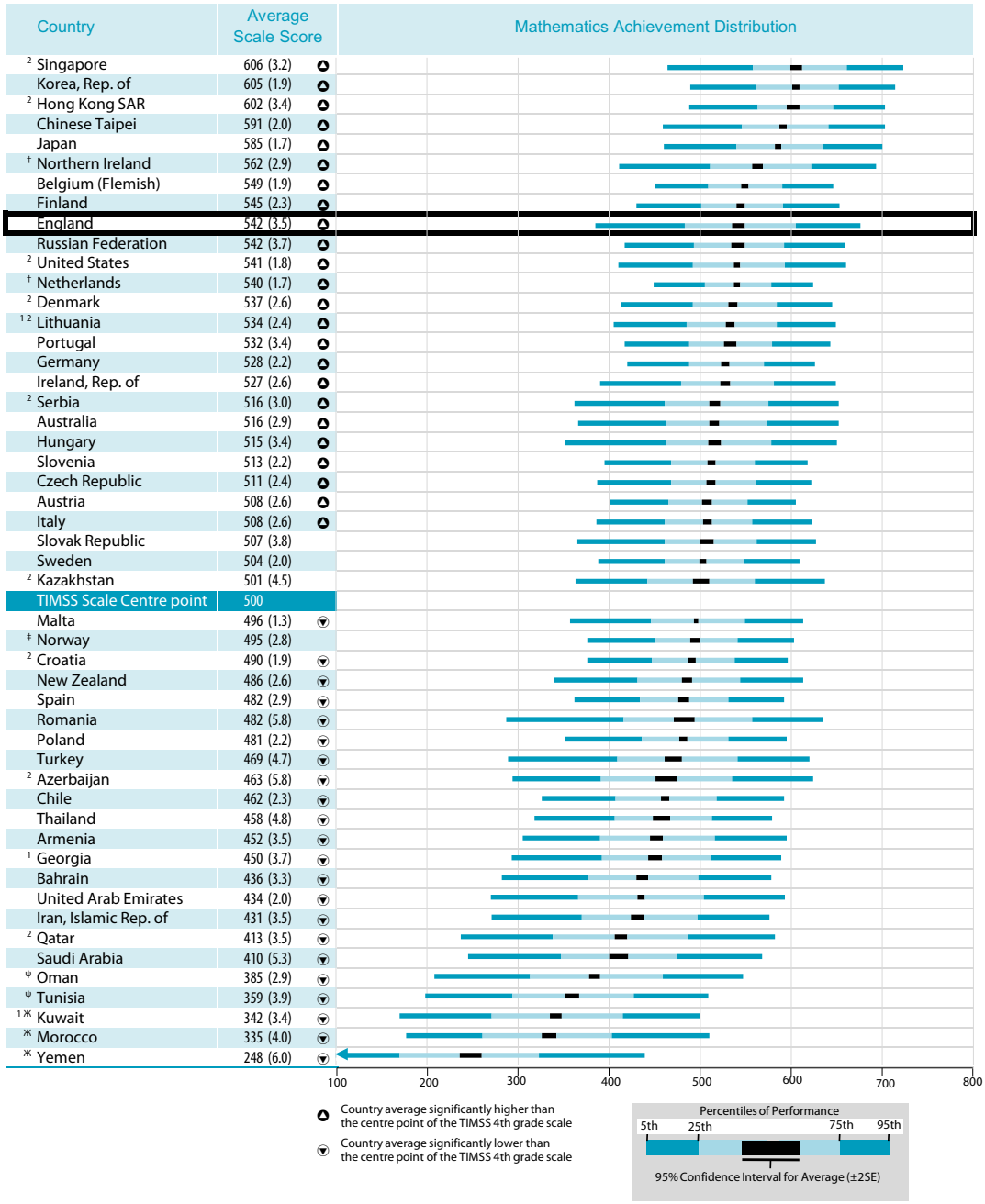
HIGHER performance compared with England Participants performing at a significantly higher level than England		**SIMILAR performance compared with England** Participants performing at a similar level to England (not statistically significantly different)		**LOWER performance compared with England** Participants 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

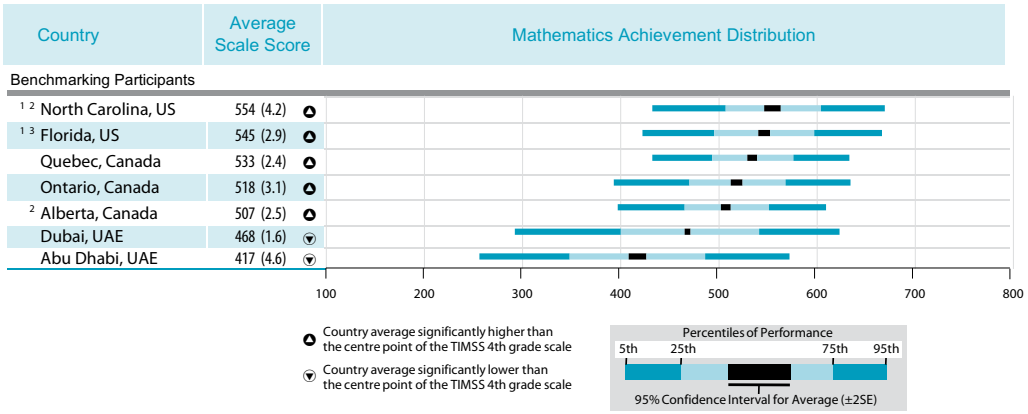
The mean scores on the TIMSS achievement scale (with 95 per cent confidence intervals) are shown graphically as the darkened areas on the achievement distributions, and listed (together with their standard errors) in the 'Average Scale Score' column of the table. Arrows beside the scores indicate whether 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'.



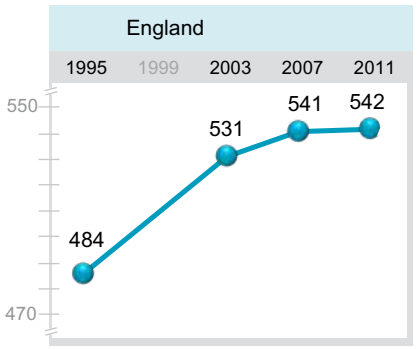
Source: Exhibit 1.1, international mathematics report

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

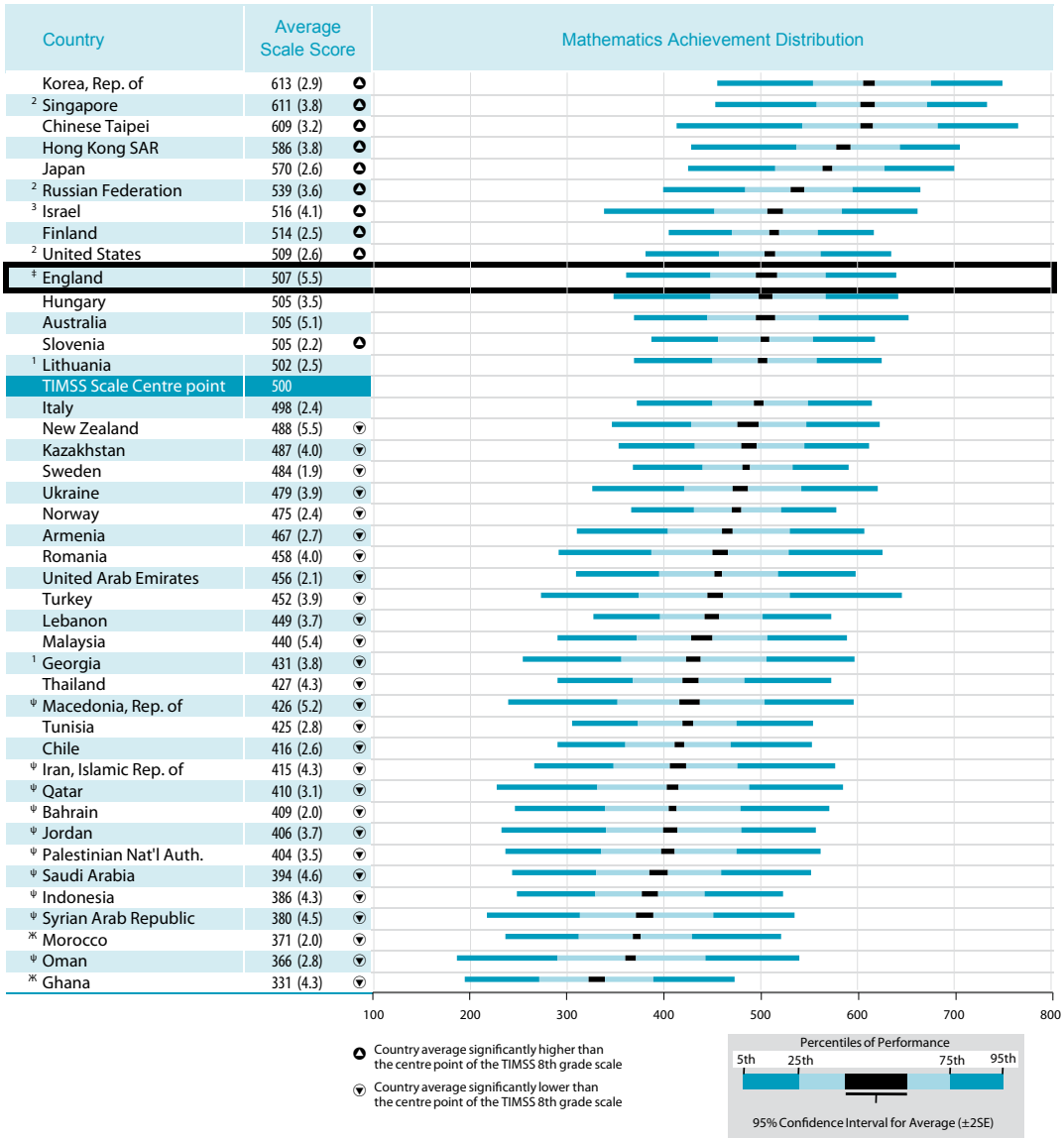
HIGHER performance compared with England Participants performing at a significantly higher level than England		**SIMILAR performance compared with England** Participants performing at a similar level to England (not statistically significantly different)		**LOWER performance compared with England** Participants 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



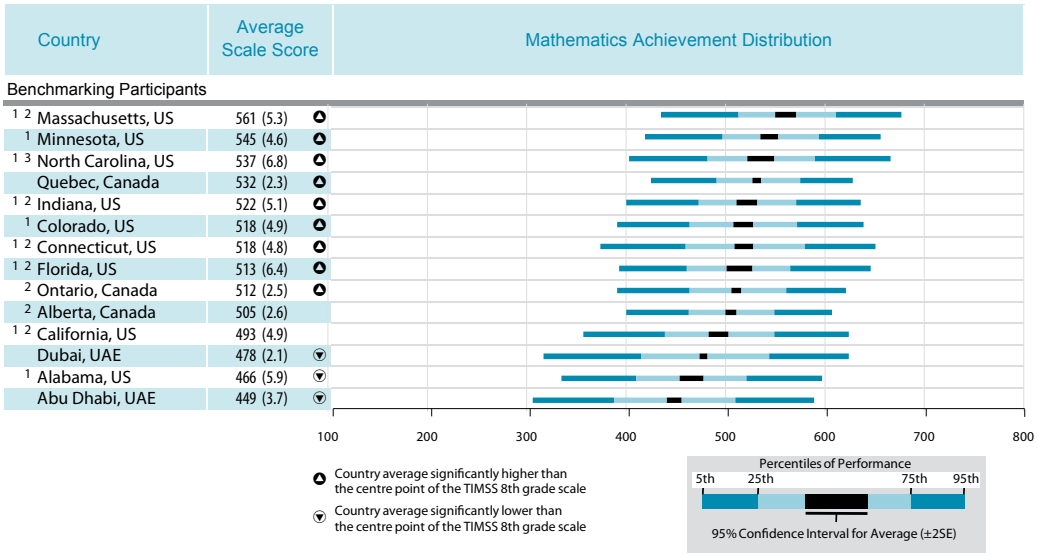
Country	Average Scale Score
Korea, Rep. of	613 (2.9) ▲
[2] Singapore	611 (3.8) ▲
Chinese Taipei	609 (3.2) ▲
Hong Kong SAR	586 (3.8) ▲
Japan	570 (2.6) ▲
[2] Russian Federation	539 (3.6) ▲
[3] Israel	516 (4.1) ▲
Finland	514 (2.5) ▲
[2] United States	509 (2.6) ▲
‡ England	507 (5.5)
Hungary	505 (3.5)
Australia	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.



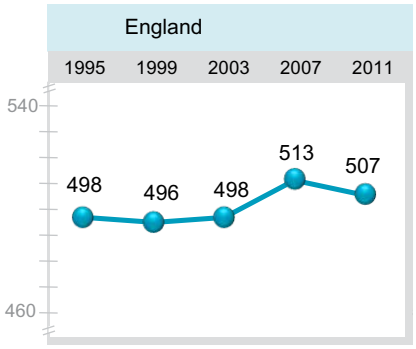
Source: Exhibit 1.2, international mathematics report

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

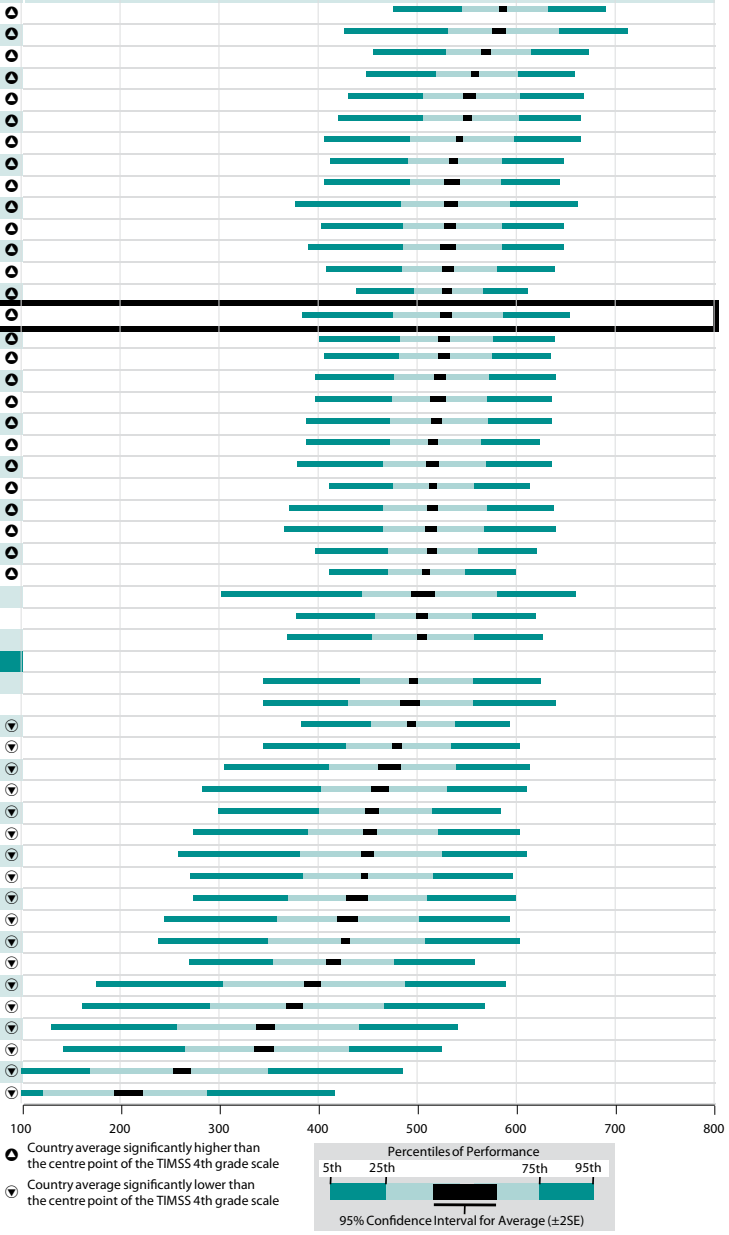
12 Taking account of the size of standard errors, this score is significantly higher than the mean score for England, despite being lower than the mean score for North Carolina (which has a larger standard error).

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)	▼

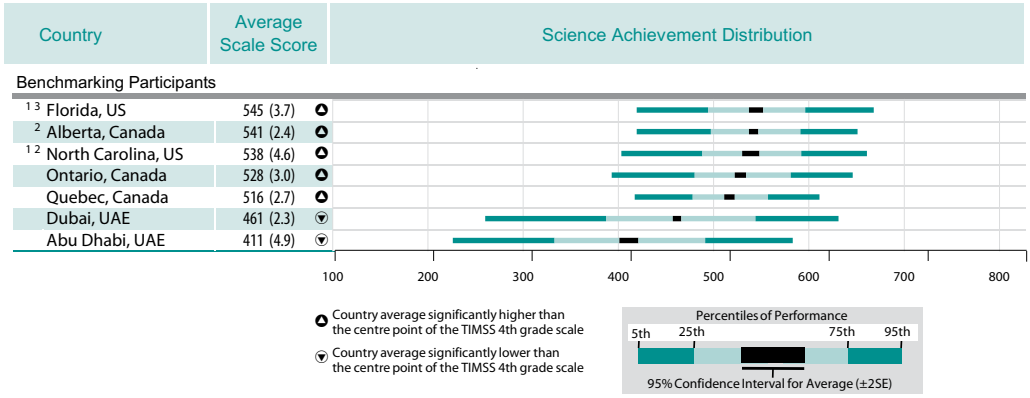


Ж Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

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.



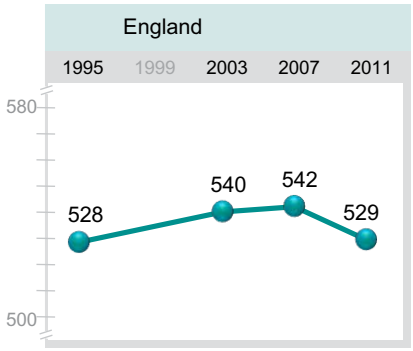
Source: Exhibit 1.1, international science report

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

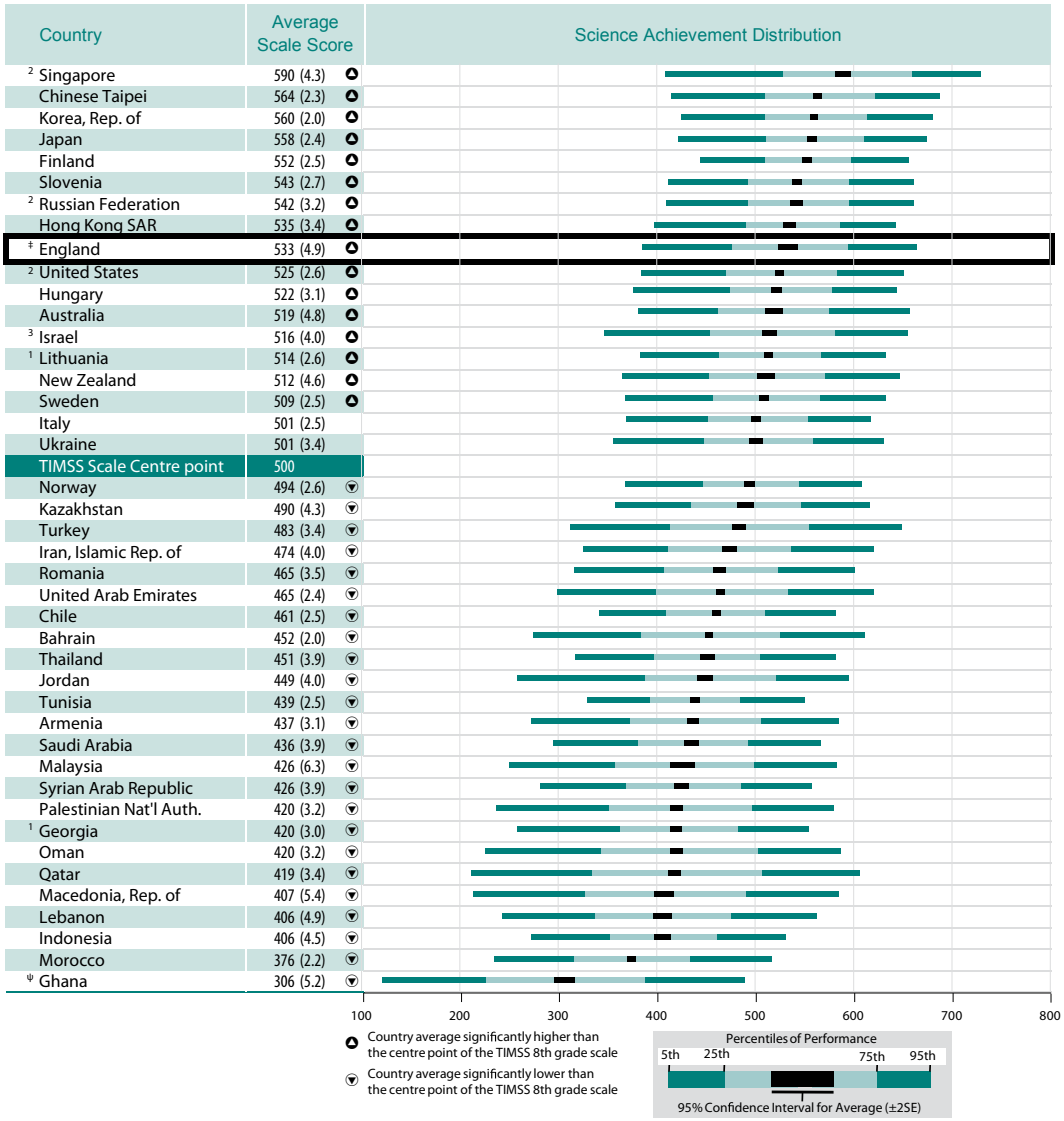
HIGHER performance compared with England Participants performing at a significantly higher level than England		**SIMILAR performance compared with England** Participants performing at a similar level to England (not statistically significantly different)		**LOWER performance compared with England** Participants 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.

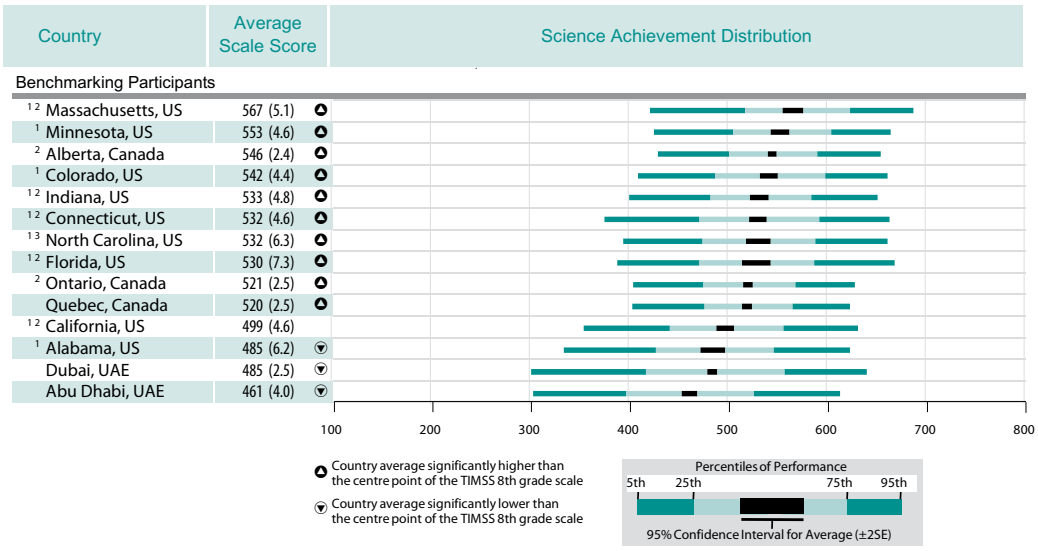
Table 1.9 Mean scores and distribution of Y9 science achievement, TIMSS 2011



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.



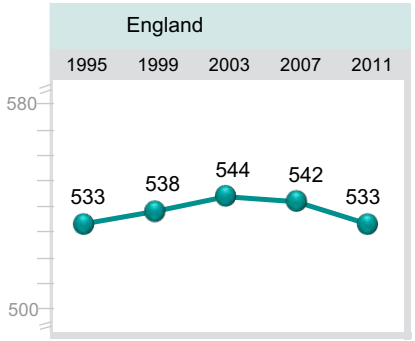
Source: Exhibit 1.2, international science report

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)