



Department
for Education



Trends in Maths and Science Study (TIMSS): National Report for England

Research report

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About the research team

Professor Toby Greany (Principal Investigator) oversaw all aspects of the research analysis and reporting as well as the dissemination. Toby is Professor of Leadership and Innovation and Director of the London Centre for Leadership in Learning at the UCL Institute of Education (UCL IOE).

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Dr Iain Barnes supported the report writing and analysis. Christina Swensson provided project management throughout and led on the dissemination strand of the project. Iain and Christina are both associates of the London Centre for Leadership in Learning, UCL IOE.

Executive summary

What is TIMSS?

The Trends in International Mathematics and Science Study (TIMSS) is overseen by the International Association for the Evaluation of Educational Achievement (IEA). It provides participating countries internationally comparable data on the performance and attitudes of 9 to 10 (year 5) and 13 to 14 year-olds (year 9) in maths and science as well as comparisons of the curriculum and the teaching of these subjects in primary and secondary schools. Fifty-seven countries and seven benchmarking entities participated in TIMSS 2015¹. England has participated in TIMSS since the study was first carried out in 1995 and in each subsequent four-yearly cycle², meaning that 2015 represents the study's sixth cycle. The study therefore provides valuable trends in England's absolute and relative performance over a twenty-year period.

In England, testing was conducted with pupils in years 5 and 9 in May and June 2015, with a sample of over 8,800 pupils across 290 schools. England's year 5 cohort started school in 2009 and sat the new Key Stage 2 tests in the summer of 2016. The year 9 cohort started school in 2005 and will take the new GCSEs in summer 2017, having started secondary school in 2012. This TIMSS National Report for England focuses on comparisons of our pupils' performance and their experiences of maths and science teaching compared to: high-performing and rapidly improving countries; other English-speaking countries; and similar countries in terms of context and geography. The TIMSS International Report 2015 offers comparisons across all participating countries³.

How does the maths and science performance of pupils in England compare internationally?

Pupils in England performed, on average, significantly⁴ above the international mean in maths and science in both years 5 and 9 in TIMSS 2015. Comparing England's overall performance in 2015 with 2011, there were increases in maths and science performance in both years 5 and 9, although none of these were significant.

¹ During the development of the TIMSS questionnaires, careful testing and translation is undertaken to ensure appropriate adaptation for different national contexts; nevertheless, it is important to consider the potential impact of cultural and language differences when interpreting the findings.

² Year 5 pupils did not participate in assessments in 1999, but year 9 pupils did.

³ <http://timssandpirls.bc.edu/timss2015/international-results/>

⁴ Where the term significant is used this refers to statistical significance.

Between 1995 and 2015, the maths performance of year 5 and year 9 pupils in England has improved. The performance of year 5 pupils in science has been more varied, but has seen significant improvement over the 20 year period. In year 9, the science performance of pupils in England has remained broadly static over the same period.

England's performance in 2015 places it in the second highest-performing group of countries in maths and science in both years 5 and 9. Overall, as in previous years, the five East Asian countries that participated in TIMSS (Singapore, Hong Kong, South Korea, Taiwan and Japan), together with Russia, performed highly across both subjects and year groups, although there were other countries that performed highly in one or more areas as detailed below⁵. The report also identifies a group of 'fast-moving' countries (Kazakhstan, Poland, Slovenia and the Czech Republic) that have seen significant improvements in one or more area.

Maths - year 5

The trend in England's year 5 maths score is one of improvement over time, from significantly below the international mean in 1995 to significantly above it in 2015. The performance of pupils in England has increased in each consecutive TIMSS cycle (see Figure 1). Between 2011 and 2015, the average performance of pupils in England increased by four points, but this increase was not significant in statistical terms.

In 2015, England remained in the second highest-performing group of countries, significantly above the international mean. Seven countries scored significantly higher than England (compared to six in 2011), seven countries scored at broadly the same level, and 34 countries scored significantly lower. The five East Asian countries continue to dominate this highest-performing group, with Northern Ireland and Russia also scoring significantly higher than England.

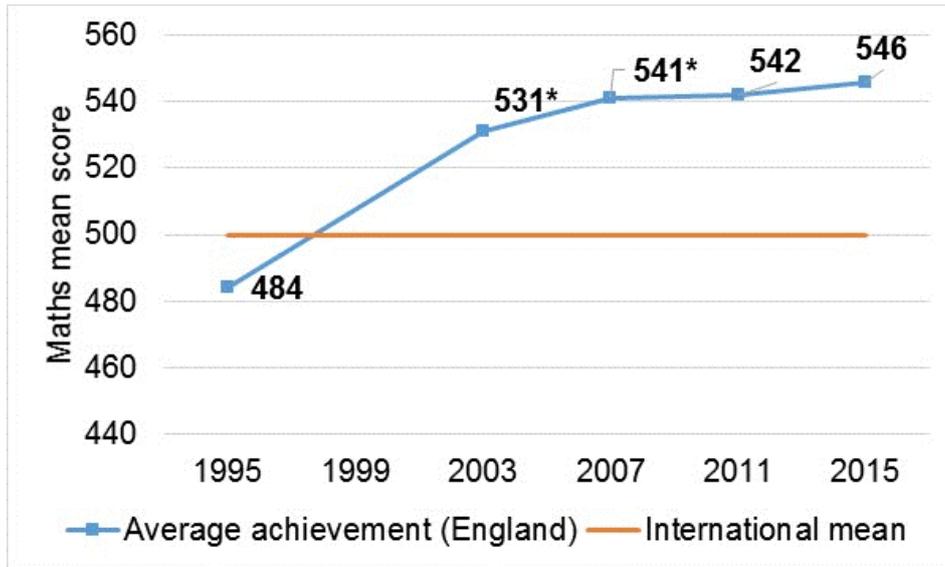
Between 1995⁶ and 2015 there has been a significant improvement in the proportion of year 5 pupils in England reaching each of the international benchmarks (see Figure 2)⁷. The proportion of year 5 pupils reaching the Low international benchmark improved significantly between 2011 and 2015, indicating that the achievement of the lowest performers in England has improved in the last four years.

⁵ Hong Kong and Russia were in the top seven countries in year 9 science, although they performed at a similar level to England in 2015, not significantly higher as they did across all other assessments.

⁶ In 1995 only, participating pupils were drawn from years 4 and 5 in England. In each cycle since 1995 only year 5 pupils have been assessed. This might have affected England's score in 1995.

⁷ The distribution of pupil performance can be compared across countries and over time using the international mean (an average centred at 500) of pupils' scores from each country and also against the percentage of pupils that reach each of four international benchmarks - Advanced, High, Intermediate and Low .

Figure 1: Trend in mean year 5 maths score (England)



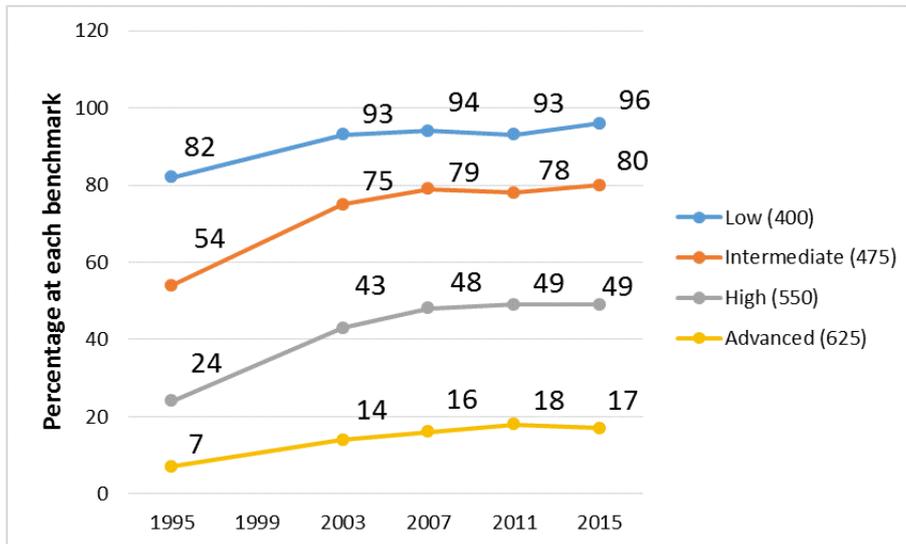
Source: TIMSS 2015.

Note 1: The 1995 score is an average across the performance of year 4 and year 5 pupils.

Note 2: The 1999 cycle of TIMSS included only year 9, not year 5 pupils.

Note 3: A significant increase or decrease from the previous year is marked with an asterisk.

Figure 2: Trend in the percentage of year 5 pupils meeting each of the TIMSS international benchmarks in maths (England)



Source: TIMSS 2015.

Note 1: The 1995 score is an average across the performance of year 4 and year 5 pupils.

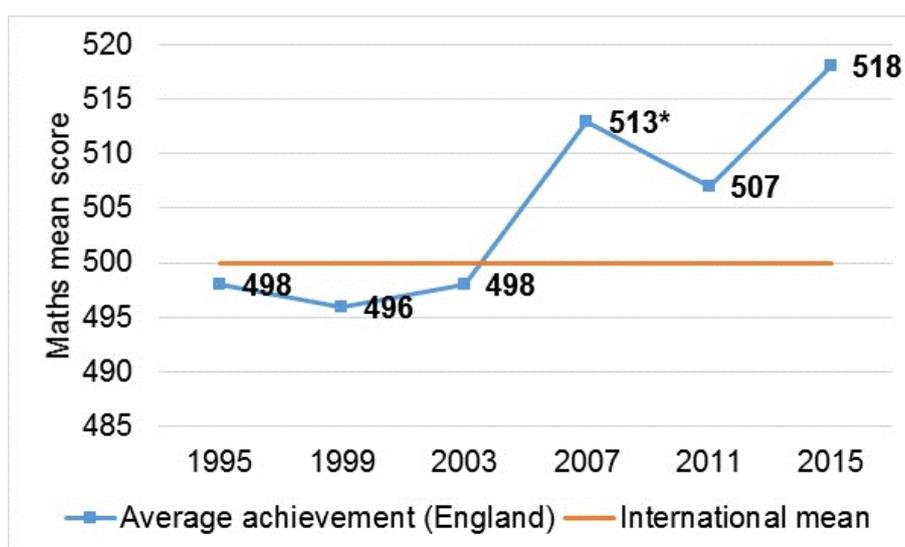
Note 2: Figures in parentheses refer to TIMSS scores needed to reach each International Benchmark.

Maths - year 9

The performance in year 9 pupils in maths has seen significant improvement over the last 20 years, in particular between 2003 and 2007, albeit with a small drop in 2011 (see Figure 3). In 2007, year 9 pupils in England performed above the TIMSS international mean for the first time. The 2015 TIMSS mean score for England was 518. This represents an increase of 11 score points since 2011, though this increase is not significant.

As is the case for primary maths, England remains in the second highest-performing group of countries in year 9 maths. Six countries scored significantly higher than England (as in 2011), nine countries scored at broadly the same level, and 23 countries scored significantly lower. There has been no change since 2011 in terms of the six countries that make up the highest-performing group at year 9 maths - the five East Asian countries of Singapore, Hong Kong, South Korea, Taiwan and Japan, and Russia.

Figure 3: Trend in the year 9 maths score (England)



Source: TIMSS 2015.

Note 1: A significant increase or decrease from the previous TIMSS cycle is marked with an asterisk.

Note 2: The score for 1995 is the average across pupils in year 8 and year 9.

As in year 5, between 1995 and 2015, there has been a significant improvement in the proportion of year 9 pupils in England reaching all the international benchmarks. In 2015, the increases were largest amongst the lower performers, where the share of pupils achieving the Low benchmark rose significantly.

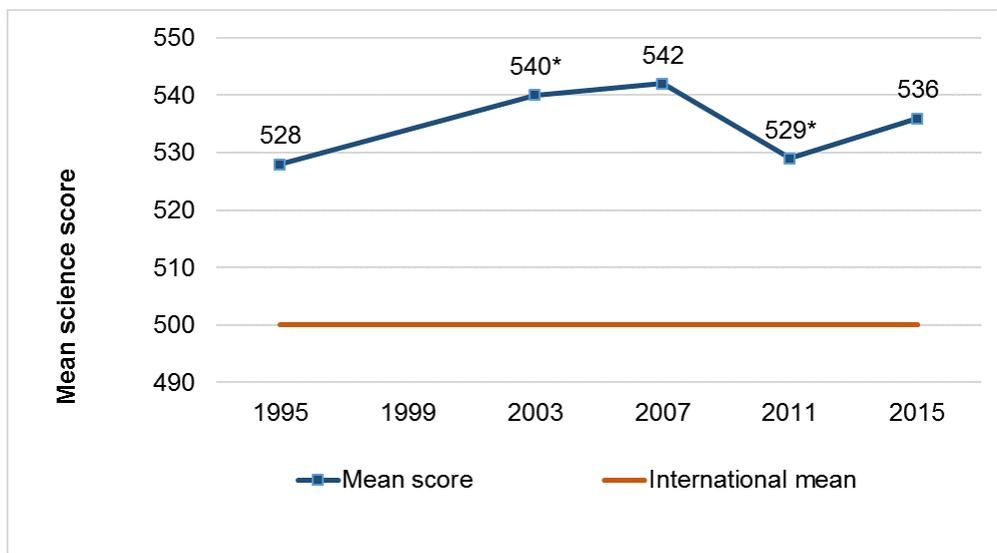
Science - year 5

Year 5 pupils' performance in science has been consistently above the international mean score in all TIMSS cycles (see Figure 4). Over the 20 year period, from 1995

to 2015, the performance of year 5 pupils in England has improved significantly, although with some variation. After a decline in performance in 2011 there was an increase of seven points in 2015, although this increase was not significant.

Ten countries performed significantly higher than England in 2015 (eight in 2011); eight at a similar level and 28 significantly lower. The countries performing significantly higher than England remained consistent in some respects across the 2011 and 2015 cycles: the five East Asian countries (except Hong Kong in 2011), Finland, Russia and the United States. Poland and Kazakhstan joined the highest-performing group in 2015, having performed significantly lower than England in 2011.

Figure 4: Trend in the mean year 5 science score (England)



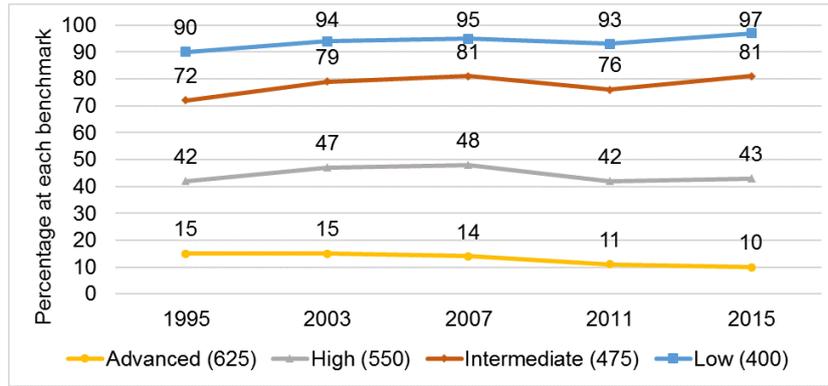
Source: TIMSS 2015.

Note 1: The 1999 cycle of TIMSS included only year 9, not year 5 pupils.

Note 2: A significant increase or decrease from the previous TIMSS cycle is marked with an asterisk.

Since 2011 (see Figure 5 below), there have been significant improvements in the percentage of pupils achieving the Low and Intermediate benchmarks, partly mirroring the improvement in attainment of the Low benchmark in maths. Since 1995, achievement against the Advanced benchmark has shown a significant decline.

Figure 5: Trend in the percentage of year 5 pupils meeting each of the TIMSS international benchmarks in science (England)



Source: TIMSS 2015.

Note 1: The 1999 cycle of TIMSS included only year 9, not year 5 pupils.

Note 2: The 1995 score is an average across year 4 and year 5 pupils.

Note 3: Figures in parentheses refer to TIMSS scores needed to meet each International Benchmark.

Science - year 9

Year 9 pupils' overall performance in science has been consistently and significantly above the international mean score (see Figure 6 below). In 2015 England's mean science score increased by four points from 2011, although this was not significant.

England remains in the second highest-performing group of countries in 2015 for year 9 science. Five countries performed significantly higher than England (as in 2011); six at a similar level and 27 significantly lower. The five highest-performing countries were four of the five East Asian countries: Singapore, Japan, Taiwan, South Korea, and Slovenia, whose pupils had performed similarly to England in 2011.

Figure 6: Trend in the mean year 9 science score (England)



Source: TIMSS 2015.

Note 1: A significant increase or decrease from the previous TIMSS cycle is marked with an asterisk.

Note 2: The score for 1995 is the average across pupils in year 8 and year 9.

Since 2011, there have been small increases in the percentage of year 9 pupils in England achieving the High, Intermediate and Low international benchmarks, although none of these were significant.

Differences by pupil characteristics

In 2015, year 5 boys performed significantly higher than girls in maths, indicating the reopening of a gender gap that had almost disappeared by 2007. When this same cohort reached year 6, in 2016, there were no differences by gender in boys' and girls' maths attainment at the expected standard⁸, although slightly more boys achieved the higher score. In TIMSS 2015, the higher performance of year 5 boys in England was also found in all the other English-speaking countries, although the differences were not consistently significant. Girls scored three points higher than boys in year 9 maths, but this difference was not significant. There were no significant gender differences in science in either year 5 or year 9.

Based on the TIMSS measure of disadvantage (the number of books pupils say there are at home), England has a relatively large gap compared to other countries between the average achievement of disadvantaged and advantaged pupils. This is the case in both maths and science and includes the majority of the highest-performing countries: for example, Japan had narrower gaps in all areas, while Taiwan had narrower gaps in all areas except year 9 maths and Hong Kong and Russia had narrower gaps in all areas except year 9 science.

Year 5 and 9 pupils in England whose first language is English performed higher than pupils for whom English is an additional language (EAL) in science. While this was also true for year 5 pupils in maths, it was not the case for year 9 EAL pupils, who performed slightly higher than native English speakers in maths. Using the TIMSS measure for EAL⁹, pupils in the other English-speaking countries who did not always speak the language of the assessments at home tended to perform better in maths than those who did.

Pupil attitudes

On average, pupils in England were more likely than their peers in the highest-performing countries to say that: their teaching is engaging; that they like learning

⁸ Based on provisional 2016 data, 70% per cent of both boys and girls achieved the expected standard at the end of Key Stage 2. Although the same cohort, the TIMSS sample is smaller set of pupils than all pupils assessed nationally in Key Stage 2 assessments.

⁹ The TIMSS pupil questionnaire asked pupils to state whether they always, almost always, sometimes or never spoke the language of the test at home. A response of almost always, sometimes or never indicates the language of the test is not their native language. Pupils who sometimes or never spoke the language of test at home tended not to perform as well in maths as native speakers.

maths and science; that they are confident in their ability in these subjects; and that they value them¹⁰. The extent to which year 5 and 9 pupils in England responded positively in these four areas in each subject was, in all but one instance, associated with higher levels of average achievement. These positive associations in each domain were also evident, on average, across all countries.

The greatest range in average achievement was found in the pupil confidence domain, indicating that pupil confidence in a subject may have a stronger influence on achievement compared with the other three domains (engaging teaching, valuing the subject and liking learning it).

Whole-school factors

Year 5 pupils in England were twice as likely to attend a school that puts a very high emphasis on academic success compared with their peers in other countries as a whole, while year 9 pupils were more than three times as likely to attend one. In both years and both subjects, the greater the emphasis on academic success, the higher the performance of year 5 and 9 pupils in England and, on average, across all participating countries.

Compared to other countries, pupils in England experienced relatively few problems in their school conditions or with a lack of resources. One area of resourcing in which there were notable differences between England and many other countries was that of teacher recruitment. Headteachers in England were more likely to report vacancies that were very difficult to fill than their peers in the other four comparator groups of countries analysed in this report. Around two thirds of year 9 pupils were taught in schools where vacancies in both subjects were either somewhat or very difficult to fill.

Pupils in England and across all countries who were in schools where discipline, orderliness and safety and bullying issues were more common generally had lower achievement. According to headteachers and teachers, pupils in England were mostly taught in schools with fewer issues compared to other countries. However, according to pupils in England themselves, their experience of bullying was, on average, similar to that of pupils across all countries.

Teachers and teaching

More time is devoted to teaching maths in year 5 in England than the average in other countries as a whole, while in science it was below the average. Pupils in year

¹⁰ The extent to which pupils valued maths and science was assessed in year 9, but not year 5.

9 in England spend less time learning maths than the international mean, and substantially less time learning science. However, across all countries, there does not appear to be a positive association between more teaching time and higher average achievement.

On average, pupils in England had more access to computers in class than their peers in other countries, except in maths in year 9, where computer access was in line with the international average. Across all countries, there is an association between availability of computers and higher average achievement across both year groups and subjects.

Year 9 pupils in England spent less time on homework, on average, than other countries. In England, in both maths and science, there is an association between pupils spending more time on homework and higher average achievement. However, internationally, year 9 pupils who spend three hours a week or more on homework in maths and science perform worse, on average, than their peers who spend between 45 minutes and three hours¹¹.

Year 5 and 9 pupils in England were more likely to be taught by teachers with fewer years of experience than the average across other countries. However, in England, pupils taught by more experienced teachers did not necessarily perform better than those taught by less experienced teachers. Indeed, in year 9 maths, pupils in England taught by teachers with less than five years' experience performed higher than all other groups.

Teachers in England report relatively challenging teaching conditions (an overarching term that covers issues such as having too many teaching hours or difficulty keeping up with curriculum changes), particularly teachers of year 9 science. Higher average achievement is associated to an extent with lower levels of teacher challenge.

Job satisfaction among year 5 and 9 teachers in England is low compared to teachers in most other countries. Only pupils in Japan were taught by teachers with lower levels of job satisfaction at year 9. In England there is a positive association between pupils' average achievement and the level of their teachers' satisfaction.

The majority of year 5 and 9 pupils in England were taught maths by teachers who reported receiving professional development in the previous two years centred upon content, curriculum and pedagogy/instruction. These proportions are higher than in most other countries, potentially reflecting the introduction of the new National Curriculum in England in September 2014. Overall, most year 5 and 9 pupils in

¹¹ Only one per cent of year 9 pupils in England reported spending three hours or more of homework in maths and science, so this finding cannot be tested for England.

England were taught by teachers that largely reported very high or high levels of confidence in the different aspects of teaching maths and science

Home environment

Almost all year 5 and year 9 pupils in England reported having access to the internet at home and most used this for their homework. Most also either possessed their own computer/tablet or had access to a shared one. Fewer year 5 pupils had access to a study desk at home than their international peers, while the opposite was the case for year 9 pupils.

Notably fewer year 9 pupils in England received additional tuition in maths and science than pupils in other countries, with about three-times as many pupils in the high-performing East Asian countries receiving this. Pupils receiving home tuition in England performed lower than their peers who did not receive any tuition. It is possible that this is because the pupils most likely to engage with home tuition are those with low prior attainment.

Conclusions

The story of England's performance in TIMSS over the last 20 years is one of improvement in maths, albeit from a low base, improvement in year 5 science and consistency in year 9 science, leaving us securely in the second highest-performing group of countries overall. The significant increases in the proportions of pupils reaching the Low benchmark in maths in years 5 and 9 in 2015 are particularly welcome.

Three performance issues that stand out for England from the 2015 results are: that pupils here make relatively little progress in maths between years 5 and 9; that far higher proportions achieve the Advanced and High benchmarks in both subjects in the highest-performing countries; and that we have wider gaps between our more and less advantaged pupils (according to the number of books pupils say there are at home) than most other high performing countries. Equally though, pupils in England appear to value, enjoy and feel confident in learning maths and science more than many of their international peers, with confidence correlating most strongly with achievement.

England's schools compare relatively well with their international comparators in several areas. For example, there were fewer challenges with lack of resources, poor conditions, and pupil behaviour than in most other countries. Schools in England also score highly for their focus on academic performance: a factor that is particularly associated with student achievement in England and across all schools in other countries, on average. However, there are other areas, such as teacher

recruitment, teacher challenges and job satisfaction, where England compares less favourably.

Beyond these headline results lie many important findings that are explored in more detail in the report. For example, curriculum areas where we perform poorly, and that therefore warrant attention, include Chemistry and Algebra in Key Stage 3, and Geometric Shapes and Measures in Key Stage 2.

Clearly, there is much that England can and should learn from some of the other school systems highlighted in this report. Once again, the East Asian group of countries has performed phenomenally well in the assessments. What is also notable is how these countries score in some of the other areas of TIMSS: for example, with fewer pupils valuing or liking learning maths and science in most cases and with high levels of home tutoring, often involving more than 50 per cent of pupils. England is working hard to apply aspects of the East Asian model in its curriculum and pedagogy; in the years to come it will be important to understand how these wider factors interact to secure overall high performance.

Chapter 1. Introduction

1.1 What is the Trends in International Mathematics and Science Study (TIMSS)?

Designed by the International Association for the Evaluation of Educational Achievement (IEA), TIMSS is a worldwide research project, taking place every four years¹². Boston College in the United States coordinates TIMSS with support from the IEA, Statistics Canada and the Educational Testing Service.

The study's main purpose is to provide internationally comparable data about trends in mathematics and science achievement over time. TIMSS provides a range of data on maths and science achievement at primary and secondary school levels. Teachers and headteachers in participating schools also complete questionnaires on factors that potentially impact on academic attainment. The findings from TIMSS therefore have policy and practice implications for readers at a range of levels.

TIMSS was first carried out in 1995 and data have been collected every four years since, so that 2015 represents the study's sixth cycle over a twenty-year period. To enable robust international comparisons, the study uses data collected from samples of pupils in the same academic year groups: 9-10 year olds and 13-14 year olds. In England, these pupils are in years 5 and 9¹³. Pupil data are collected through academic assessments and attitudinal surveys. Contextual data from the pupils' headteachers and teachers are also collected through attitudinal surveys.

In 2015, 57 countries and seven benchmarking entities¹⁴ participated in TIMSS (see Table 1 below). Across these countries and entities, more than 580,000 pupils participated in TIMSS in 2015. More information on the study design and conduct in each country can be found in the TIMSS International Report 2015¹⁵. England participated in both the year 5 and 9 maths and science assessments in 2015.

¹² The IEA is 'an independent, international cooperative of national research institutions and governmental research agencies. It conducts large-scale comparative studies of educational achievement and other domains of education, with the aim of gaining in-depth understanding of the effects of policies and practices within and across systems of education' (source: http://www.iea.nl/about_us.html). Its list of member states is available at: http://www.iea.nl/institutional_members.html [Accessed 26 August 2016].

¹³ In the IEA's methodology and TIMSS International Reports, these year groups are referred to as 4th and 8th grade, reflecting terminology used in a wide range of participating countries.

¹⁴ Benchmarking entities are states and provinces within countries that collect representative samples in TIMSS and so can provide comparative findings.

¹⁵ <http://timssandpirls.bc.edu/timss2015/international-results/>

Table 1: TIMSS 2015: participating countries and benchmarking entities

	Participating Countries and benchmarking entities
Africa	Botswana, South Africa
Asia	Armenia, Taiwan ¹⁶ , Georgia, Hong Kong, Indonesia, Japan, Kazakhstan, South Korea, Malaysia, Singapore, Thailand
Australasia	Australia, New Zealand
Europe	Belgium (Flanders), Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, England, Finland, France, Georgia, Germany, Hungary, Ireland, Lithuania, Malta, Netherlands, Norway, Northern Ireland, Poland, Portugal, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Turkey
North Africa and Middle East	Bahrain, Egypt, Iran, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, United Arab Emirates (UAE)
The Americas	Canada, Chile, United States
Benchmarking entities	Abu Dhabi (UAE), Dubai (UAE), Buenos Aires (Argentina), Florida (USA), Ontario (Canada), Quebec (Canada)

Source: TIMSS 2015.

Countries and benchmarking entities participating in 2015 that had not done so in 2011 were: Buenos Aires (Argentina), Bulgaria, Canada, Cyprus, Egypt and France.

Test administration and national data analysis and reporting in England were managed by a consortium comprising RM Results, World Class Arena Ltd (WCAL) and University College London (UCL) Institute of Education (IOE). Together they recruited schools for the field trial and main study assessments; adapted the test items for use in England; supported participating schools in the administration of the tests during the main study period from March 2nd to May 12th 2015; marked all assessment and questionnaire responses; and undertook a curriculum matching exercise to identify which of the TIMSS test items pupils in English schools would have been expected to have studied by the time of the TIMSS tests. The UCL Institute of Education team was responsible for national data analysis and for writing this national report.

The IEA analysed the international database of country results and the evidence from pupil, headteacher and teacher questionnaires. This analysis is available in the

¹⁶ Taiwan is named Chinese Taipei in the TIMSS International Report 2015.

IEA's TIMSS International Report 2015¹⁷. The IEA also commissioned a TIMSS Encyclopaedia article from each participating country, to provide an overview of the structure of each participating education system¹⁸. England's encyclopaedia article was written by UCL IOE.

The purpose of this national report is to establish how well pupils in England have performed over time, both in relation to England's previous achievements and to the achievements of pupils in other participating countries. It also considers and compares factors identified as influential on achievement, such as pupil attitudes towards maths and science and their perceptions of teaching in these subjects as well as headteachers' and teachers' views on school discipline and resources.

[Appendix B](#) provides more detailed information about the TIMSS survey methodology and the processes that underpinned the creation of the IEA's TIMSS International Report 2015¹⁹.

1.2 About the TIMSS sample

All countries and benchmarking entities participating in TIMSS follow strict guidelines and sampling targets to ensure that the group of pupils that eventually participates in the study is nationally representative.

In England, one randomly selected year 5 or year 9 class was selected from each of 300 schools across the country and invited to participate. At least 85 per cent of the selected schools were required to participate to meet the IEA's response rate target. In total, 4,006 year 5 pupils and 4,814 year 9 pupils participated from 147 primary and 143 secondary schools, meaning that a response rate of well over 90 per cent was achieved for each phase (98% for primary and 97% for secondary schools). More details of the study design and sample response can be found in [Appendix B](#).

¹⁷ <http://timssandpirls.bc.edu/timss2015/international-results/>

¹⁸ Mullis, I. V. S., Martin, M. O., Goh, S., & Cotter, K. (Eds.) (2016). TIMSS 2015 Encyclopedia: Education Policy and Curriculum in Mathematics and Science. Available at:

<http://timssandpirls.bc.edu/timss2015/Encyclopedia/>

¹⁹ <http://timssandpirls.bc.edu/timss2015/international-results/>

Table 2 below profiles the TIMSS school sample for England in 2015.

Table 2: Pupils and schools participating in TIMSS (England, 2015)

Pupil characteristics²⁰	Year 5 TIMSS sample	Year 5 population (England)*	Year 9 TIMSS sample	Year 9 population (England)*
Percentage of female pupils	50.7	49.2	50.4	49.4
Percentage of pupils eligible for Free School Meals (FSM)	14.3	15.5	11.1	13.3
Percentage of pupils with English as Additional Language (EAL)	22.5	19.6	13.2	15.0
Percentage of pupils with Special Educational Needs (SEN)	13.7	16.8	10.5	13.1
Percentage of pupils who are:				
White	71.4	74.9	79.4	78.3
Asian	13.6	11.1	9.8	9.7
Black	6.3	6.0	3.7	4.9
Mixed	5.1	5.3	3.7	4.4
Other	2.9	2.2	1.1	1.7
Key Stage One mean science score (standard deviation)	15.9 (3.3)	15.7 (3.4)	16.0 (3.2)	15.7 (3.4)
Key Stage One mean maths score (standard deviation)	16.4 (3.5)	16.0 (3.6)	16.3 (3.4)	16.0 (3.6)
Key Stage Two mean maths score (standard deviation)			29.0 (4.8)	28.0 (5.2)
Total number of pupils in TIMSS	4,006		4,814	
Total number of pupils with a National Pupil Database Record	3,591	561,012	4,348	526,663

²⁰ This table is based on 4,006 pupils in the TIMSS year 5 sample, 3,591 of whom had matched records in the NPD and 4,814 year 9 pupils (4,348 of whom have records in the NPD). Overall population figures for year 5 pupils are based on 561,012 pupils and 526,663 pupils for year 9 pupils.

School Type ²¹	Year 5 TIMSS Schools	Year 5 English schools*	Year 9 TIMSS Schools	Year 9 English schools*
Academy Converters	10.2	11.7	45.5	41.6
Academy Sponsor Led Schools	4.1	5.5	16.8	17.3
Community Schools	47.6	46.4	19.6	17.6
Foundation Schools	3.4	4.1	7.0	8.0
Voluntary Aided / Controlled Schools	29.3	31.5	5.6	9.7
Free Schools*	0.0	0.7	0.0	5.9
Independent School	5.4	N/A	5.6	N/A
Total number of schools	147	16,788	143	3,381

Source: Matched TIMSS- National Pupil Database (NPD) data.

* Primary and Secondary school figures refer to state funded, mainstream schools only. Free schools includes (including UTCs, Studio Schools and CTCs)

1.3 Educational experience of the TIMSS cohorts

The year 5 and 9 pupils that participated in the study have experienced different curriculum and assessment arrangements during their schooling which may have influenced their achievement and attitudes.

The cohort of year 5 pupils involved in TIMSS 2015

The year 5 pupils that completed TIMSS 2015 were born in 2004/5, entering full-time education from September 2009. They were taught according to the previous National Curriculum (DfEE, 1999) for at least their first four years of schooling. When these pupils entered year 4 in September 2013, however, the government allowed schools to choose whether these pupils continued to be taught using the existing National Curriculum (DfEE, 1999), or the new *National curriculum in England: framework for Key Stages 1 to 4* (DfE, 2013), with the latter becoming statutory in September 2014²²). All year 5 pupils involved in TIMSS 2015 therefore experienced

²¹ Data on school type is missing for some English schools

²² The government's timescale for National Curriculum implementation in the primary years is available at:

teaching of the new National Curriculum in mathematics and science from at least September 2014, while some may have experienced this from up to a year earlier²³.

These pupils were assessed in maths and science at the end of Key Stage 1 in 2012, with teachers using statutory tasks/tests (for pupils working at level 1 or above in maths and reading and writing) to inform their teacher assessments. In 2016, when these pupils were in year 6, they received teacher assessments in maths and science. They also took standard assessment tests (SATs) in maths. Key Stage 2 science SATs for all pupils ended in 2010. However, a national sample of pupils in this cohort was statutorily assessed through science SATs in 2016.

The cohort of year 9 pupils involved in TIMSS 2015

The year 9 pupils that completed TIMSS 2015 were born in 2000/1, entering full-time education from September 2005. They were taught according to the previous National Curriculum up until September 2013. For the academic year 2013-14, when these pupils were in year 8, the government disapplied the existing National Curriculum (DfEE, 1999) to aid transition to the new National Curriculum (DfE, 2013). Schools were able to choose whether to use the existing curriculum or not. From September 2014, the revised programmes of study in maths and science in the new National Curriculum (DfE, 2013) became statutory²⁴.

The pupils were assessed at the end of Key Stage 2 in 2012 in maths, both through teacher assessment and SATs. They also received a teacher assessment for science and a national sample of pupils was statutorily assessed through science SATs.

In addition, this cohort of pupils was in year 5 at the time of the previous TIMSS 2011 assessment. This enables comparison of this cohort's progress over time using representative samples from each cycle of TIMSS assessments.

The TIMSS Encyclopaedia article for England provides more detail about the education context in England at the time of the TIMSS tests²⁵.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/276634/Curriculum_and_testing_changes.PDF [Accessed 1 September 2016].

²³ Unless taught in Academies using their discretion not to teach the National Curriculum or in independent schools.

²⁴ Unless taught in Academies using their discretion not to teach the National Curriculum or in independent schools.

²⁵ Mullis, I. V. S., Martin, M. O., Goh, S., & Cotter, K. (Eds.) (2016). TIMSS 2015 Encyclopedia: Education Policy and Curriculum in Mathematics and Science. Available at: <http://timssandpirls.bc.edu/timss2015/Encyclopedia/>

1.4 Report structure

This report is structured using a series of questions which can be asked of the TIMSS 2015 data. These enable users to identify the questions most relevant to them. Data for England in 2015 are presented for each question and comparisons made with, as appropriate, previous TIMSS studies and/or other countries' data. England's TIMSS data has also been matched to data from the National Pupil Database, allowing additional analysis of factors such as Free School Meals (FSM), ethnicity and English as an additional language that would not have been possible using TIMSS data alone.

The report comprises six main foci:

- **Overall performance in maths and science.** This section (chapters 3 - 5) focuses on how England's year 5 and 9 pupils have performed over time and in comparison with other countries, both in terms of average achievement and achievement against international benchmarks. It includes analyses of how pupils have performed in different aspects of the curriculum (content domains), as well as different cognitive domains.
- **Differences in maths and science performance by pupil characteristics.** This section (chapter 6) focuses on how well different groups of England's year 5 and 9 pupils have performed in comparison, where appropriate, with other countries.
- **Pupil engagement and confidence in maths and science.** This section (chapter 7) focuses on pupils' attitudes towards their teaching, their subject confidence and whether they like and value these subjects, compared to other countries.
- **School environment, leadership and resources.** This section (chapter 8) focuses on a range of whole-school issues, such as a focus on academic success, to provide a broader context to the schooling England's year 5 and 9 pupils receive and how this compares to their peers in other countries.
- **Teachers and teaching.** This section (chapter 9) focuses on matters relating to aspects such as teaching time, professional development and years of experience and its impact on average achievement. Where appropriate, comparisons are made with other countries.
- **Home environment.** This section (chapter 10) focuses on the extent to which England's year 5 and 9 pupils are supported in their maths and science learning through resources at home and how they use these. It also focuses on the extent to which they receive additional tuition, for what purpose and its

impact on achievement. Comparisons are provided with the experiences of pupils in other countries.

A conclusion draws together the main findings and provides a perspective on their implications at a range of levels.

Throughout the report, comparisons are made with other countries that took part in the study. The report analyses England's performance in relation to all participating countries in some places, but readers are generally referred to the IEA's TIMSS International Report 2015²⁶ for such comparisons. The main focus here is therefore on comparing England's performance to the four groups of countries outlined below, although other countries of interest are highlighted where appropriate:

- The five East Asian countries that consistently perform significantly higher than England, as a way of highlighting their high levels of achievement.
- Other English-speaking countries, since these can be seen as having similar socio-economic circumstances and backgrounds to England and so provide helpful benchmarks.
- A selection of European countries, particularly from Scandinavia and Western Europe, since these have similar socio-economic circumstances and backgrounds to England and so provide useful benchmarks.
- Fast-moving and other high-performing countries. These countries (Russia, Kazakhstan, Poland, Slovenia and the Czech Republic) are interesting because they have seen rapid improvements in some or all areas of performance in 2015 or are high performers that do not fit in any of the above groups.

Whenever comparisons are made with other countries, but particularly in chapters 5-10 which largely draw on responses from the attitudinal questionnaires that accompanied the main TIMSS assessments, it is important to consider the potential effect of cultural and language differences.²⁷

Although the benchmarking entities follow the same guidelines that apply to countries participating in TIMSS, in this report, international comparisons are made between England and other participating countries, rather than benchmarking entities.

Throughout the report, explanations of how the data were collected are given so that users can understand the methodology used and how to interpret data presented. Where the terms 'significant' or 'not significant' are stated, these mean that the

²⁶ <http://timssandpirls.bc.edu/timss2015/international-results/>

²⁷ The TIMSS process involves a rigorous translation and cultural adaptation phase during which the wording of questions are tested for differential functioning according to culture and language.

finding referred to is either statistically significant or not statistically significant at conventional levels²⁸.

²⁸ Five per cent significance tests are applied throughout. Significance levels will depend on the averages but also on the standard deviations. Both averages and standard deviations are used to calculate a T-statistic which is then compared to the critical values in t-tables.

Chapter 2. TIMSS: Assessment Approach and Curriculum Match

The TIMSS assessment is based on the TIMSS curriculum model, which has three domains:

1. The National, Social and Educational Context which informs the creation of the Intended Curriculum
2. The School, Teacher and Classroom Context which affects the Implemented Curriculum
3. Student Outcomes and Characteristics which reflect the Attained Curriculum

The second and third of these domains form the basis of the TIMSS contextual (pupil and teacher) questionnaires and pupil assessment.

This curriculum model differs from that used in the Programme for International Student Assessment (PISA) study from the Organisation for Economic Co-operation and Development (OECD)²⁹, which was also administered in 2015. This three-yearly international study assesses 15 year old pupils (assessed at the beginning of year 11 in England) in maths, science and reading. The TIMSS and PISA reports are complementary, but they also have some important differences. For example, TIMSS assesses pupils across two year groups (years 5 and 9) and its assessments are more focused on pupils' knowledge and understanding of curriculum content than PISA, which assesses pupils' ability to apply their science, maths and reading skills to everyday situations.

2.1 How the TIMSS scores are calculated

The main measures of maths and science performance in TIMSS are the mean scores, which are calculated for each participating country based on the scores achieved by pupils that took the TIMSS assessments. The full distribution of TIMSS mean scores is centred at 500 corresponding to the mean of the overall achievement distribution, with 100 points on the scale corresponding to the standard deviation. The scale was established in TIMSS 1995 and linked to the subsequent TIMSS assessment cycles to allow the achievement scores in a given subject and year group to be compared over time and across countries. Reference will be made throughout the report to this international mean, except with respect to the international benchmarks which use international medians as an average measure.

²⁹ More information about PISA can be found on the OECD's website: <http://www.oecd.org/pisa/>

Every mean score calculated using the TIMSS data is accompanied by a standard error (SE) indicating how precisely the estimated sample mean can be generalised for the population. Standard errors are used to calculate confidence intervals (at the 95% level) for all the TIMSS mean scores. The lower the standard error, the more accurate the estimated mean and, therefore, the better the TIMSS sample is as an estimate of the whole population's performance.

The TIMSS performance scales are not constructed to be comparable across subjects and year groups as they measure different competences. However, because the scores in each subject and each year group are based on parallel scales and are nationally representative, it is possible to compare the relative position of pupils in different countries at any point in time. If the same cohort of pupils is studied in a subsequent cycle of TIMSS it is possible to evaluate how well that same cohort of pupils has performed over time, relative to the international mean in each study.

2.2 The TIMSS international benchmarks

In each TIMSS cycle the distribution of pupil scores is described using a set of international benchmarks reflecting different levels of pupil achievement. There are four benchmarks in both maths and science and these are designed to be comparable over time. A score of 625 indicates that a pupil has reached an Advanced level; a score of 550 indicates a High level; a score of 475 indicates an Intermediate level; and a score of 400 indicates a Low level of application. Tables 3 and 4 below describe the main statements of what is expected of pupils' application of knowledge and understanding in order for them to achieve these benchmarks: full descriptions can be found in [Appendix C](#).

Table 3: International Benchmarks for TIMSS maths achievement at years 5 and 9

Advanced international benchmark (TIMSS Score of 625)	
Year 5	Year 9
Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning.	Students can apply and reason in a variety of problem situations, solve linear equations, and make generalisations.
High international benchmark (TIMSS Score of 550)	
Year 5	Year 9
Students can apply their knowledge and understanding to solve problems.	Students can apply their understanding and knowledge in a variety of relatively complex situations.
Intermediate international benchmark (TIMSS Score of 475)	
Year 5	Year 9
Students can apply basic mathematical knowledge in straightforward situations.	Students can apply basic mathematical knowledge in a variety of situations.
Low international benchmark (TIMSS Score of 400)	
Year 5	Year 9
Students have some basic mathematical knowledge.	Students have some knowledge of whole numbers and basic graphs.

Source: TIMSS 2015.

Table 4: International Benchmarks for TIMSS science achievement at years 5 and 9

Advanced international benchmark (TIMSS Score of 625)	
Year 5	Year 9
Students communicate understanding of life, physical, and Earth sciences and demonstrate some knowledge of the process of scientific enquiry.	Students communicate understanding of complex concepts related to biology, chemistry, physics and Earth science in practical, abstract, and experimental contexts.
High international benchmark (TIMSS Score of 550)	
Year 5	Year 9
Students communicate and apply knowledge of the life, physical, and Earth sciences in everyday and abstract contexts.	Students apply and communicate understanding of concepts from biology, chemistry, physics, and Earth science in everyday and abstract situations.
Intermediate international benchmark (TIMSS Score of 475)	
Year 5	Year 9
Students show basic knowledge of life, physical, and Earth sciences.	Students demonstrate and apply their knowledge of biology, chemistry, physics, and Earth science in various contexts.
Low international benchmark (TIMSS Score of 400)	
Year 5	Year 9
Students show basic knowledge of life and physical sciences.	Students show some basic knowledge of biology, chemistry, physics, and Earth science.

Source: TIMSS 2015.

2.3 To what extent were the TIMSS maths and science curriculum topics taught to pupils in England prior to the 2015 assessments?

TIMSS assesses year 5 and 9 pupils in a number of maths and science topics. The IEA reports the extent to which these topics are intended to be taught to pupils in these year groups so that the level of curriculum match can be established. Full

information on the curriculum match for other countries can be found in the TIMSS International Report 2015 and the TIMSS Encyclopaedia³⁰.

Overall, in England, the TIMSS 2015 assessments are well-matched with the content of the National Curriculum (DfE, 2013), both in maths and science. However, it should be noted that year 5 and 9 pupils were only statutorily taught this content from September 2014, the academic year in which pupils undertook their TIMSS assessments. Therefore, pupils may not necessarily have been taught this content prior to September 2014. It should also be noted that a high level of curriculum match is not necessarily associated with high levels of performance. For example, Singapore was the highest-achieving country for science in year 9, but it had taught only seven of the 23 TIMSS topics by the time these pupils took their TIMSS assessments.

Year 5

In maths, all 17 topics included in the TIMSS assessments are intended to be taught by the end of year 5. In science, 22 of the 23 topics are intended to be taught to year 5 pupils. Just one Earth Science topic included in the assessments does not form part of the National Curriculum for pupils up to this age: understanding how seasons are related to the Earth's annual movement around the Sun.

Year 9

In maths, all of the 20 TIMSS assessment topics are intended to be taught by the end of year 9. In science, 21 of the 22 topics are intended to be taught by the end of year 9. There is one Chemistry topic included in the assessments that does not form part of the National Curriculum for pupils up to this age: the role of electrons in chemical bonds.

Sample TIMSS items

The test items cover a range of questions used to test pupils at the High and Low International Benchmarks for maths and science in both years 5 and 9. The look and feel of the items is similar to national assessment items. A sample of the questions used in TIMSS 2015 is included in [Appendix D](#).

³⁰ Mullis, I. V. S., Martin, M. O., Goh, S., & Cotter, K. (Eds.) (2016). TIMSS 2015 Encyclopedia: Education Policy and Curriculum in Mathematics and Science. Available at: <http://timssandpirls.bc.edu/timss2015/Encyclopedia/>

Chapter 3. Overall performance in maths

This chapter summarises the findings from TIMSS 2015 on maths performance for year 5 and year 9 pupils in England. The chapter covers the changes in mean performance over time and changes in the percentage of pupils achieving each of the international benchmarks for achievement in maths. The chapter then goes on to compare England's performance with other countries participating in TIMSS.

3.1 Main Findings

- In 2015, the performance of both year 5 and 9 pupils in maths in England was significantly above the TIMSS international mean.
- Year 5 pupils' performance in maths has increased steadily over time, improving with each TIMSS cycle from 1995 to 2015. The increase in England's score between 2011 and 2015, however, was not significant.
- The performance of year 9 pupils in maths increased between 2011 and 2015, following a decrease in 2011. As for year 5, the increase between 2011 and 2015 was not significant.
- For both years 5 and 9, England remains in the second highest-performing group of countries. Seven countries scored significantly higher than England in the year 5 assessment, while six scored significantly higher at year 9. England's performance was significantly higher than 34 countries in year 5 and 23 countries in year 9.
- The five East Asian countries and Russia performed highest in year 9 maths, the same group as in 2011. In year 5, the five East Asian countries and Northern Ireland performed highest, as in 2011, but with Russia joining this group in 2015.
- A larger share of year 5 and 9 pupils achieved each of the international benchmarks in England compared to the median across all participating countries.
- There is evidence that the lowest performers in England are making progress since the proportion of both year 5 and year 9 pupils reaching the Low international benchmark improved significantly.
- The relative performance of year 9 pupils in England in 2015 compared to their performance as year 5 pupils in TIMSS 2011 was lower than that found in some comparator countries, including most of the highest achieving East Asian group.

3.2 What does TIMSS tell us about England's performance in year 5 maths?

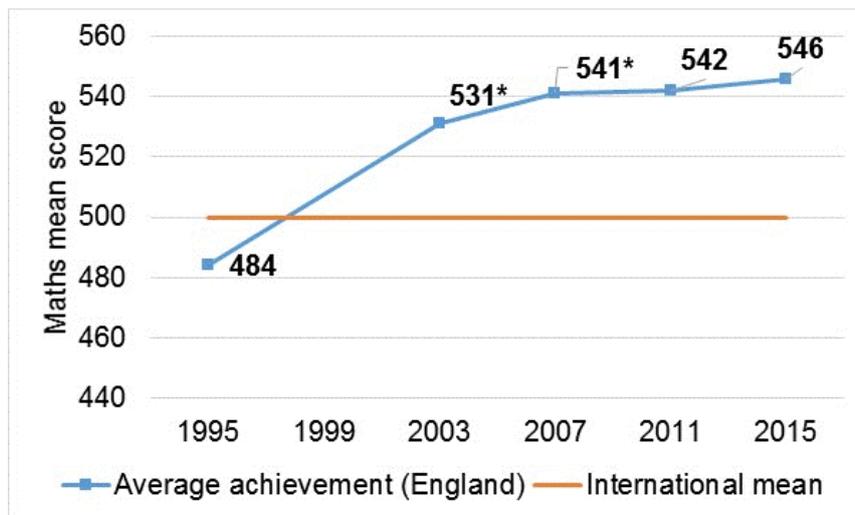
3.2.1 How has England's performance in maths changed over time for year 5 pupils?

The trend in England's year 5 maths score is one of improvement over time from significantly below the international mean in 1995 to significantly above in 2015. Year 5 pupils' performance has improved in each consecutive TIMSS cycle, although the increases since 2007 have been smaller than the initial improvements between 1995 and 2007. While performance in 2015 was significantly higher than in 1995 and 2003, it was not significantly higher than performance in either 2007 or 2011. The 2015 TIMSS mean maths score for England of 546 is significantly³¹ above the international mean score of 500.

Figure 7 below shows this trend over time and how this relates to the international mean. Scores marked with an asterisk are significantly higher than the previous score. It should be noted that in 1995, the TIMSS sample comprised both year 4 and 5 pupils, which may have affected average achievement levels for that year and the level which may have affected average achievement levels for that year and therefore the level of significance of the difference in mean scores between 1995 and the subsequent cycle in 2003.

³¹ Significance levels will depend on the averages but also on the standard deviations. Both averages and standard deviations are used to calculate a T-statistic which is then compared to the critical values in t-tables.

Figure 7: Trend in mean year 5 maths score (England)



Source: TIMSS 2015.

Note 1: The 1999 cycle of TIMSS included only year 9, not year 5 pupils.

Note 2: The 1995 score is an average across the performance of year 4 and year 5 pupils as the 1995 cycle assessed pupils across both year groups.

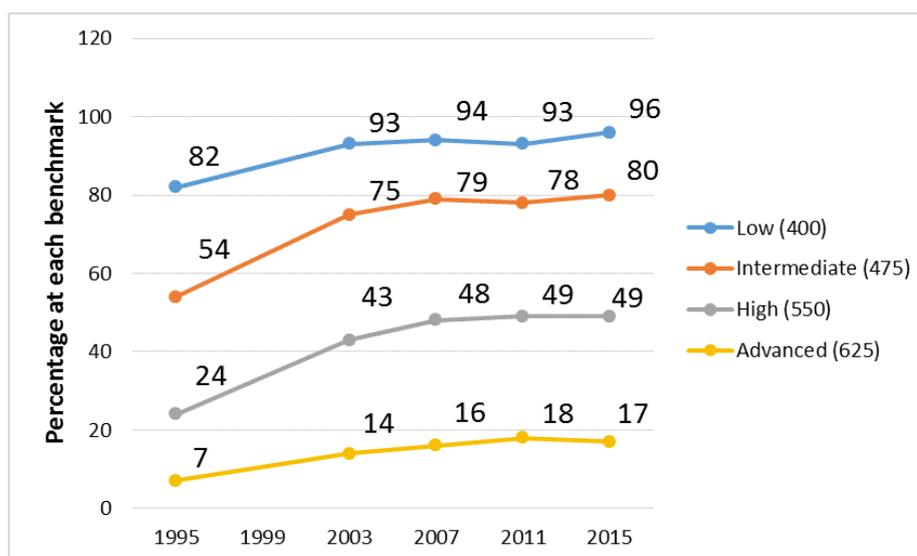
Note 3: Response rates for TIMSS in England were relatively low in 1995, 1999 and 2003.

Note 4: Maths scores that represent a significant increase on the previous TIMSS cycle are marked with an asterisk.

Between 1995 and 2015 there has been a significant upward trend in the proportion of year 5 pupils in England reaching each of the international benchmarks (see Figure 8). Since 1995, the share of pupils in England achieving the High and Advanced benchmarks has approximately doubled (albeit from a low base for the Advanced benchmark). In the last three TIMSS cycles, performance against the higher benchmarks has been consolidated. Since 2011, there has been an increase in the proportion of year 5 pupils achieving the Intermediate benchmark, although this was not significant. Notably, there has been a significant increase in the proportion of pupils achieving the Low benchmark. Figure 8 below shows these trends over time³².

³² See [Appendix C](#) for a description of the international benchmarks.

Figure 8: Trend in the percentage of year 5 pupils reaching each of the TIMSS international benchmarks in maths (England)



Source: TIMSS 2015.

Note 1: The 1999 cycle of TIMSS included only year 9, not year 5 pupils.

Note 2: The 1995 score is an average across the performance of year 4 and year 5 pupils as the 1995 cycle assessed pupils across both year groups.

Note 3: Response rates for TIMSS in England were relatively low in 1995, and 2003.

Note 4: Figures in parentheses refer to TIMSS scores needed to reach each International Benchmark.

3.2.2 How do year 5 pupils in England perform in maths relative to their peers in all other TIMSS countries?

There were 49 countries participating in the TIMSS 2015 year 5 maths assessments, one fewer than in 2011. Full international analyses of their performance can be found in the TIMSS International Report 2015.

In 2015, England remained in the second highest-performing group of countries, significantly above the international mean score of 500. Seven countries scored significantly higher than England, seven countries scored at broadly the same level, and 34 countries scored significantly lower.

The five East Asian countries of Singapore, Hong Kong, South Korea, Taiwan and Japan continue to dominate the international table, with Northern Ireland and Russia also scoring significantly higher than England. Russia has improved its performance from 2011 to move into this group.

The make-up of the group performing at a similar level to England in 2015 has changed notably from 2011. Ireland, Kazakhstan and Portugal have all improved their performance to join England, Belgium (Flanders), the United States and

Denmark. Norway has also joined this group but the age of pupils assessed has changed since 2011³³.

In contrast, the performance of both Finland and the Netherlands has decreased, meaning that they become two of the 34 countries which performed significantly lower than England. This group also includes Germany, Sweden, Italy and Spain.

Table 5 shows all of the countries that performed significantly higher or at a similar level to England and some of the notable countries that performed significantly below England in 2011 and 2015. Bold highlighting shows countries that moved categories between 2011 and 2015, some of which are discussed in more detail below.

Table 5: Countries performing significantly above, at a similar level to, or below England in 2011 and 2015 (Year 5 maths)

Level of performance	2011	2015
Significantly higher than England	Singapore (606) South Korea (605) Hong Kong (602) Taiwan (591) Japan (585) Northern Ireland (562)	Singapore (618) Hong Kong (615) South Korea (608) Taiwan (597) Japan (593) Northern Ireland (570) Russia (564)
At a similar level to England	Belgium (Flanders) (549) Finland (545) Russia (542) United States (541) Netherlands (540) Denmark (537)	Norway (grade 5: 549) ³⁴ Ireland (547) Belgium (Flanders) (546) Kazakhstan (544) Portugal (541) United States (539) Denmark (539)
Significantly lower than England	Lithuania (534) Portugal (532) Germany (528) Ireland (527)	Lithuania (536) Finland (535) Poland (535) Netherlands (530)

³³ In 2011, grade 4 and 8 pupils in Norway took the TIMSS assessments, whereas in 2015, grade 5 and 9 pupils did. For further information on the reasons for this, please see: <http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/norway/timss-target-grades-and-the-norwegian-curriculum-in-basic-and-secondary-schools/>

³⁴ For an explanation of Norway's change in year groups assessed in 2015, please see: <http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/norway/timss-target-grades-and-the-norwegian-curriculum-in-basic-and-secondary-schools/>

Level of performance	2011	2015
Significantly lower than England (continued)	Australia (516) Austria (508) Italy (508) Sweden (504) Kazakhstan (501) Norway (grade 4: 495) New Zealand (486) Spain (482) ...and 26 others	Hungary (529) Czech Republic (528) Bulgaria (524) Cyprus (523) Germany (522) Slovenia (520) ...and 24 others

Source: TIMSS 2015.

Note 1: Average achievement is shown in parentheses.

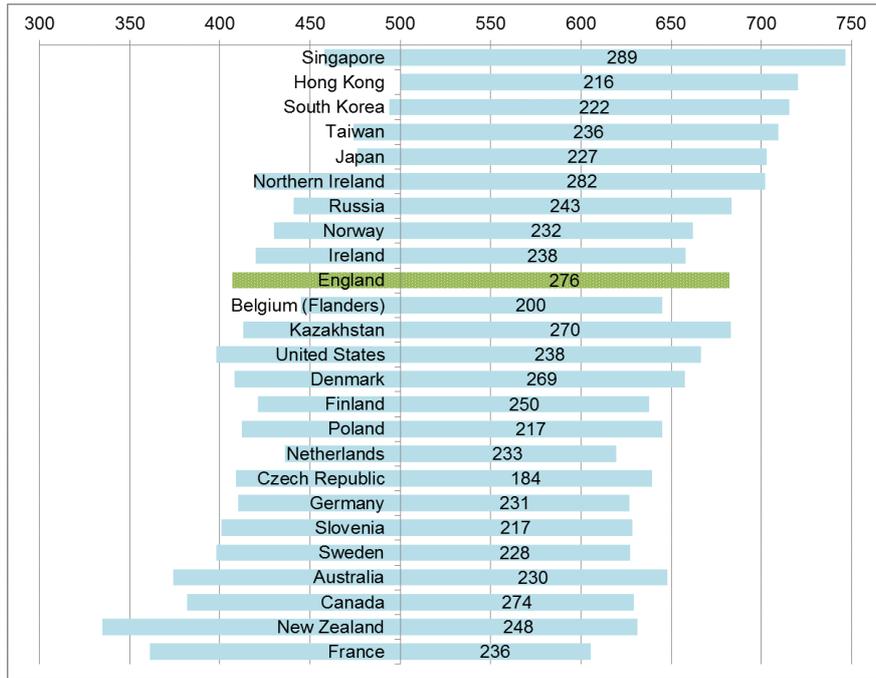
Note 2: Bold type indicates countries that have moved category between 2011 and 2015.

Of the countries in the four comparator groups that took the first TIMSS assessments in 1995, Singapore, Hong Kong and Japan have retained their position as performing significantly higher than England in year 5 maths. Ireland and the United States performed significantly higher than England in 1995 and have also improved significantly between 1995 and 2015. However, they now perform at a similar level to England as England's rate of improvement across the 20 years has been higher. Portugal now performs at a similar level to England, having performed significantly lower than England in 1995. Five countries that performed significantly higher than England in 1995, performed significantly lower in 2015: Australia, Canada, Slovenia, the Netherlands and the Czech Republic.

Comparing England's results with those of other English-speaking countries, only Northern Ireland achieved a significantly higher mean score than England in 2015. England performed significantly higher than Australia, Canada and New Zealand, and at a similar level to Ireland and the United States.

England has a relatively wide variation in performance between its highest- and lowest-performing pupils – a range of 276 TIMSS scale points. In contrast, in most of the higher-performing countries, including Ireland, Norway, Taiwan, Japan and Hong Kong, the range was narrower. Singapore, however, is comparable to England in having a wider range of performance than most countries from the four comparison groups. Figure 9 below shows the range of performance between the highest and lowest scoring pupils in the participating countries that make up the four comparison groups described in chapter 2. Data on all other participating countries is available in the TIMSS International Report 2015.

Figure 9: Range of year 5 maths achievement across countries from the four comparator groups



Source: TIMSS 2015.

Countries from the highest-performing group (the five East Asian countries, Russia and Northern Ireland) achieved significantly higher than England at the Advanced and High benchmarks, particularly the East Asian group. For example, three-times as many year 5 pupils in Singapore reached the Advanced benchmark as pupils in England (50% compared to 17%). Furthermore, four out of five pupils from Singapore reached the High benchmark (80%), compared to just less than half in England (49%), while 93 per cent achieved the Intermediate benchmark, compared to 80 per cent in England.

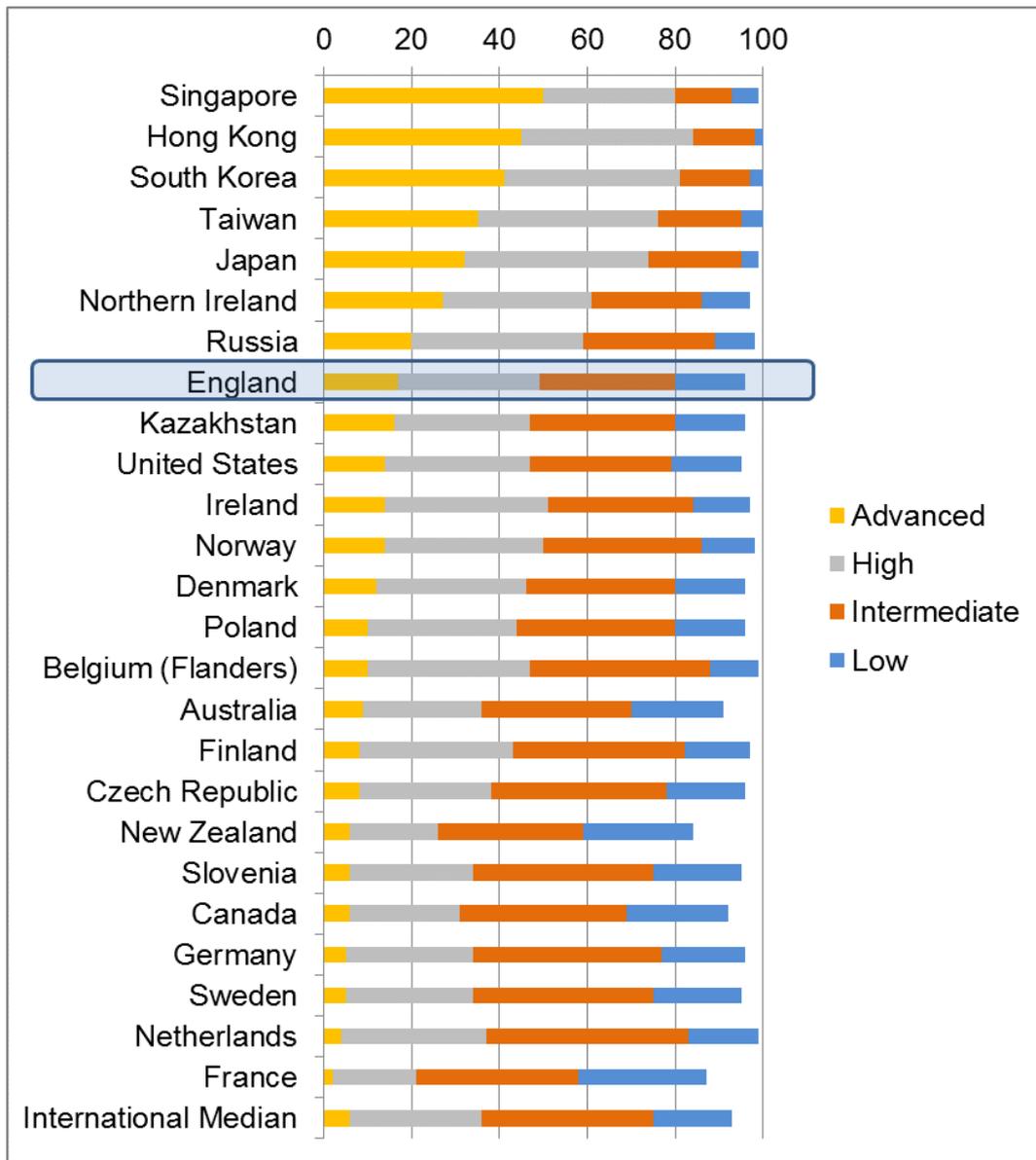
Nevertheless, a larger share of pupils in England reached each benchmark compared to the average (median) position across all participating countries³⁵, with almost three-times as many pupils in England reaching the Advanced benchmark.

England also achieved higher scores at each benchmark than most of the other English-speaking countries. The exceptions are Northern Ireland, which performed higher than England at each benchmark, and Ireland, which scored slightly lower at the Advanced benchmark, but slightly higher at the other three benchmarks.

Figure 10 below compares in more detail England's performance at the international benchmarks with countries from the four comparator groups described in chapter 2.

Figure 10: Percentages of year 5 pupils reaching the international benchmarks in maths (England and countries from the four comparator groups)

³⁵ International medians rather than international means are calculated for this data set.



Source: TIMSS 2015.

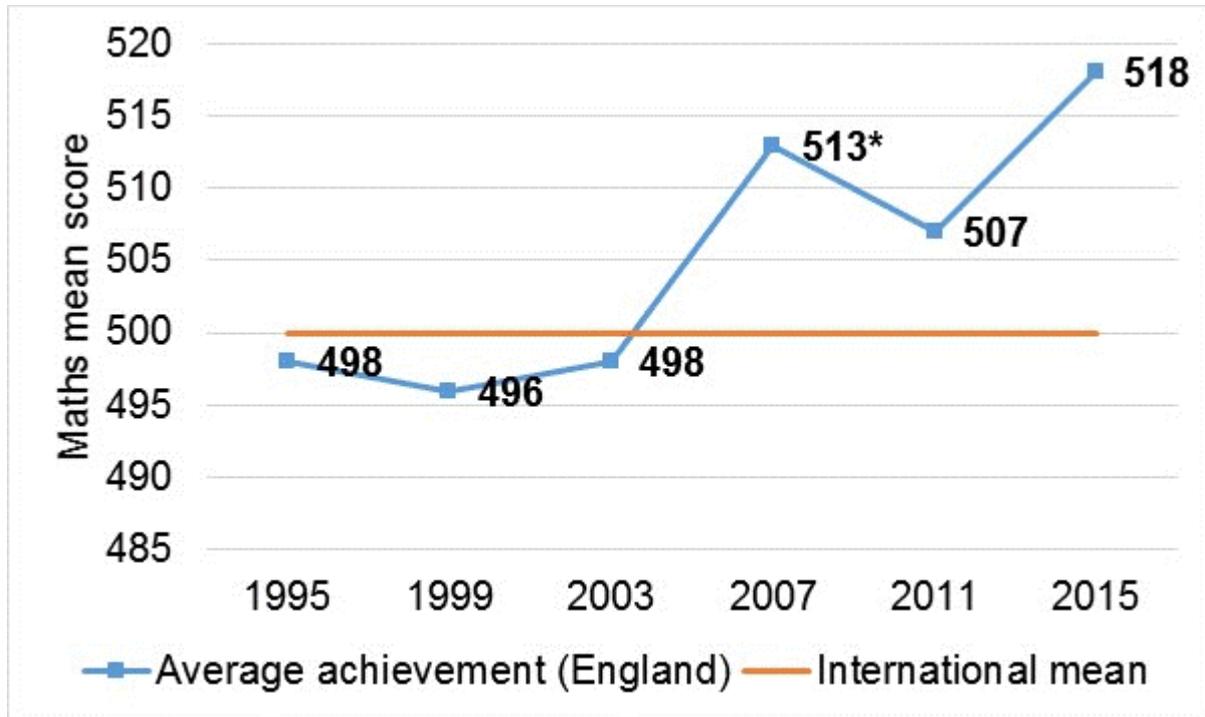
3.3 What does TIMSS tells us about England’s performance in year 9 maths?

3.3.1 How has England’s performance in maths changed over time for year 9 pupils?

England’s performance in year 9 maths has seen significant improvement over the last 20 years, most notably between 2003 and 2007, albeit with a small drop in 2011. In 2007, year 9 pupils in England performed above the TIMSS international mean for the first time. The 2015 TIMSS mean maths score for England was 518, 11 scale points higher than 2011, although this increase is not significant. England’s performance in 2015 maintains its position above the international mean. Figure 11

below shows this trend over time. It should be noted that in 1995, the TIMSS sample comprised both year 8 and 9 pupils, which may have affected average achievement levels for that year and corresponding comparisons made.

Figure 11: Trend in the year 9 maths score (England)



Source: TIMSS 2015.

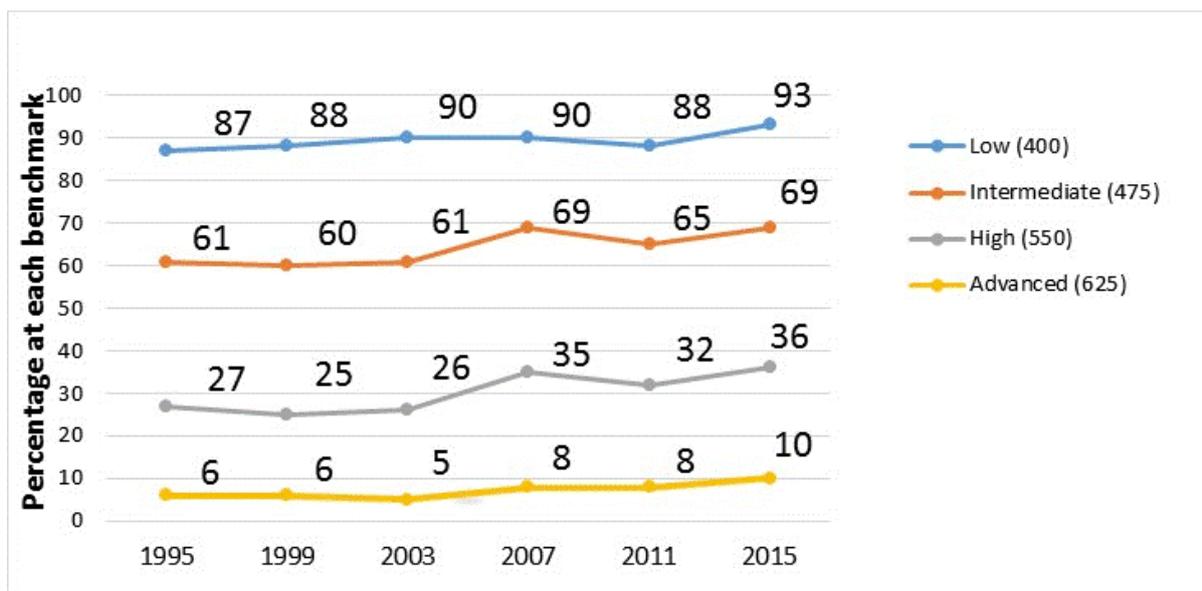
Note 1: The 1995 score is an average across the performance of year 8 and year 9 pupils as the 1995 cycle assessed pupils across both year groups.

Note 2: Response rates for TIMSS in England were relatively low in 1995, 1999 and 2003.

Note 3: Scores that represent a significant increase on the previous TIMSS cycle are marked with an asterisk.

As in year 5, between 1995 and 2015, there has been a significant improvement in the proportion of year 9 pupils in England reaching all the international benchmarks. Between 2003 and 2007 there was a particularly large increase around the centre of the performance distribution – i.e. the Intermediate and High levels. However, in 2015, the improvements are largest amongst the lower performers where the share of pupils achieving the Low benchmark rose significantly, by five percentage points. The Intermediate, High and Advanced benchmarks all saw smaller, non-significant, increases since 2011. Figure 12 below shows these trends over time.

Figure 12: Trend in the percentage of year 9 pupils reaching each of the TIMSS international benchmarks in maths (England)



Source: TIMSS International Report 2015.

Note 1: The 1999 cycle of TIMSS included only year 9, not year 5 pupils.

Note 2: The 1995 score is an average across the performance of year 8 and year 9 pupils as the 1995 cycle assessed pupils across both year groups.

Note 3: Response rates for TIMSS in England were relatively low in 1995, 1999 and 2003.

Note 4: Figures in parentheses refer to TIMSS scores needed to reach each International Benchmark

3.3.2 How do year 9 pupils in England perform in maths relative to their peers in other TIMSS countries?

There were 39 countries participating in TIMSS 2015 year 9 maths assessments, three fewer than in 2011. Full international analyses of their performance can be found in the TIMSS International Report 2015.

As is the case for primary maths, England remains in the second highest-performing group of countries in TIMSS. Six countries scored significantly higher than England, nine countries scored at broadly the same level, and 23 countries scored significantly lower.

There has been no change since 2011 in terms of the six countries that make up the highest-performing group at year 9 maths - the five East Asian countries of Singapore, Hong Kong, South Korea, Taiwan and Japan, plus Russia. This mirrors the year 5 findings with the exception of Northern Ireland, which did not participate in the year 9 assessments.

Kazakhstan has improved its performance since 2011 to reach a similar level to England. Norway has also joined this group but the age of pupils assessed has

changed since 2011³⁶. In contrast, pupils in Italy and Australia now perform at a lower level than England, having previously performed at a similar level. Apart from Australia, New Zealand is the only other English-speaking country that performed significantly lower than England, as it did in 2011, while Canada, Ireland and the United States performed at a similar level.

Table 6 below shows all of the countries that performed significantly higher or at a similar level to England, as well as some of those that performed significantly lower than England in 2011 and 2015. Bold highlighting shows countries that moved categories between 2011 and 2015 and these are discussed below.

³⁶ In 2011, grade 4 and 8 pupils in Norway took the TIMSS assessments, whereas in 2015, grade 5 and 9 pupils did. For further information on the reasons for this, please see:

<http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/norway/timss-target-grades-and-the-norwegian-curriculum-in-basic-and-secondary-schools/>

Table 6: Countries performing significantly above, at a similar level to, or below England (Year 9 maths)

Level of performance	2011	2015
Significantly higher than England	South Korea (613) Singapore (611) Taiwan (609) Hong Kong (586) Japan (570) Russia (539)	Singapore (621) South Korea (606) Taiwan (599) Hong Kong (594) Japan (586) Russia (538)
At a similar level to England	Israel (516) Finland (514) United States (509) Hungary (505) Australia (505) Slovenia (505) Lithuania (502) Italy (498)	Kazakhstan (528) Canada ³⁷ (527) Ireland ³⁸ (523) United States (518) Slovenia (516) Hungary (514) Norway (grade 9: 512) ³⁹ Lithuania (512) Israel (511)
Significantly lower than England	New Zealand (488) Kazakhstan (487) Norway (grade 8: 475) ...and 24 others	Australia (505) Sweden (501) Italy (494) Malta (494) New Zealand (493) ...and 18 others

Source: TIMSS 2015.

Note 1: Average achievement is shown in parentheses.

Note 2: Bold type indicates countries that have moved category between 2011 and 2015.

Of the countries in the four comparator groups that took the first TIMSS assessments in 1995, Singapore, South Korea, Hong Kong and Japan retain their position as countries performing significantly higher than England. Ireland and Slovenia performed significantly higher than England twenty years ago, but now perform at a similar level to England as a result of England's mean score improving. The United States has maintained its position in performing at a similar level to England between

³⁷ Canada did not participate in TIMSS 2011.

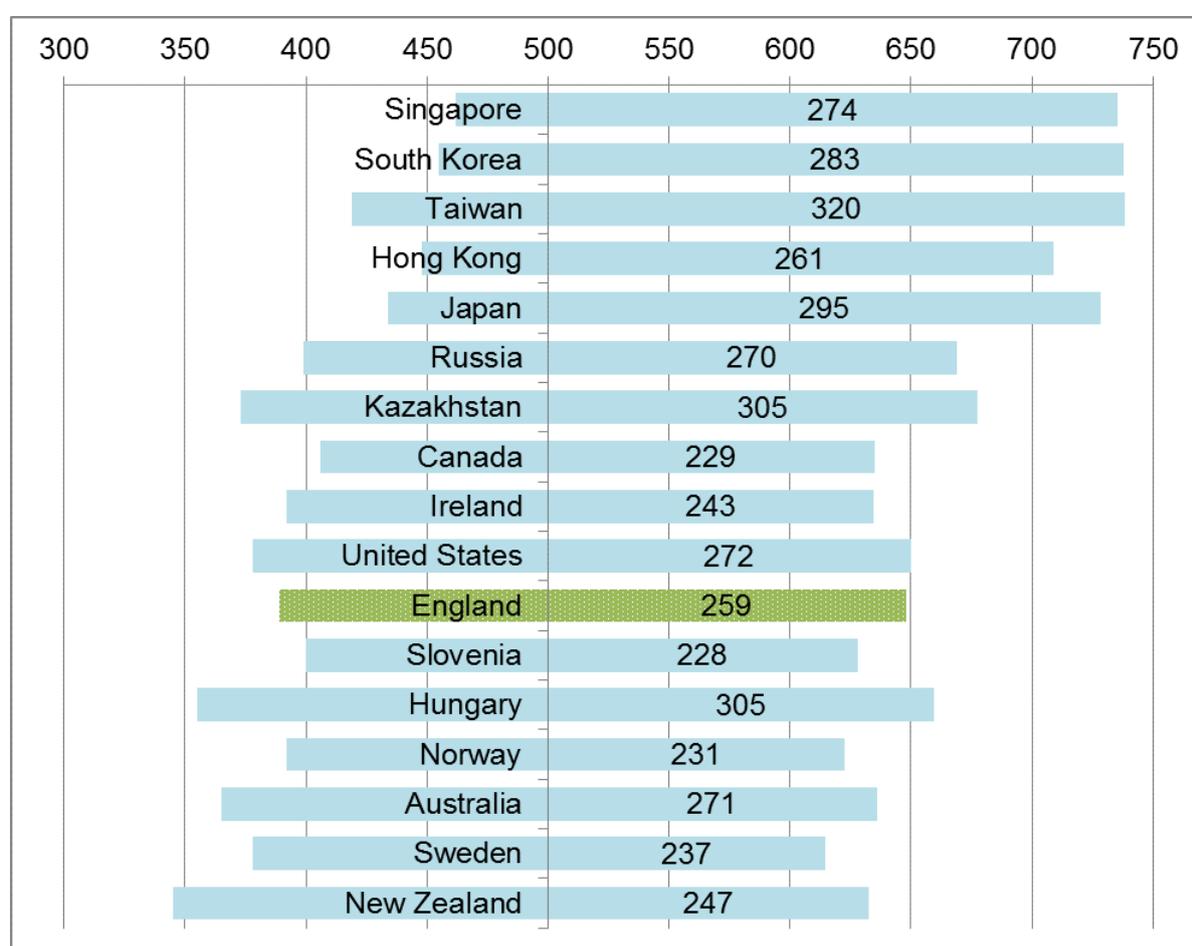
³⁸ Ireland did not participate in the year 9 maths assessments in TIMSS 2011.

³⁹ For an explanation of Norway's change in year groups assessed in 2015, please see: <http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/norway/timss-target-grades-and-the-norwegian-curriculum-in-basic-and-secondary-schools/>

1995 and 2015. Having performed significantly higher than England in 1995, Australia and Sweden have seen a decrease in their mean score and so performed significantly lower in 2015, joined by New Zealand which performed at a similar level to England in 1995.

The variation between the performance of the highest and lowest scoring pupils in England is 259 TIMSS scale points (see Figure 13 below). This is narrower than some of the other higher-performing countries from the four comparator groups, such as Singapore, Taiwan and Japan. It is wider, however, than Ireland, Canada and Norway, for example.

Figure 13: Range of year 9 maths achievement across countries from the four comparator groups



Source: TIMSS 2015.

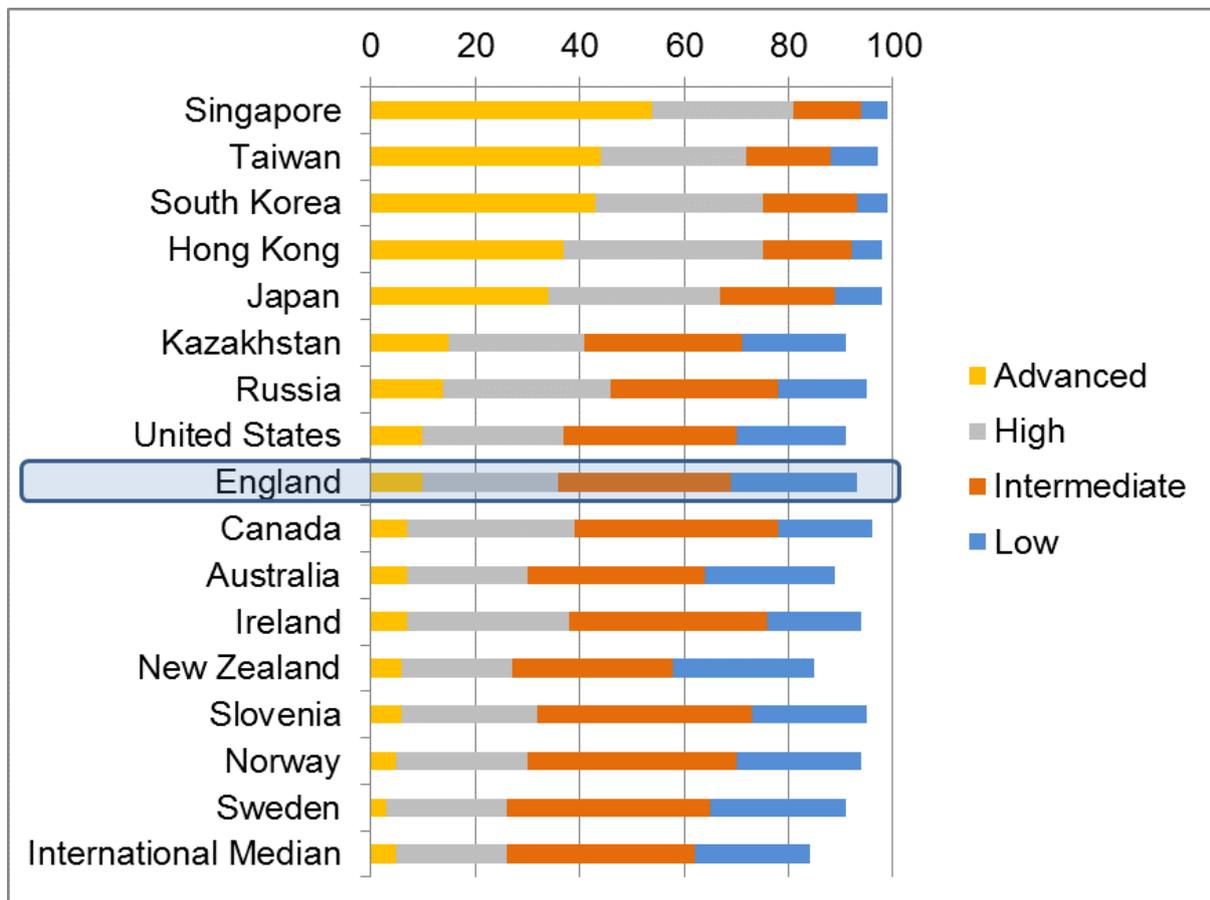
Year 9 pupils in the East Asian group perform significantly better than England at the higher benchmarks. Five other countries also had a higher proportion of year 9 pupils achieving or exceeding the Advanced benchmark than England's 10 per cent of pupils (Kazakhstan, Russia, the United States, Israel and Hungary). Five times the number of year 9 pupils in Singapore reached the Advanced benchmark than pupils in England (54% compared to 10%). Furthermore, more than twice the number of

pupils from Singapore reached the High benchmark (81% compared to 36%), while 94 per cent achieved the Intermediate benchmark, compared to 69 per cent in England

However, England’s performance at each benchmark was well above the international median⁴⁰, with England’s performance against the Advanced benchmark double the international median.

England’s overall performance against the benchmarks was slightly lower than that of the United States but above that of the remaining English-speaking countries that participated in the year 9 maths assessments⁴¹. Figure 14 below compares England’s performance at the international benchmarks with countries from the four comparator groups described in chapter 2.

Figure 14: Percentages of year 9 pupils reaching the international benchmarks in maths (England and countries from the four comparator groups)



Source: TIMSS 2015.

⁴⁰ International medians rather than international means are calculated for this data set.

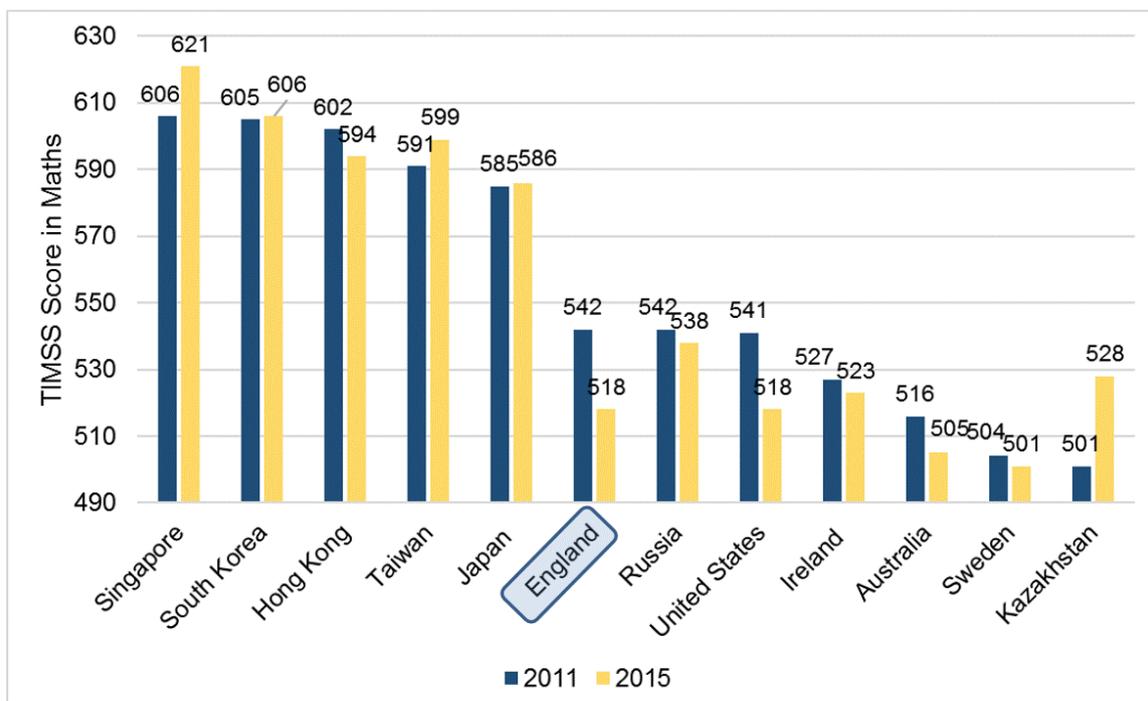
⁴¹ Northern Ireland did not participate in the TIMSS 2015 year 9 maths assessments.

3.4 What does TIMSS tell us about pupil progress in maths between years 5 and 9?

As the target year 9 cohort in 2015 are the same as those who were in year 5 in 2011, TIMSS allows for comparison of relative progress achieved by the cohort between these years. It should, however, be noted that due to the sampling approach (see section 1.2), although the year 5 pupils that took the assessments in 2011 were from the same cohort, this does not mean they are exactly the same pupils. The assessments taken by year 5 and year 9 pupils, and the frameworks from which these were taken, were also different.

As shown in Figure 15, the mean score of the year 5 cohort in 2011 in England was significantly higher (42 scale points) than the international mean. By the time this cohort reached year 9 in 2015, their average performance was just 18 points above the international mean. This is true for the year 9 cohort in some other high-performing countries, such as the United States. In all the East Asian countries, with the exception of Hong Kong, the gap between the average score of pupils and the international mean increased over this period. This indicates that the high-performing East Asian countries are securing greater progress over time than England. The difference for Kazakhstan, a ‘fast mover’ between 2011 and 2015 is also notable as it indicates a comparatively higher rate of progress.

Figure 15: A comparison of the maths performance of year 5 pupils in 2011 and year 9 pupils in 2015 (England and other countries from the comparator groups)



Source: TIMSS 2015.

Chapter 4. Overall performance in science

This chapter summarises the findings from TIMSS 2015 in terms of science performance for year 5 and year 9 pupils in England. The chapter covers the changes in mean performance over time and changes in the percentage of pupils achieving each of the international benchmarks in science. The chapter then goes on to compare England's performance with other countries.

4.1 Main Findings

- Over the 20 year period, from 1995 to 2015, the performance of year 5 pupils in England has shown significant improvement. Performance has varied between these years with a significant decline in performance in 2011, and an increase in performance in 2015, although this increase was not significant.
- The performance of year 9 pupils in England in science has been one of relative consistency between 1995 and 2015. The average score of year 9 pupils in 2015 is an increase compared to 2011, although not a significant one.
- The average scores of year 5 and 9 pupils in England have consistently been significantly above the TIMSS international mean.
- For both years 5 and 9, England remains in the second highest-performing group of countries. Ten countries performed significantly higher than England in the year 5 assessments, while five did in year 9. As in maths, these were predominantly East Asian countries.
- England's performance was significantly higher than 28 countries in year 5 and 27 countries in year 9⁴².
- A larger share of year 5 and 9 pupils achieved each of the international benchmarks in England compared to the median across all participating countries.
- In contrast to maths, the relative performance of year 9 pupils in England in 2015 improved compared to their performance as year 5 pupils in TIMSS 2011⁴³, while for some comparator countries this was not the case.

⁴² The total number of participating countries in years 5 and 9 were different. See sections 4.2.1 and 4.2.2 below.

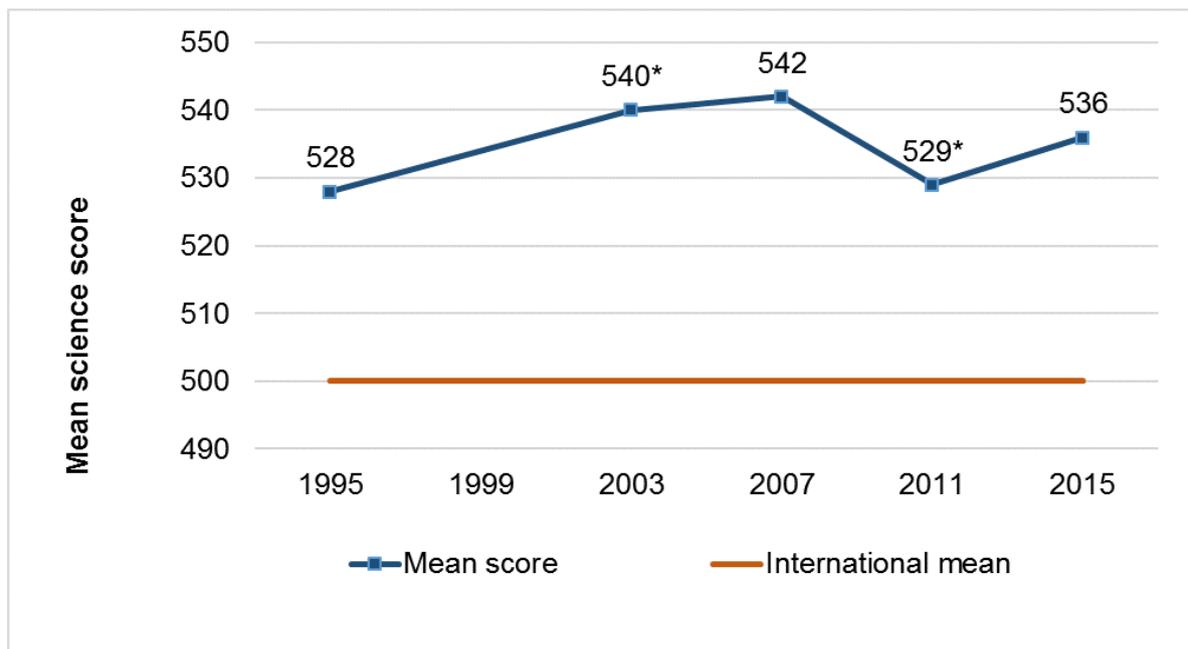
⁴³ The samples in each TIMSS cycle is nationally representative enabling these comparisons to be made, but it should be noted these are not exactly the same pupils.

4.2 What does TIMSS tell us about England's performance in year 5 science?

4.2.1 How has England's performance in science changed over time for year 5 pupils?

Year 5 pupils' overall performance in science has been consistently and significantly above the international mean score of 500. After the decrease in performance in 2011 there was an increase of seven scale points between 2011 and 2015 but, as with year 5 maths, this increase was not significant. England's mean score in 2015 is below that achieved by pupils in 2003 and 2007, but not significantly so. However, it is significantly above the performance of pupils in England in 1995. Figure 16 below shows this trend over time.⁴⁴ It should be noted that in 1995, the TIMSS sample comprised both year 4 and 5 pupils, which may have affected average achievement levels for that year and the level of significance in the subsequent cycle, 2003.

Figure 16: Trend in the mean year 5 science score (England)



Source: TIMSS 2015.

Note 1: The 1999 cycle of TIMSS included only year 9, not year 5 pupils.

Note 2: The 1995 score is an average across the performance of year 4 and year 5 pupils as the 1995 cycle assessed pupils across both year groups.

Note 3: Response rates for TIMSS in England were relatively low in 1995, 1999 and 2003.

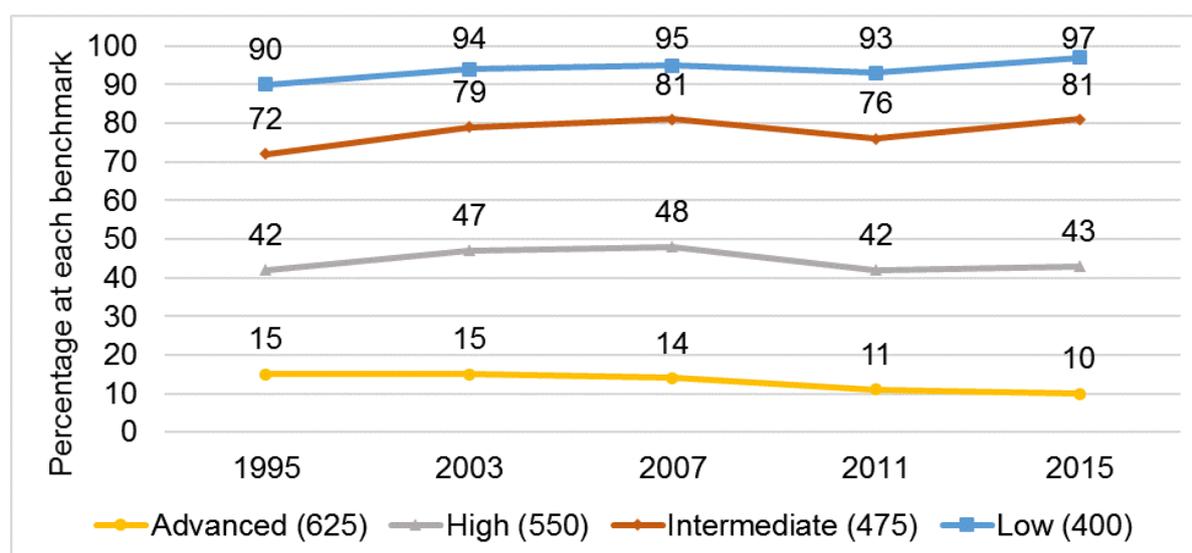
Note 4: Scores that represent a significant increase or decrease from the previous TIMSS cycle are marked with an asterisk.

⁴⁴ See [Appendix B](#) for more information on calculation of TIMSS means scores.

Since 2011, there has been a small increase in the percentage of year 5 pupils in England achieving the High benchmark in science. There have been significant improvements in the percentage of pupils achieving the Low and Intermediate benchmarks (four and five per cent points respectively), which partly mirrors the improvement in the Low benchmark in year 5 maths. As in year 5 maths, there was a small, non-significant decrease in the proportion of pupils achieving the Advanced benchmark.

Since 1995, achievement against the Advanced benchmark has shown a significant decline, although there has been greater stability against the High benchmark. By contrast, as with year 5 maths, performance at the Intermediate and Low benchmarks shows a significant upward trend overall⁴⁵. Figure 17 below shows the percentage of year 5 pupils meeting each of the international TIMSS benchmarks⁴⁶ in science since 1995.

Figure 17: Trend in the percentage of year 5 pupils reaching each of the TIMSS international benchmarks in science (England)



Source: TIMSS 2015.

Note 1: The 1999 cycle of TIMSS included only year 9, not year 5 pupils.

Note 2: The 1995 score is an average across the performance of year 4 and year 5 pupils as the 1995 cycle assessed pupils across both year groups.

Note 3: Response rates for TIMSS in England were relatively low in 1995, 1999 and 2003.

4.2.2 How do year 5 pupils in England perform in science relative to their peers in other TIMSS countries?

In 2015, England remains in the second highest-performing group of countries for

⁴⁵ It should be noted that in 1995, the TIMSS sample comprised both year 4 and 5 pupils, which may have affected average achievement levels for that year and the level of trend significance between 1995 and 2015.

⁴⁶ See [Appendix C](#) for a description of the international benchmarks.

year 5 science. Ten countries performed significantly higher than England; eight at a similar level and 28 significantly lower⁴⁷.

The countries performing significantly higher than England remain consistent in some respects across the two cycles: the five East Asian countries (except Hong Kong in 2011), Finland, Russia and the United States. The East Asian group and Russia are similarly in this highest-performing group in year 5 maths. The greatest change in 2015 is the inclusion of Poland and Kazakhstan in the highest-performing groups, two 'fast-movers' that performed significantly lower than England in 2011.

A number of changes were also evident in the group performing similarly to England, where only two countries were the same as in 2011: Hungary and Sweden. The Czech Republic joined this group, having performed significantly higher than England in 2011, while Hong Kong joined the significantly higher-performing group. Pupils in England performed significantly higher in 2015 than their peers in six European countries that had performed similarly to them in 2011: Germany, Denmark, Italy, the Netherlands, Portugal and Slovakia. By contrast, Slovenia, Ireland and Croatia all improved from 2011 to reach a similar level to England in 2015. Norway has also joined this group but the age of pupils assessed has changed since 2011⁴⁸.

Year 5 pupils in England performed significantly higher than most of their English-speaking peers: Canada, Australia, Northern Ireland and New Zealand. The exceptions were the United States, which performed significantly higher than England, and Ireland which performed at a similar level.

⁴⁷ There were 47 countries participating in the TIMSS 2015 year 5 science assessments, three fewer than in 2011. Full analysis of the performance of all these countries can be found in the TIMSS International Report 2015: <http://timssandpirls.bc.edu/timss2015/international-results/>

⁴⁸ In 2011, grade 4 and 8 pupils in Norway took the TIMSS assessments, whereas in 2015, grade 5 and 9 pupils did. For further information on the reasons for this, please see: <http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/norway/timss-target-grades-and-the-norwegian-curriculum-in-basic-and-secondary-schools/>

Table 7 below shows all of the countries that performed significantly higher or at a similar level to England, as well as a selection of those that performed significantly lower than England in 2011 and 2015. Bold highlighting shows countries that moved categories between 2011 and 2015.

Table 7: Countries performing significantly above, at a similar level to, or below England (Year 5 science)

Level of performance	2011	2015
Significantly higher than England	South Korea (587) Singapore (583) Finland (570) Japan (559) Russia (552) Taiwan (552) United States (544) Czech Republic (536)	Singapore (590) South Korea (589) Japan (569) Russia (567) Hong Kong (557) Taiwan (555) Finland (554) Kazakhstan (550) Poland (547) United States (546)
At a similar level to England	Hong Kong (535) Hungary (534) Sweden (533) Slovakia (532) Austria ⁴⁹ (532) Netherlands (531) Denmark (528) Germany (528) Italy (524) Portugal (522)	Slovenia (543) Hungary (542) Sweden (540) Norway (grade 5: 538) ⁵⁰ Bulgaria ⁵¹ (536) Czech Republic (534) Croatia (533) Ireland (529)
Significantly lower than England	Slovenia (520) Northern Ireland (517) Ireland (516) Croatia (516) Serbia (516) Australia (516) Lithuania (515)	Lithuania (528) Germany (528) Denmark (527) Canada (525) Serbia (525) Australia (524) Slovakia (520)

⁴⁹ Austria did not participate in TIMSS 2015.

⁵⁰ For an explanation of Norway's change in year groups assessed in 2015, please see: <http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/norway/timss-target-grades-and-the-norwegian-curriculum-in-basic-and-secondary-schools/>

⁵¹ Bulgaria did not participate in TIMSS 2011.

Level of performance	2011	2015
	Belgium (Flanders) (509) Spain (505) Poland (505) New Zealand (497) Kazakhstan (495) Norway (grade 4: 494) ...and 18 others	Northern Ireland (520) Spain (518) Netherlands (517) Italy (516) Belgium (Flanders) (512) Portugal (508) New Zealand (506) France (487) ...and 13 others

Source: TIMSS 2015.

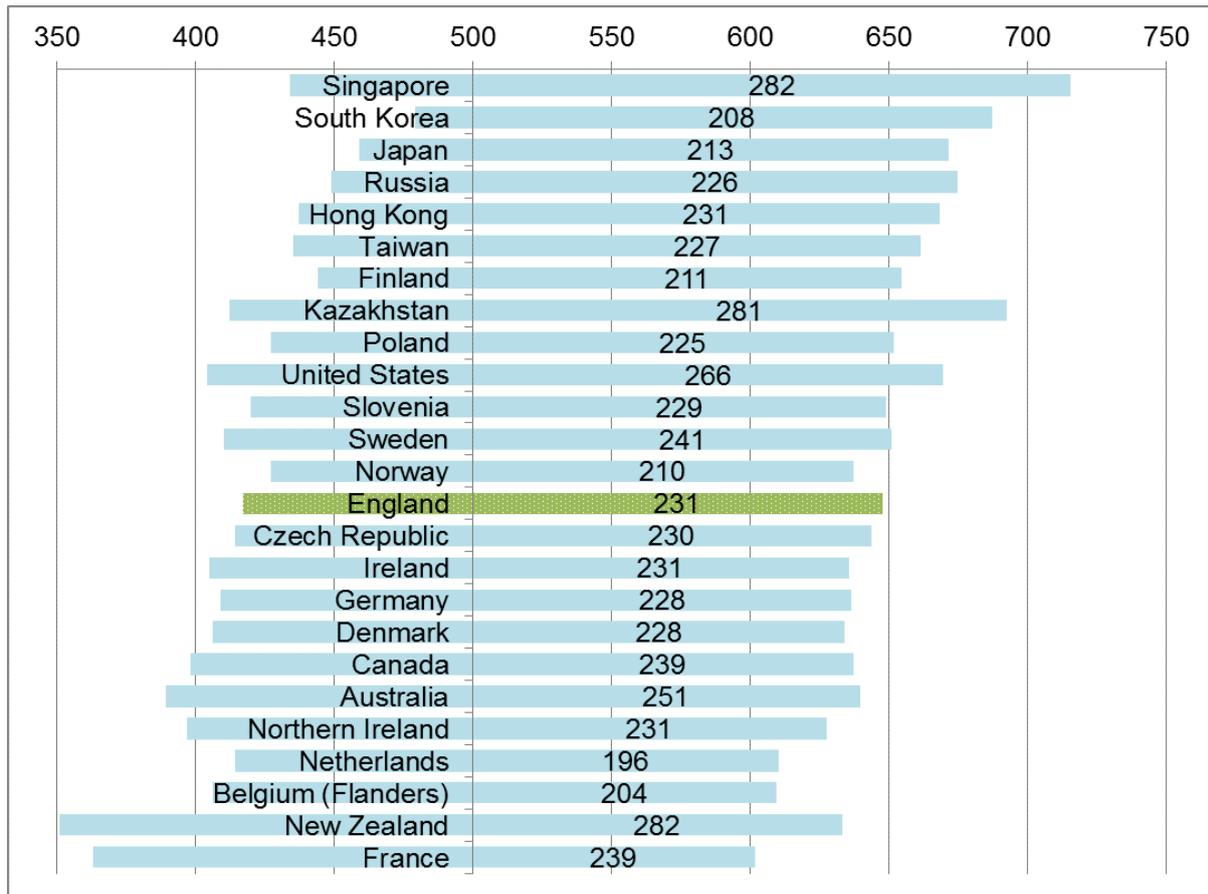
Note 1: Average achievement is shown in parentheses.

Note 2: Bold type indicates countries that have moved category between 2011 and 2015.

Of the countries in the four comparator groups that took the first TIMSS assessments in 1995, South Korea, Japan and the United States have all maintained their significantly higher year 5 performance in science compared to England. Singapore, which performed at a similar level to England in 1995, and Hong Kong, which performed significantly lower, have both improved their performance to achieve significantly higher than England in 2015. Ireland, the Czech Republic and Slovenia remain at a similar level to England, while three countries - Australia, Canada and the Netherlands - that performed similarly to England in 1995 now perform significantly lower owing to relative changes in their average scores. For example, while the performance of year 5 pupils in England has significantly improved between 1995 and 2015, the performance of pupils in the Netherlands has significantly decreased and Australia's score has remained relatively constant.

There are relatively wide variations in performance between the highest- and lowest-scoring year 5 pupils in England in science: a range of more than 231 TIMSS scale points. In some countries from the four comparator groups, the range was narrower: for example, Norway, the Netherlands and Belgium (Flanders). However, as in year 5 maths, Singapore, the highest-performing country, has a wider range than most countries from these four groups. Figure 18 below compares England's performance at the international benchmarks with countries from the four comparator groups described in chapter 2.

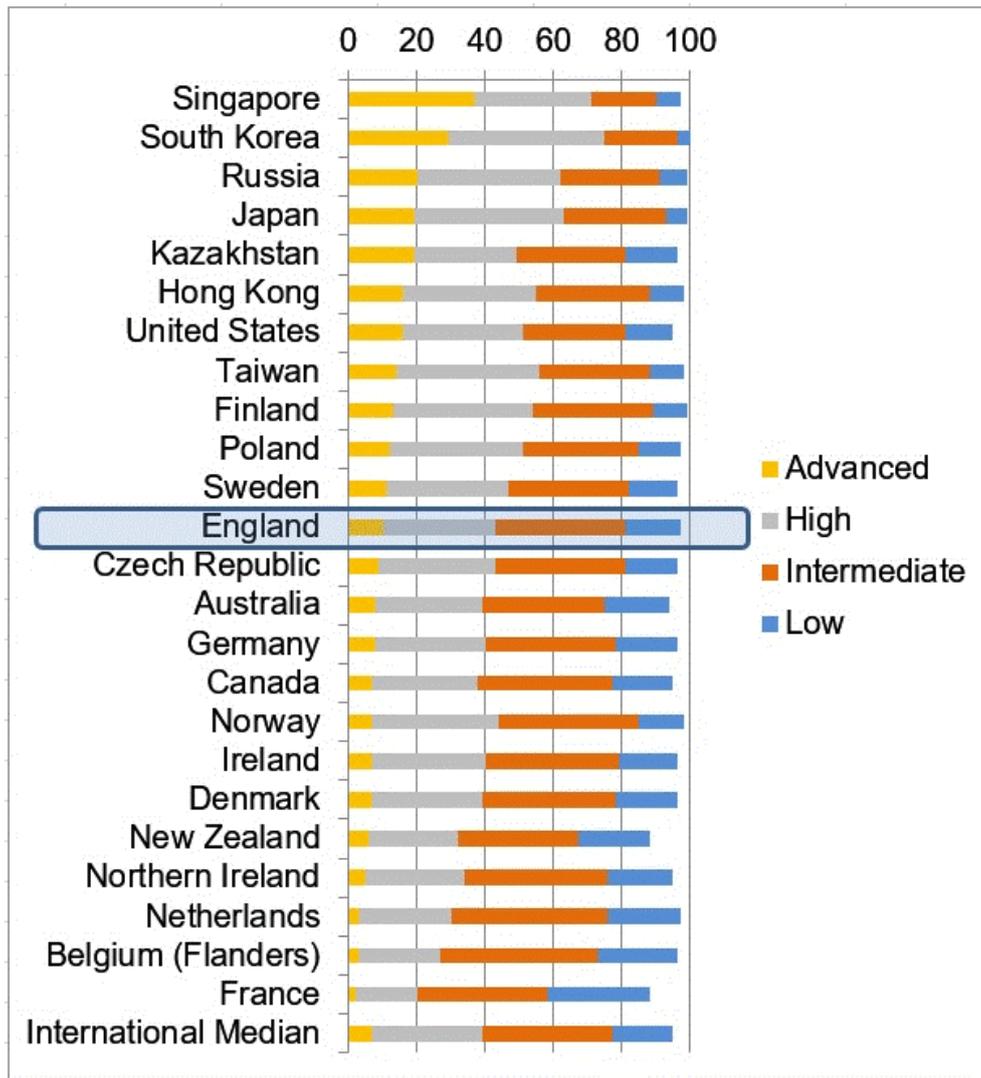
Figure 18: Range of year 5 science achievement across countries from the four comparator groups



A number of higher-performing countries from the four comparator groups performed better in year 5 science than England at the higher benchmarks (Advanced and High), although the differences were smaller than for maths. Twelve countries had a higher proportion of year 5 pupils achieving or exceeding the Advanced benchmark than England (the 11 shown in Figure 19 and Hungary). Year 5 pupils in Singapore, the highest-performing country, were almost four-times more likely to achieve the Advanced benchmark than pupils in England (37% compared to 10%). Pupils in Singapore were also more likely to achieve the High (71% compared to 43%) and Intermediate (90% compared to 81%) benchmarks. England achieved higher scores than all other English-speaking countries, except the United States. This is shown in Figure 19 below.

England's performance in year 5 science at each benchmark was above the international median³, although these differences were smaller than for maths.

Figure 19: Percentages of year 5 pupils reaching the international benchmarks in science (England and countries from the four comparator groups)



Source: TIMSS 2015.

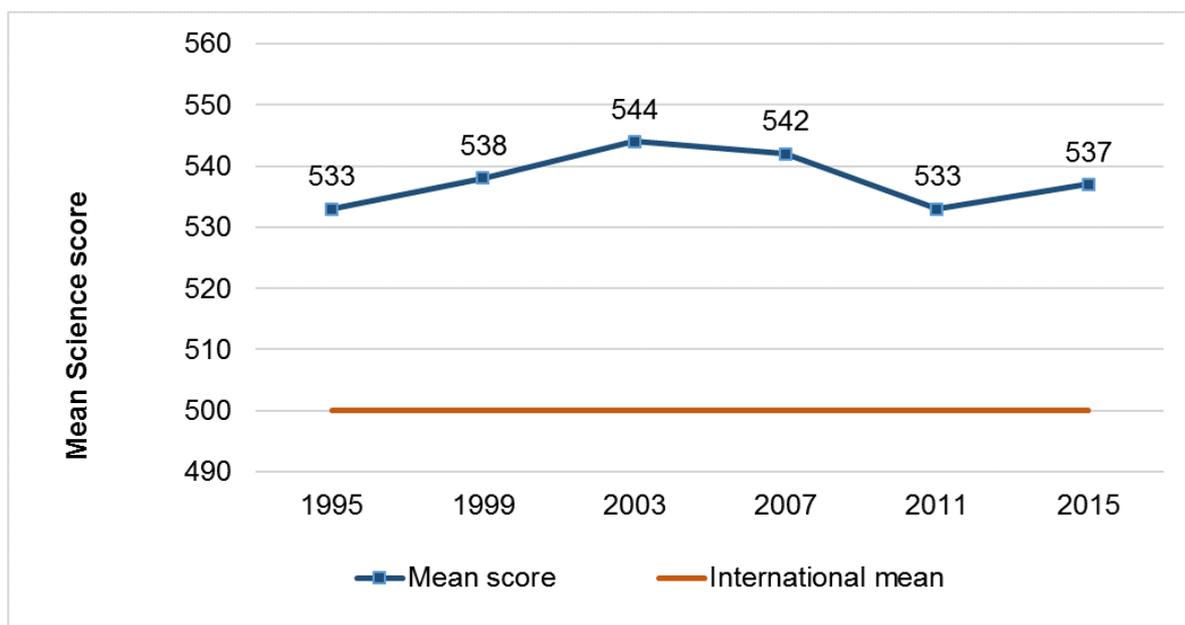
4.3 What does TIMSS tells us about England’s performance in year 9 science?

4.3.1 How has England’s absolute performance in science changed over time for year 9 pupils?

Year 9 pupils’ overall performance in science has been consistently and significantly above the international mean score of 500. In 2015 the mean science score for year 9 pupils in England was 537, higher than in 2011, although not significantly. England’s score had decreased in 2011 to below its 1999-2007 levels and the 2015 score remains below those previous levels, although not significantly so. None of the

scores from 1999 onwards are significantly different from the previous TIMSS cycle. Figure 20 below shows this trend over time.

Figure 20: Trend in the mean year 9 science score (England)



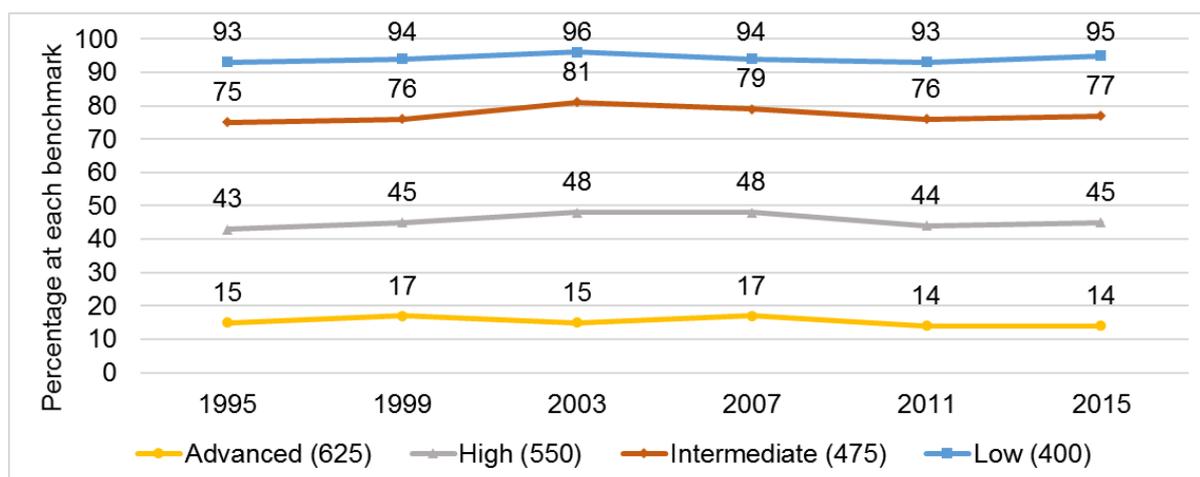
Source: TIMSS 2015.

Note 1: The 1995 score is an average across the performance of year 8 and year 9 pupils as the 1995 cycle assessed pupils across both year groups.

Note 2: Response rates for TIMSS in England were relatively low in 1995, 1999 and 2003.

In 2015, there were small increases in the percentage of year 9 pupils in England achieving the High, Intermediate and Low international benchmarks from 2011, although none of these were significant. There was no change in achievement against the Advanced benchmark. Over time, the trend in each benchmark shows a general stability in year 9 pupils' performance, with a small improvement in the Low benchmark the only significant change between 1995 and 2015. This is in contrast to year 9 maths where the general trend was one of significant improvement over the past 20 years. Figure 21 below shows these science trends.

Figure 21: Trend in the percentage of year 9 pupils reaching each of the TIMSS international benchmarks in science (England)



Source: TIMSS 2015.

Note 1: The 1995 score is an average across the performance of year 8 and year 9 pupils as the 1995 cycle assessed pupils across both year groups.

Note 2: Response rates for TIMSS in England were relatively low in 1995, 1999 and 2003.

4.3.2 How do year 9 pupils in England perform in science relative to their peers in other TIMSS countries?

England remains in the second highest-performing group of countries in 2015 for year 9 science. Five countries performed significantly higher than England; six at a similar level and 27 significantly lower⁵².

In both 2011 and 2015, year 9 pupils in five countries performed significantly higher than their English peers: four of the five East Asian countries and Slovenia, whose pupils had performed similarly to England in 2011. Finland, which performed significantly higher than England in 2011, did not participate in 2015.

Four of the six countries that performed at a similar level to England in 2015 were the same as in 2011 (this group includes Hong Kong). This group was joined by Ireland, which had not participated in the 2011 science TIMSS assessments, and Kazakhstan, a 'fast mover', which improved from performing significantly lower than England in 2011.

Pupils from all other countries performed significantly lower than their English peers, including those from three of the English-speaking countries: Canada, New Zealand and Australia. The United States and Ireland performed at a similar level to England.

⁵² There were 39 countries participating in the TIMSS 2015 year 9 science assessments, three fewer than in 2011. Full analysis of their performance can be found in the TIMSS International Report 2015: <http://timssandpirls.bc.edu/timss2015/international-results/>

Table 8 below shows all of the countries that performed significantly higher in year 9 science, or at a similar level to England, as well as a selection of those that performed significantly lower than England in 2011 and 2015. Bold highlighting shows countries that moved categories between 2011 and 2015.

Table 8: Countries performing significantly above, at a similar level to, or below England (Year 9 science)

Level of performance	2011	2015
Significantly higher than England	Singapore (590) Taiwan (564) South Korea (560) Japan (558) Finland ⁵³ (552)	Singapore (597) Japan (571) Taiwan (569) South Korea (556) Slovenia (551)
At a similar level to England	Slovenia (543) Russia (542) Hong Kong (535) United States (525) Hungary (522)	Hong Kong (546) Russia (544) Kazakhstan (533) Ireland ⁵⁴ (530) United States (530) Hungary (527)
Significantly lower than England	Australia (519) Lithuania (514) New Zealand (512) Sweden (509) Italy (501) Norway (grade 8: 494) Kazakhstan (490) ...and 23 others	Canada (526) Sweden (522) Lithuania (519) New Zealand (513) Australia (512) Norway (grade 9: 509) ⁵⁵ Italy (499) ...and 20 others

Source: TIMSS 2015.

Note 1: Average achievement is shown in parentheses.

Note 2: Bold type indicates countries that have moved category between 2011 and 2015.

⁵³ Finland did not participate in the 2015 TIMSS year 9 science assessments.

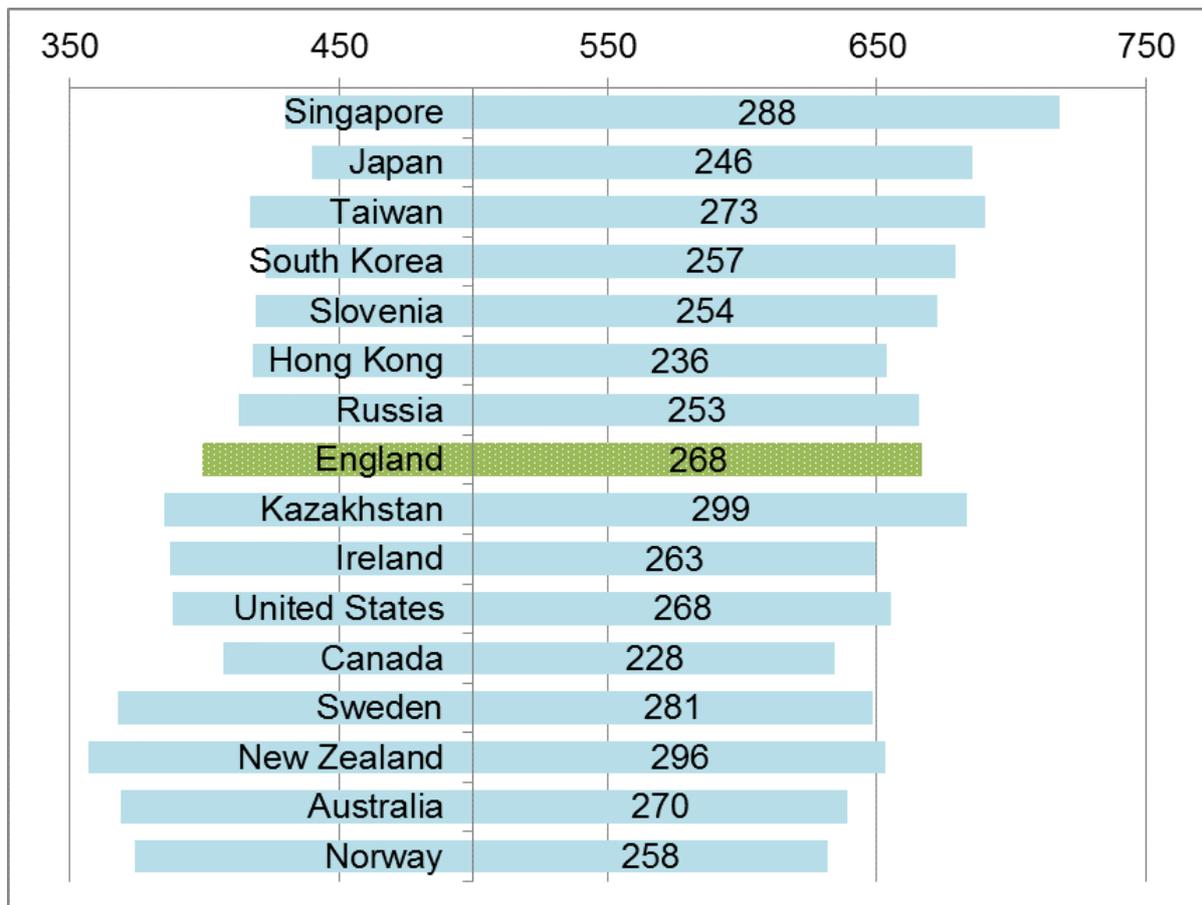
⁵⁴ Ireland did not participate in the 2011 TIMSS year 9 science assessments.

⁵⁵ For an explanation of Norway's change in year groups assessed in 2015, please see: <http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/norway/timss-target-grades-and-the-norwegian-curriculum-in-basic-and-secondary-schools/>

Of the countries in the four comparator groups that took the first TIMSS assessments in 1995, Singapore, Japan and South Korea have maintained their significantly higher performance than England in 2015. Slovenia has improved from performing at a similar level to England in 1995 to perform significantly higher in 2015. Ireland, Hungary, Russia and the United States still perform at a similar level to England, while Hong Kong has improved its score to perform at this level in 2015, having performed significantly lower than England in 1995.

As in year 5 science, there are relatively wide variations in performance between the highest and lowest scoring year 9 English pupils: a range of just under 300 TIMSS scale points. The range is smaller in some of the other higher-performing countries from the four comparator groups: for example, Canada, Hong Kong and Russia. As in year 5 science, the highest-performing country, Singapore, has a relatively wide range compared to the other countries in these groups.

Figure 22: Range of year 9 science achievement across countries from the four comparator groups



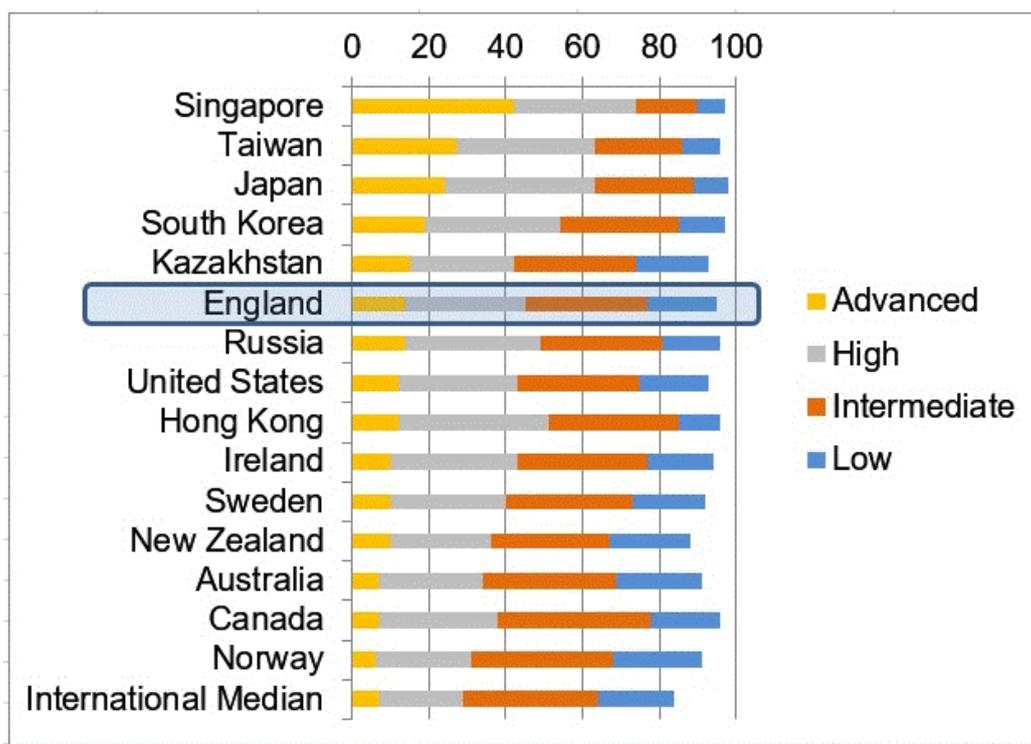
Source: TIMSS 2015.

A number of higher-performing countries from the four comparator groups perform better than England at the higher benchmarks (Advanced and High), although the differences are smaller than for maths. Five countries had a higher proportion of year

9 pupils achieving or exceeding the Advanced benchmark than England’s 14 per cent of pupils. Year 9 pupils in Singapore, the highest-performing country, were three times more likely to achieve the Advanced benchmark than pupils in England (42% compared to 14%). Singaporean pupils were also more likely to achieve the High (74% compared to 45%) and Intermediate (90% compared to 77%) benchmarks. This is shown in Figure 23 below.

England’s performance in year 9 science at each benchmark was above the international median², with its performance against the Advanced benchmark being double this median.

Figure 23: Percentages of year 9 pupils reaching the international benchmarks in science (England and countries from the four comparator groups)



Source: TIMSS 2015.

4.4 What does TIMSS tell us about pupil progress in science between years 5 and 9?

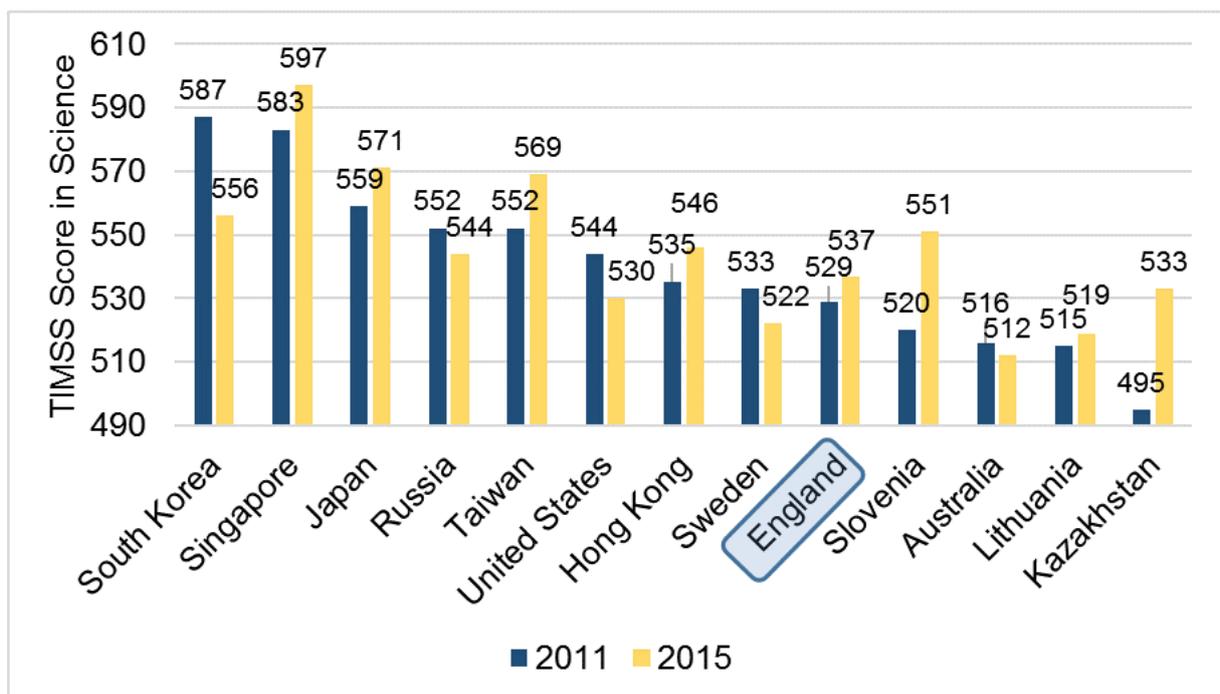
As the target year 9 cohort in 2015 are the same as those who were in year 5 in 2011, TIMSS allows for comparison of relative progress achieved by the cohort between grades. It should, however, be noted that due to the sampling approach (see section 1.2), the year 5 pupils who took the assessments in 2011 were from the same cohort but are not necessarily exactly the same pupils as those sampled in

year 9 in 2015. The assessments taken by year 5 and year 9 pupils, and frameworks from which these were taken, were also different.

As shown in Figure 24, England’s 2015 year 9 cohort achieved eight scale points higher than the international mean (500) compared to when they were year 5 pupils in 2011. This indicates that this cohort of pupils have made progress since 2011 and is in contrast to the cohort’s performance in maths, which saw a decrease in average achievement over the same period.

Of the five highest-performing countries for year 5 science in 2011 (South Korea, Singapore, Japan, Russia and Taiwan), only South Korea and Russia did not secure a higher level of achievement in year 9 in 2015. In addition to these five highest-performing countries, other countries from the comparator groups achieving higher year 9 mean scores in 2015 included Hong Kong, Slovenia and Kazakhstan. The latter two ‘fast movers’ performed particularly well in year 9, with 31 and 38 scale point score increases respectively.

Figure 24: A comparison of the science performance of year 5 pupils in 2011 and year 9 pupils in 2015 (England and other countries from the comparator groups)



Source: TIMSS 2015.

Chapter 5. Maths and science performance in subject and cognitive domains.

TIMSS enables a detailed comparison of pupils' maths and science performance in specific subject and cognitive domains. Each of the assessment questions⁵⁶ is categorised according to the area of the curriculum it covers (referred to in TIMSS as *content* domains) and the different cognitive skills it requires (referred to in TIMSS as *cognitive* domains).

In year 5 maths, there are three content domains: Number, Geometric Shapes and Measures, and Data Display. In year 9, there are four: Number; Algebra; Geometry; Data and Chance. The same is true for science: the year 5 content domains are Life Science; Physical Science; and Earth Science. For year 9 science, they are: Biology; Chemistry; Physics; and Earth Science.

The cognitive domains are the same across maths and science in years 5 and 9: Knowing, Reasoning and Applying.

⁵⁶ See the TIMSS 2015 Assessment Frameworks: Mullis, I.V.S. & Martin, M.O. (Eds.). (2013). TIMSS 2015 Assessment Frameworks. Available at: <http://timssandpirls.bc.edu/timss2015/frameworks.html>

5.1 Main Findings

Maths

- In 2015, the performance of year 5 pupils in England was strongest in Data Display, around the average overall score for maths in Number, and weaker in Geometric Shapes and Measures.
- There was a significant improvement in the performance of year 5 pupils in England in the Number domain between 2007 and 2015. Since 2011, however, the improvement has not been significant.
- Year 9 pupils in England are strongest in Number and Data and Chance and weakest in Algebra and Geometry. These relative strengths and weaknesses mirror the 2011 assessment outcomes.
- Across years 5 and 9 the content domains that are focused on data are relative strengths while the domains that are focused on geometry are relative weaknesses.
- England's relative strength in Data Display in year 5 is in contrast to the majority of the highest-performing countries, where strengths lie in the other domains. Similarly, in year 9, while pupils in England perform relatively strongly in Data and Chance, the strengths of the highest-performing countries tend to lie across the Algebra, Geometry and Number domains.
- Year 5 pupils in England are strongest in the Knowing cognitive domain, and weakest in the Reasoning domain. Conversely, our year 9 pupils are strongest in Reasoning and weakest in Knowing.
- Pupils from nearly all the highest-performing countries in year 5 maths demonstrated a relative strength in Knowing, the same as England's pupils. Only half of the highest-performing countries, however, perform relatively strongly in Knowing in year 9 maths.

Science

- In 2015, the performance of year 5 pupils in England was strongest in Physical Science, weakest in Earth Science and around the average score in Life Science. This mirrors the pattern of performance in 2011.
- Year 5 performance in 2015 was higher in all three content domains than in 2011, but not significantly so.
- Year 9 pupils in England performed most strongly in Biology, weakest in Chemistry and around the average score for science in both Earth Science and Physics.
- Comparing 2015 with 2011, year 9 pupils' scores increased in Biology and Physics but not significantly. Performance in Chemistry was the same and there was a decrease in pupils' score in Earth Science, although this was not significant.
- There were no clear patterns of relative strength and weakness across countries that performed significantly higher than England's year 9 pupils in the content domains, while those performing at a similar level tended to be stronger in Life Science.
- There were no significant differences in England's year 5 pupils' performance in the cognitive domains compared to their overall mean score.
- As in maths, year 9 pupils in England performed most strongly in Reasoning and weakest in Knowing.
- In the cognitive domains, there are no clear patterns in the relative strengths and weaknesses of the highest-performing countries or those performing at a similar level to England.

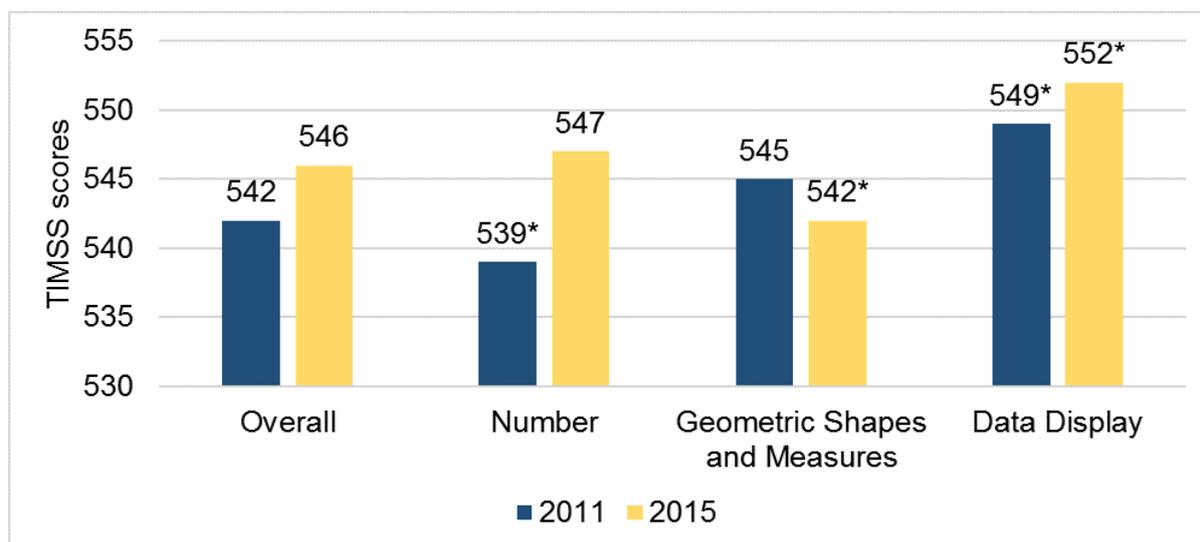
5.2 How do year 5 pupils in England perform across different areas of maths?

To assess the relative strengths and weaknesses of year 5 pupils across the different TIMSS content domains, it is possible to compare their average score in each domain to England's overall average (546 in 2015) as well as to the international mean (500). In year 5 maths, there are three content domains: Number, Geometric Shapes and Measures, and Data Display.

As shown in Figure 25, year 5 pupils in England perform above the international mean in each domain. Pupils performed most strongly in the Data Display domain

and were weakest when faced with questions around Geometric Shapes and Measures. Compared to 2011, the average performance of year 5 pupils in England has increased in the Number and Data Display domains, though not significantly.

Figure 25: Mean scores for 2011 and 2015 in different maths domains compared to the overall mean score (England, year 5)



Source: TIMSS 2015.

Note 1: Asterisks indicate domain mean scores that are significantly different to England's overall mean score.

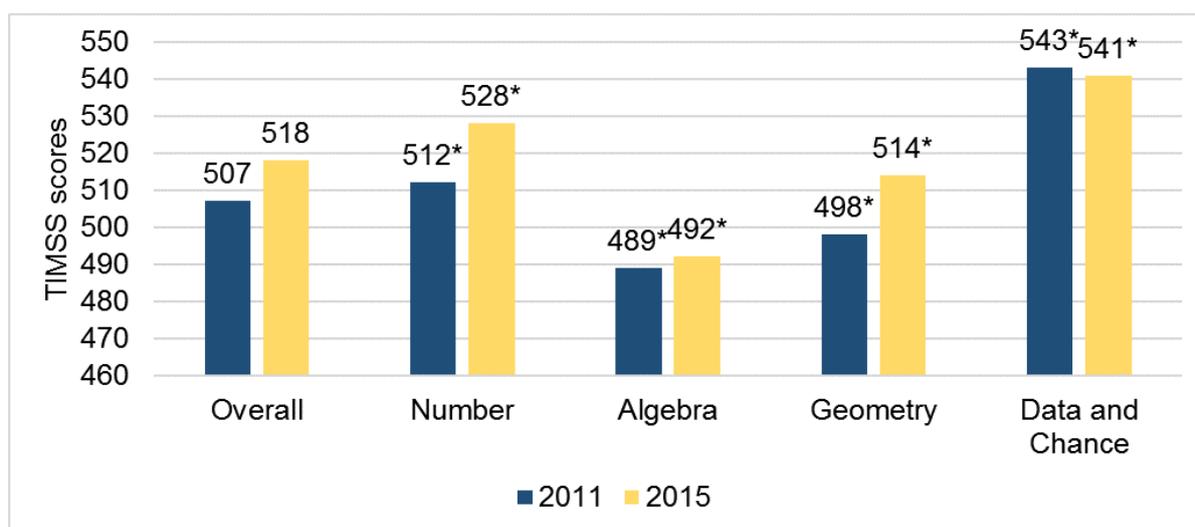
Even in their strongest domains pupils in England are outperformed by their peers in the countries with significantly higher mean year 5 maths scores (the South East Asian countries, Russia and Northern Ireland). These countries tend to perform relatively well in Number and Geometric Shapes and Measures. For example, Singapore and Northern Ireland are relatively strong in the Number domain, Japan is strong in Geometric Shapes and Measures, while Hong Kong, South Korea and Taiwan perform relatively well in both Number and Geometric Shapes and Measures. Russia is the only top performer in year 5 maths with a relative strength in Data Display. England's performance in Data Display, its strongest domain, is 21 scale points below the lowest of the highest-performing countries, Russia.

5.3 How do year 9 pupils in England perform across different areas of maths?

As is the case for year 5 pupils' performance in maths, year 9 pupils in England also performed better in some subject areas compared to others. Within the year 9 assessment, the mathematics items are classified into Number, Algebra, Geometry and Data and Chance domains.

As shown in Figure 26 below, year 9 pupils in England performed best in the Number and Data and Chance domains. Performance was comparatively weaker in the Geometry domain and much weaker in the Algebra domain, which is the only domain in which pupils in England performed below the international mean. This performance profile corresponds with the pattern of year 9 pupils' achievement in these domains in 2011, with the same relative higher and lower scores and levels of significance. England's increased performance in year 9 maths can largely be attributed therefore to pupils' significantly higher performance in the Number and Geometry domains.

Figure 26: Mean scores for 2011 and 2015 in different maths content domains compared to the overall mean score (England, year 9)



Source: TIMSS 2015.

Note 1: Asterisks indicate domain mean scores that are significantly different to England's overall mean score.

There is no clear pattern of domain strength in the highest-performing countries. Pupils in Singapore are particularly strong in Number; pupils in South Korea and Taiwan strong in both Geometry and Algebra; and pupils in Hong Kong perform most strongly in Geometry. Russia, which also outperforms England in the mean year 9 maths scores, is relatively strong in Algebra and relatively weak in Data and Chance – a profile that is the opposite of England's. Even in their strongest domain (Data and Chance), pupils in England perform well below (47 points lower) their peers in Japan, the lowest-placed of the five East Asian countries in this domain. However the performance of pupils in England in this domain is 34 scale points above that of their peers in Russia, despite Russia performing significantly higher overall.

The majority of the countries that performed similarly to England in year 9 maths overall also underperformed in Algebra (Canada, Ireland, Slovenia, Hungary, Norway, Lithuania). The countries in this group tend to mirror England's relative

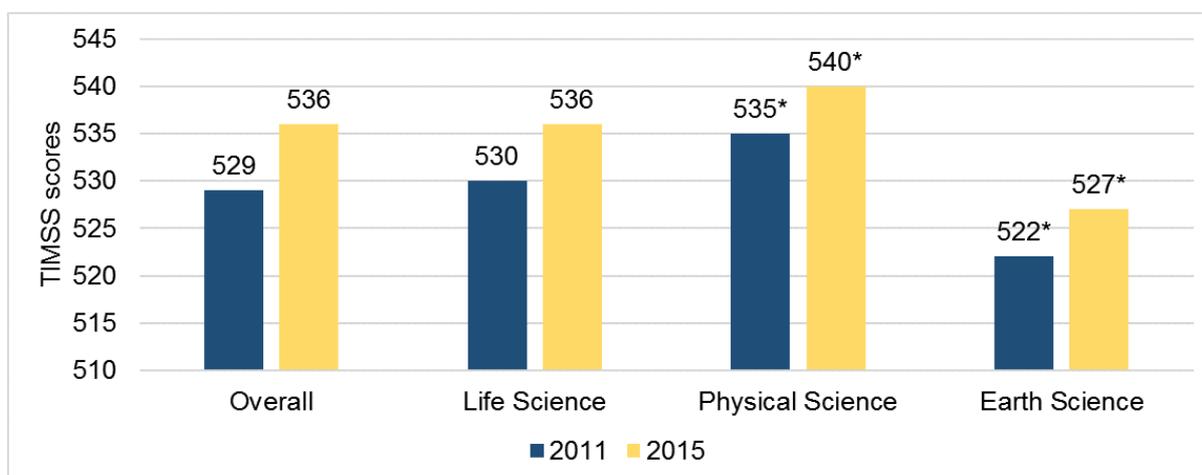
strengths in Number and Data and Display. Two notable exceptions are the United States, which is strong across the domains of Number, Algebra, and Data and Chance and is only relatively weak in one area (Geometry), and Kazakhstan, which has a similar profile to Russia (relatively strong in Algebra but weak in Data and Chance).

5.4 How do year 5 pupils in England perform across different areas of science?

In year 5, science is split into three content domains (Life Science, Physical Science and Earth Science).

Pupils in England performed best in Physical Science and were weakest in Earth Science (see Figure 27 below). Their performance in Life Science was the same as England’s overall mean science score. In every domain pupils in England performed above the international mean. This mirrors the pattern of 2011 assessments. However, performance in 2015 was higher in all three domains, although these differences were not significant.

Figure 27: Mean scores for 2011 and 2015 in different science content domains compared to the overall mean score (England, year 5)



Source: TIMSS 2015.

Note 1: Asterisks indicate domain mean scores that are significantly different to England’s overall mean score.

Compared to the countries that performed similarly to England, pupils in England were the exception in performing relatively strongly in Physical Science, with most having this as a relative weakness. There is a mixed picture amongst the highest-performing countries in year 5 science, with Singapore particularly strong in the Life Science domain, South Korea, Taiwan and Japan strong in Physical Science, and Hong Kong relatively strong in Earth Science. Russia performed consistently across

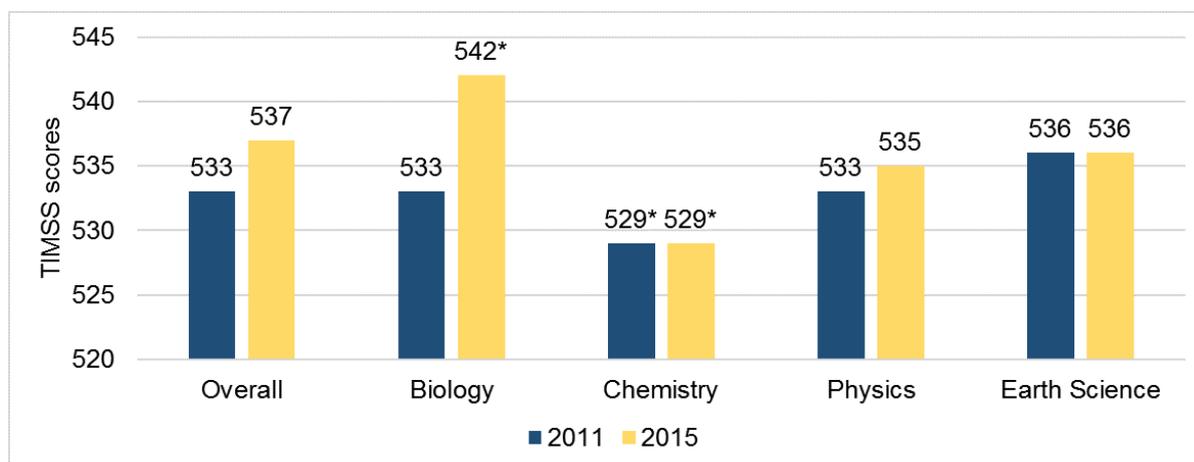
all the science domains in year 5. English pupils' performance in Physical Science, their strongest domain, is three scale points above that of the United States (one of the countries performing significantly higher than England), but 15 scale points below the lowest-achieving East Asian country in this domain, Hong Kong.

5.5 How do year 9 pupils in England perform across different areas of science?

Performance in the year 9 science assessment is also split into four content domains (Biology, Chemistry, Physics and Earth Science). In 2015, in comparison with England's overall mean score in science, year 9 pupils performed best in Biology, were weakest in Chemistry and at a similar level to the overall mean in Earth Science and Physics (see Figure 28 below). Performance in all domains is higher than the international mean.

In comparison with 2011, year 9 pupils' performance had increased by 2015 in both Biology and Physics, with Biology accounting for the bulk of England's overall mean score increase, although neither difference is significant. Performance in both Chemistry and Earth Science was unchanged between 2011 and 2015.

Figure 28: Mean scores for 2011 and 2015 in different content domains of science compared to the overall mean score (England, year 9)



Source: TIMSS 2015.

Note 1: Asterisks indicate domain mean scores that are significantly different to England's overall mean score.

There was no clear pattern in the performance across countries that had significantly higher year 9 science scores than England. Singapore performed relatively well in Biology, Taiwan did well in Chemistry, Singapore and South Korea both did well in Physics, while Japan, Taiwan and Slovenia all did well in Earth Science. The content domain in which year 9 pupils in England scored highest, Biology, was six scale

points below the achievement of pupils in Slovenia (the lowest-achieving of the five highest-performing countries).

5.6 How do pupils in England perform in different cognitive domains?

In both maths and science, TIMSS assesses pupils' performance in three cognitive domains: Knowing, Applying and Reasoning.⁵⁷ The domains describe the kind of thinking that pupils do when engaged with both maths and science tests, although with different emphasis depending on the subject and year group. For example, there is more emphasis on the Reasoning domain in year 9 and more emphasis on Knowing in year 5. Pupil performance in the three cognitive domains is highly correlated with performance in the TIMSS subject domains and performance overall, meaning that no one domain is more or less important for overall performance.

The descriptions of the three domains differ slightly between maths and science; broadly they are described as encompassing the following:

- Knowing: the facts, concepts, and procedures pupils need to know
- Applying: focuses on pupils using knowledge and understanding to, for example, solve problems and answer questions
- Reasoning: goes 'beyond the solution of simple problems' in maths and, in science 'includes using evidence and science understanding to analyze, synthesize, and generalize. In both subjects there is an emphasis upon doing these within 'unfamiliar situations and complex contexts'⁵⁸

5.6.1 How did pupils in England score in the cognitive domains in each subject and year group?

Maths

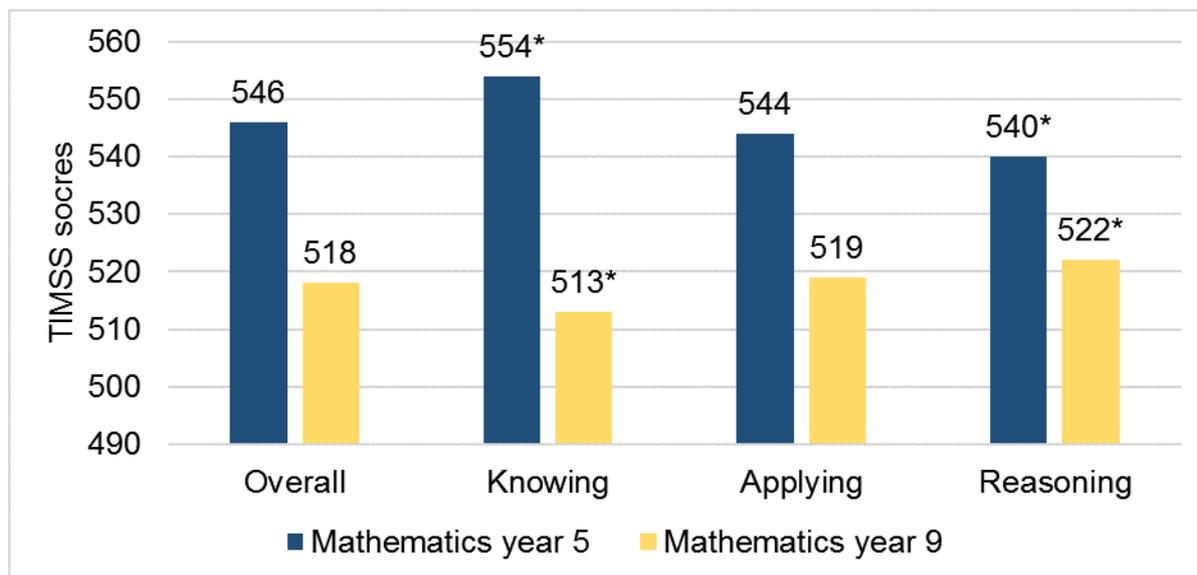
Figure 29, below, shows how year 5 and year 9 pupils in England performed across the three cognitive domains in maths compared to their overall average score. It shows that while year 5 pupils performed highest in Knowing and lowest in

⁵⁷ TIMSS 2015 Assessment Frameworks, p.9. For further information on the cognitive domains see: Mullis, I.V.S. & Martin, M.O. (Eds.). (2013). TIMSS 2015 Assessment Frameworks. Available at: <http://timssandpirls.bc.edu/timss2015/frameworks.html>

⁵⁸ TIMSS 2015 Assessment Frameworks, p.24 and p.54. For further information on the cognitive domains see: Mullis, I.V.S. & Martin, M.O. (Eds.). (2013). TIMSS 2015 Assessment Frameworks. Available at: <http://timssandpirls.bc.edu/timss2015/frameworks.html>

Reasoning, the opposite was true for year 9 pupils, where Reasoning was a relative strength and Knowing was a relative weakness.

Figure 29: Year 5 and 9 pupils' average achievement in each cognitive domain compared to overall achievement in maths (England)



Source: TIMSS 2015.

Note 1: Asterisks indicate domain mean scores that are significantly different to England's overall mean score.

Even in their lowest scoring cognitive domains, the highest-performing countries significantly outperform England, but it is nevertheless instructive to look at areas of relative strength and weakness for these high-performing countries and the extent to which these compare with England.

Similarly to England, year 5 pupils from the majority of the highest-performing countries demonstrated a relative strength in Knowing. Pupils in Russia scored relatively better in Reasoning and were weaker in Knowing, while those in Hong Kong and Northern Ireland were weakest in Reasoning and performed better in Applying and Knowing. Over half of the highest-performers in year 5 maths (Singapore, Hong Kong, Taiwan and Northern Ireland) were relatively weaker in the Reasoning domain.

In year 9 maths, half of the highest-performing countries (Singapore, Hong Kong and Russia) performed relatively strongly in the Knowing domain, a pattern similar to that observed for year 5 maths. Japan is the exception amongst the highest performers, with a relatively low score in Knowing.

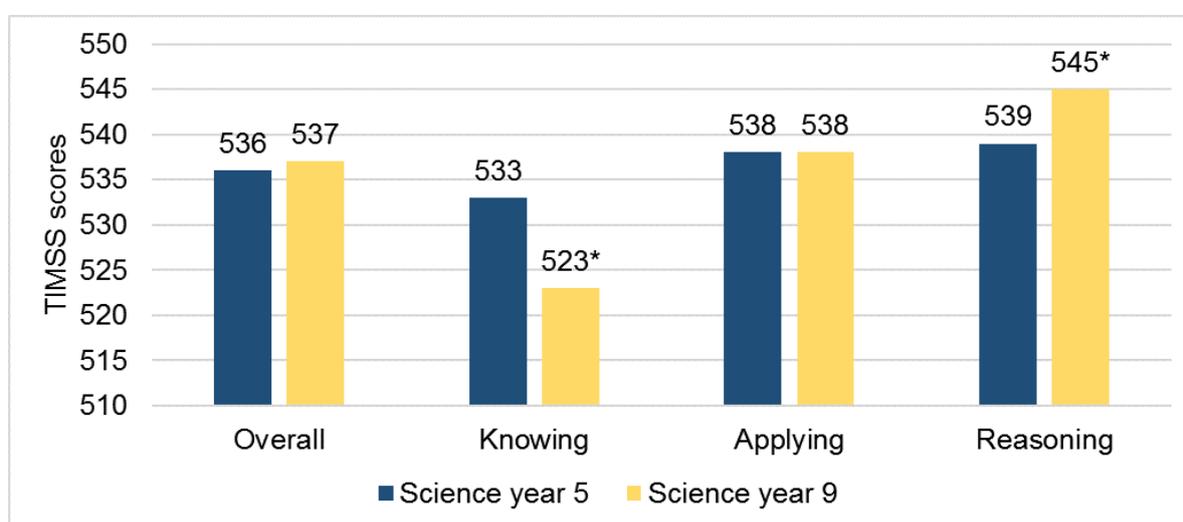
Taiwan follows a similar pattern to pupils in England with relatively poor performance in Reasoning at year 5 and a stronger performance in year 9. Singapore and Hong Kong underperform in Reasoning in maths in both year 5 and year 9 (relative to their

overall maths score) but the difference between their overall maths score and the domain score is less for year 9 pupils.

Science

Year 5 and year 9 pupils in England performed highest in the Reasoning domain and lowest in the Knowing domain, as shown in Figure 30 below. However, the range of performance is greater in year 9 science than in year 5: the year 9 relative score for Knowing is significantly below the overall score, while the relative score for Reasoning is significantly above it. This broad pattern (stronger in Reasoning and weaker in Knowing) matches the findings for year 9 maths, but it is the opposite of those for year 5 maths.

Figure 30: Year 5 and 9 pupils' average achievement in each cognitive domain compared to overall achievement in science (England)



Source: TIMSS 2015.

Note 1: Asterisks indicate domain mean scores that are significantly different to England's overall mean score.

The highest-performing countries significantly outperform England, even in their lowest scoring cognitive domains, but it is nevertheless instructive to look at areas of relative strength and weakness for these high-performing countries and the extent to which these compare with England.

In year 5, all but one of the countries that performed significantly higher than England has higher scores in each of the cognitive domains. The exception is Slovenia, compared to which, England's pupils perform one scale point higher in Reasoning (539 compared to 538).

In year 5, the relative performance across the domains in the six highest-performing countries (the East Asian group and Russia) shows variation in relative strengths. The top three countries from this group, Singapore, South Korea and Japan, have

lower scores for Knowing than for the other two domains. In Singapore, the difference between its weakest domain, Knowing, and strongest domain, Reasoning, is 31 scale points, while Japan has a difference of 50 scale points between these two domains. By contrast, the remaining two countries in this group – Russia and Hong Kong – perform best in the Knowing domains, although, like England, their domain scores are more evenly distributed. Of the countries that performed at a similar level to England, only pupils from Sweden had the same domain score profile as England.

In year 9, there is no evident pattern of performance across the five highest-performing countries (Singapore, Japan, Taiwan, South Korea and Slovenia). While the two highest-performing countries - Singapore and Japan - have relative strengths in Applying; Taiwan and Slovenia have strengths in Knowing. By contrast to year 5 scores, the difference between these countries' domain scores and the overall mean for science achievement is far smaller, exceeding nine scale points in only one case. Of the 10 highest-performing countries, England's year 9 pupils were alongside those from South Korea and Hong Kong in having Reasoning as their domain of relative strength. Their reasoning score of 545 was only five scale points below that of pupils from Slovenia, the lowest-achieving of the five highest-performing countries. Of the countries that performed at a similar level to England, none had the same profile of relative strengths and weaknesses, with no clear patterns evident across their relative performance in the domains.

Chapter 6. Maths and science performance by pupil characteristics

This chapter presents findings on the relative performance of pupils in maths and science according to certain characteristics, namely gender, socio-economic status, ethnicity and language. This data was gathered through pupil questionnaires, TIMSS assessments and the National Pupil Database (NPD).

6.1 Main Findings

Gender

- In 2015, year 5 boys performed significantly higher in maths than girls, increasing the gap since 2011 where boys also out-performed girls, but not significantly. In all other English-speaking countries, boys out-performed girls, although the differences were not consistently significant.
- In contrast to year 5, girls in year 9 continued to perform slightly better than boys in maths. These differences were not significant, however, in either 2011 or 2015.
- In 2015, as in 2011, year 5 and 9 boys performed at a level comparable to girls in science.

Socio-economic status

- Based on the TIMSS 'books at home' measure, England has a relatively large gap, compared to other countries from the comparator groups, between the achievement of its more disadvantaged pupils compared to their non-disadvantaged peers.
- Free School Meals (FSM) pupils perform lower than their non-FSM peers in both maths and science at years 5 and 9. While year 5 FSM pupils scored above the international mean in maths and at the international mean in science, year 9 FSM pupils performed below the international mean in both maths and science.

Ethnicity

- Chinese pupils in England have the highest average achievement in both years 5 and 9 (although sample numbers were very small). In maths, both year 5 and 9 White Other, Asian and Mixed groups perform, on average, better than White British pupils. In science, however, White British pupils

achieve higher scores, on average, than their Asian peers. Pupils from Black and Other groups have low levels of achievement in both subjects. All pupil groups (except the Other group in year 5 science) performed, on average, above the international mean.

Differences by first language

- Pupils whose first language is English performed higher than pupils for whom English is an additional language (EAL) in science in both years 5 and 9. While this was also the case for year 5 pupils in maths, it was not the case for year 9 EAL pupils in maths, who performed slightly higher than native English speakers. Year 9 EAL pupils in Australia also had higher maths average achievement than native English speakers, but lower science achievement.

6.1 Does the performance of boys and girls differ?

Girls have generally outperformed boys in most of England's overall national assessment measures in recent years, although performance in maths has been more equal. For example, at Key Stage 4 in 2015, 61.8 per cent of girls achieved five or more GCSEs at grades A*– C (including English and maths), compared to 52.5 per cent of boys. At the end of Key Stage 2 in 2015, 83 per cent of girls achieved Level 4 or above in reading, writing and maths, compared to 77 per cent of boys. However, 87 per cent of both boys and girls achieved Level 4 or above in maths. This picture of performance is mirrored in girls' and boys' relative performance in the revised Key Stage 2 assessments in 2016. While maths achievement is the same (with 70% of girls and boys achieving the expected standard), 57 per cent of girls achieved the expected standard in reading, writing and maths, compared to 50 per cent of boys⁵⁹.

TIMSS data enables comparisons to be drawn between the performance of boys and girls in each subject in their respective year groups and to compare England's gender differences with those of other countries.

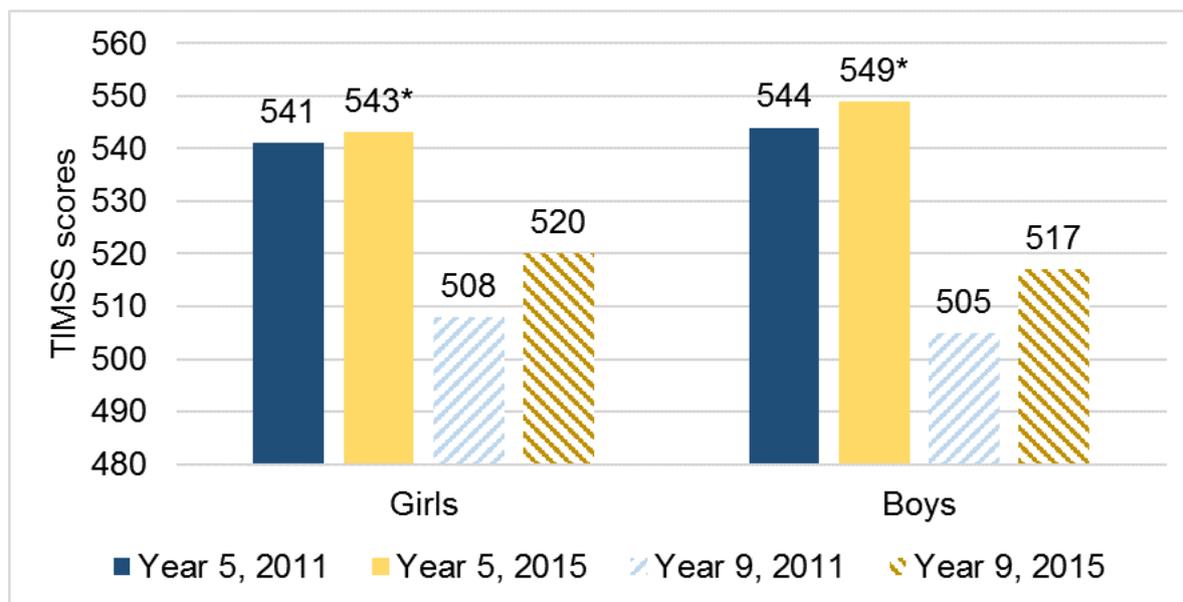
6.1.1 How does performance differ by gender in maths?

As shown in Figure 31 below, in 2015, year 5 boys in England performed significantly higher than girls in maths. This difference in performance at year 5 is in

⁵⁹ DfE (2016) National curriculum assessments at Key Stage 2 in England, 2016 (provisional)

contrast with year 6 boys' and girls' maths attainment in both the 2015 and 2016⁶⁰ national assessments, which showed no differences. The increases in achievement for both girls and boys since 2011 are, similarly to the year 5 overall score in maths, not significant. In year 9, girls in England outperformed boys, as in 2011, but not significantly so.

Figure 31: Year 5 and 9 maths average achievement by gender in 2011 and 2015 (England)



Source: TIMSS 2015.

Note 1: Asterisks denote significant differences in achievement between genders.

In relation to the four comparator groups of countries, the higher performance of year 5 boys in maths was also found in all the other English-speaking countries, although the differences were not significant in either Ireland or Northern Ireland. Performance across the other groups varied, for example year 5 boys in Hong Kong, Taiwan and South Korea performed significantly higher than girls, while in Singapore, year 5 girls performed higher than boys, but not significantly so. Year 5 boys and girls in Japan, as in Russia, performed the same.

In year 9, England was the only English-speaking country in which girls performed higher than boys in maths. Girls in Singapore performed significantly higher than boys, while Taiwan's pupils performed the same. Similarly to pupils in England, girls and boys from two of the other highest-performing countries – Japan and South Korea – performed within three scale points of one another. In the remaining two highest-performing countries, boys from both Russia and Hong Kong performed higher than girls, but only significantly so in the former.

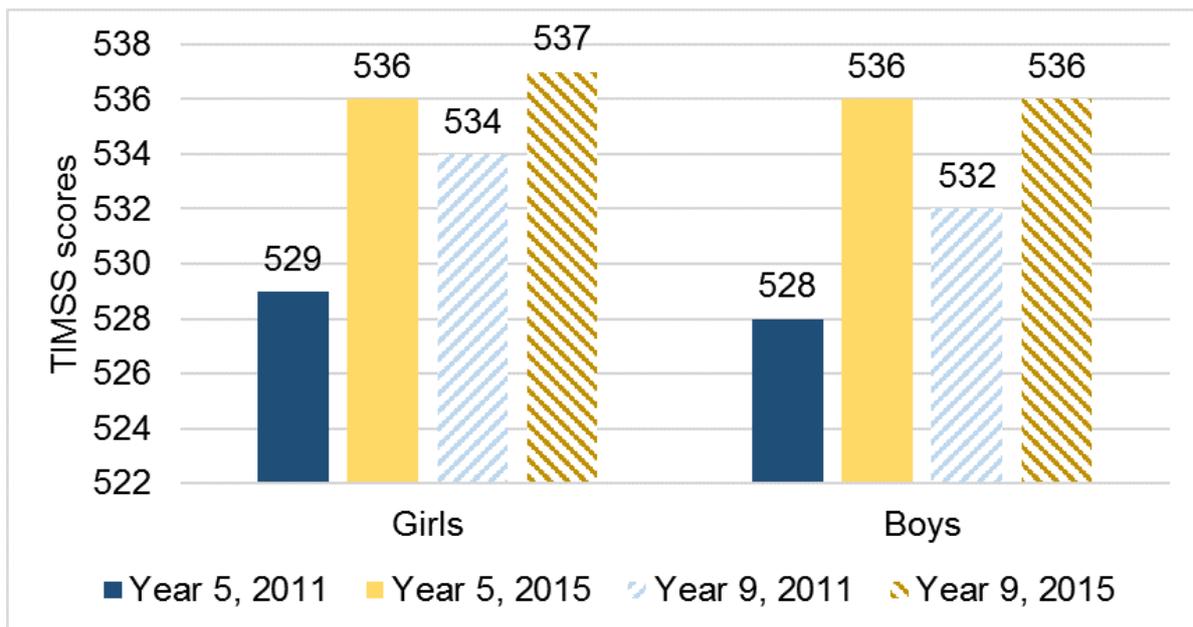
⁶⁰ Based on provisional 2016 data, 70% per cent of both boys and girls achieved the expected standard at the end of Key Stage 2.

6.1.2 Does performance differ by gender in science?

In contrast to year 5 maths, in 2015, there were no significant gender differences in the science performance of either year 5 or 9 pupils in England. The increases in boys' and girls' average achievement shown in Figure 32 below are similarly, not significant.

Across the comparator groups, as in maths, there was a range of gender differences represented. Boys in Hong Kong, Taiwan and South Korea performed significantly higher than girls in year 5 science, while this pattern was repeated in year 9 but only significantly so in the case of Hong Kong. In year 5, the Netherlands, Australia, Norway, Singapore, Russia, France and Northern Ireland joined England in having no, or minimal one per cent differences. In year 9, Japan and New Zealand joined England in having no or only one per cent differences between boys' and girls' achievement. No countries from the comparator groups had girls achieving significantly higher than boys.

Figure 32: Year 5 and 9 science average achievement by gender in 2011 and 2015 (England)



Source: TIMSS 2015.

6.2 How does TIMSS assess socio-economic status and how does this compare with Free School Meals?

In England, closing the attainment gap between disadvantaged and non-disadvantaged pupils remains a government priority in tackling social disadvantage and improving social mobility.

The national measure used to define disadvantage encompasses: eligibility for FSM in any of the previous six years; children looked after by the local authority for at least one day; or children who have been adopted from care. Thirty-two per cent of 11 year olds were classed as disadvantaged in 2015. As this measure is not something that can be applied internationally, TIMSS asks pupils how many books they have at home to provide an indication of their socio-economic status, with fewer books being associated with lower socio-economic status.

As shown in Tables 9 and 10, the TIMSS ‘books at home’ measure aligns with England’s national FSM measure to some extent. For example, while over half of year 5 pupils eligible for FSM report 25 or fewer books in the home, this is only true for one in three pupils not eligible for FSM. The measures do not, however, identify exactly the same pupils as disadvantaged: seven per cent of year 5 FSM pupils report at least 200 books in their homes. The distributions of the number of books pupils report in their homes are similar for year 5 and year 9 pupils, although a higher proportion of both FSM and non-FSM pupils in year 9 report having only 0-10 books in their homes.

Table 9: The proportion of year 5 pupils with different quantities of ‘books at home’ matched to FSM eligibility (England)

Number of books	Not eligible for FSM		Eligible for FSM	
	Percentage of pupils	(SE) ⁶¹	Percentage of pupils	(SE)
0 to10	10	(0.7)	24	(1.6)
11 to 25	23	(0.9)	28	(2.2)
26 to 100	35	(1.1)	30	(2.4)
101 to 200	18	(0.8)	11	(1.6)
More than 200	14	(0.9)	7	(1.2)

Source: TIMSS 2015 and National Pupil Database.

Note1: Standard errors are in parentheses.

Note 2: Figures are for pupils who provided a valid response for the number of books in the home.

Note 3: Percentages are based on a total of 3476 pupils (2979 non-FSM and 497 FSM).

⁶¹ A standard error is a statistical term that measures the accuracy with which a sample represents its parent population. The smaller the standard error, the more accurate a statistic is. The reverse is also true.

Table 10: The proportion of year 9 pupils with different quantities of ‘books at home’ matched to FSM eligibility (England)

Number of books	Not eligible for FSM		Eligible for FSM	
	Percentage of pupils	(SE) ⁶²	Percentage of pupils	(SE)
0 to 10	16	(1.0)	31	(3.0)
11 to 25	23	(1.0)	27	(2.8)
26 to 100	30	(0.8)	27	(2.3)
101 to 200	17	(0.8)	9	(1.3)
More than 200	15	(0.9)	6	(1.2)

Source: TIMSS 2015 and National Pupil Database.

Note 1: Standard errors are in parentheses.

Note 2: Figures are for pupils who provided a valid response for the number of books in the home.

Note 3: Percentages are based on a total of 4310 pupils (3835 non-FSM and 475 FSM).

Given the points above, some caution needs to be exercised in attributing a lack of books at home to socio-economic disadvantage as usually measured in England. However, as FSM data are not available for other countries participating in TIMSS, international comparisons are provided in the next section using the ‘books at home’ measure, alongside analysis according to FSM status.

6.2.1 Does performance in TIMSS differ by level of disadvantage?

In both maths and science, using the TIMSS ‘books at home’ measure, across the four comparator groups, there is an association in all countries between the number of books at home and average achievement: the more books pupils reported; the higher their achievement – up to the 200 books mark. However, in a relatively small number of countries, there is no association beyond this mark, with achievement for pupils who reported having more than 200 books at home being lower, on average, than for those who reported having 101-200 books at home. . This was the case for year 5 pupils in England in maths, but not science, although the lower reported maths score was not likely to be significant.

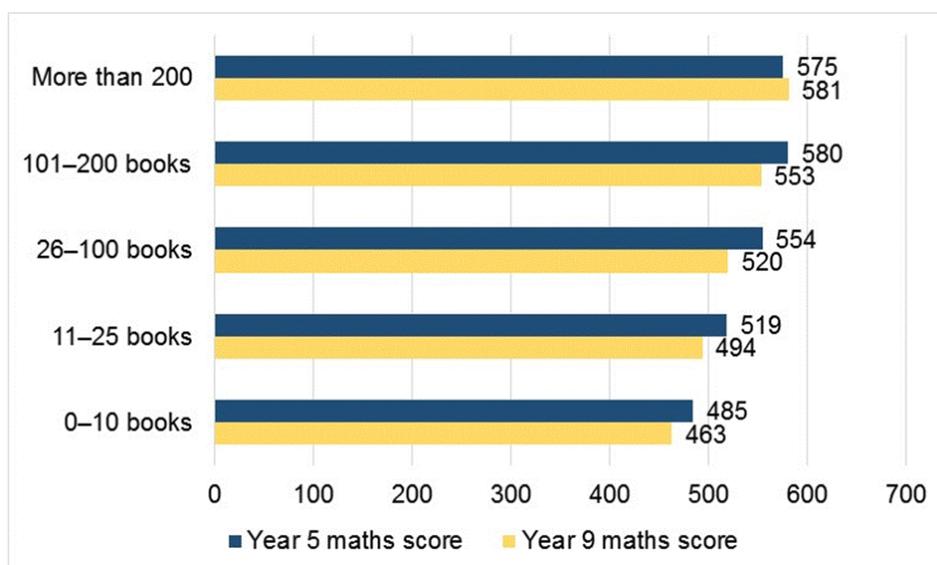
⁶² A standard error is a statistical term that measures the accuracy with which a sample represents its parent population. The smaller the standard error, the more accurate a statistic is. The reverse is also true.

As shown in Figures 33 and 34 below, there are large differences in the average maths and science achievement between year 5 and 9 pupils in England for whom there were 0-10 books at home compared to their peers for whom there were more than 200. In year 5, the differences were 90 (485 and 575) and 97 (475 and 572) scale points in maths and science respectively. In year 9, the differences were 118 and 132 scale points respectively.

At year 5, in maths, only eight (of 28 countries in the comparator groups) had larger differences and in science only four (out of 24 from these groups). Singapore and New Zealand were the only countries represented in both subjects as having larger differences than England. At year 9, in maths, only Taiwan and New Zealand had larger differences, and in science, only New Zealand (out of 15 countries in both cases). Kazakhstan’s differences were the lowest of all countries in the comparator groups: not exceeding 37 scale points across both years and subjects. This would indicate that, based on this measure, England has a relatively large gap between the average achievement of its more disadvantaged pupils compared with their non-disadvantaged peers, in both maths and science.

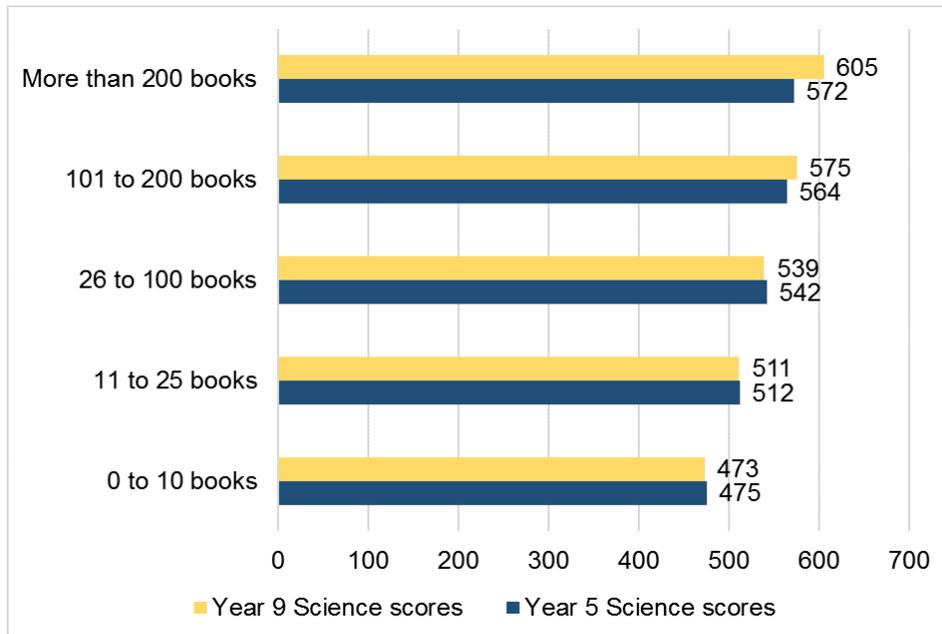
The countries that performed significantly higher than England across both subjects at year 5 but had smaller differences were Japan, Russia and Hong Kong. In year 9 maths, all of the highest-performing countries – except Taiwan – had smaller differences than in England, while in science, all five of the highest-performing countries did. Japan was the only country represented across both years and subjects, while Hong Kong and Russia were represented across all of these except year 9 science (in which both countries performed at a similar level to England).

Figure 33: Year 5 and 9 maths achievement in relation to the number of books at home, as reported by pupils (England)



Source: TIMSS 2015.

Figure 34: Year 5 and 9 science achievement in relation to the number of books at home, as reported by pupils (England)



Source: TIMSS 2015.

Nationally, in 2015, at Key Stage 4, 33.1 per cent of FSM pupils achieved five or more GCSEs at grades A*– C (including English and maths) compared to 60.9 per cent of non-FSM pupils⁶³. For disadvantaged pupils (Ever 6 FSM pupils⁶⁴ and those either looked-after for at least one day or adopted from care), the percentage point gap is similar: 36.7 per cent compared to 64.7 per cent for non-disadvantaged peers. At the end of Key Stage 2 in 2015, 66 per cent of FSM pupils achieved Level 4 or above in reading, writing and maths, compared to 83 per cent⁶⁵ of their non-FSM peers; a percentage point gap of 17. A similar gap was evident for disadvantaged pupils: 70 per cent compared to 85 per cent⁶⁶.

Turning to TIMSS 2015, as Figure 35 below shows, year 5 and 9 non-FSM pupils in England achieve higher on average in maths and science in comparison with their FSM peers. In maths, this performance gap is similar across both years 5 and 9 (41 points and 42 points on the TIMSS mean score scale respectively). In science, the gap is slightly wider (37 points and 45 points respectively). This means that year 9 FSM pupils in England performed below the international mean in both maths and science.

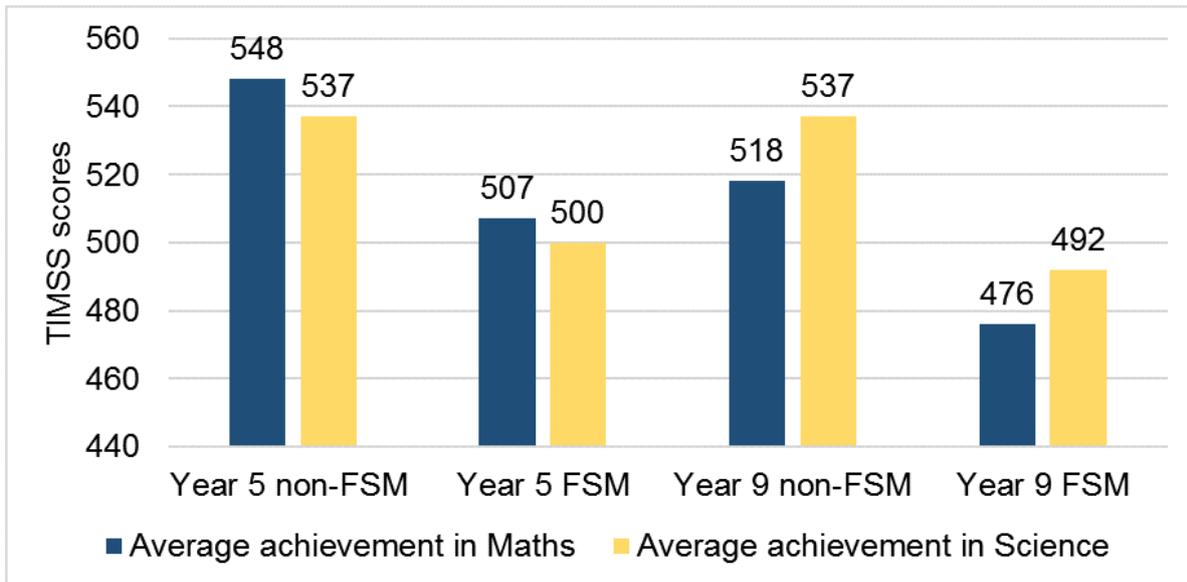
⁶³ DfE (2016) Revised GCSE and equivalent results in England, 2014-15.

⁶⁴ Pupils eligible for FSM in any of the previous 6 years, as well as those first known to be eligible at January of the current academic year.

⁶⁵ Key Stage 2 percentages are rounded to whole numbers in national assessment publications.

⁶⁶ DfE (2015) National curriculum assessments at Key Stage 2 in England, 2015 (revised).

Figure 35: The achievement gap in maths and science between FSM pupils and non-FSM pupils: years 5 and 9 (England)



Source: TIMSS 2015 and National Pupil Database

6.3 Does performance differ by ethnicity?

The relative performance of pupils from different ethnic groups remains a focus nationally, to reduce differences in achievement. Chinese pupils in England performed higher than all other groups both in terms of achieving Level 4 or above in the 2015 Key Stage 2 national assessments in reading, writing and maths combined and, at Key Stage 4, achieving five or more GCSEs at grades A*– C GCSEs (including English and maths). Black pupils overall tend to perform below the national average at both Key Stage 2 and 4 assessments. White British pupils tend to achieve around the national average in these measures.

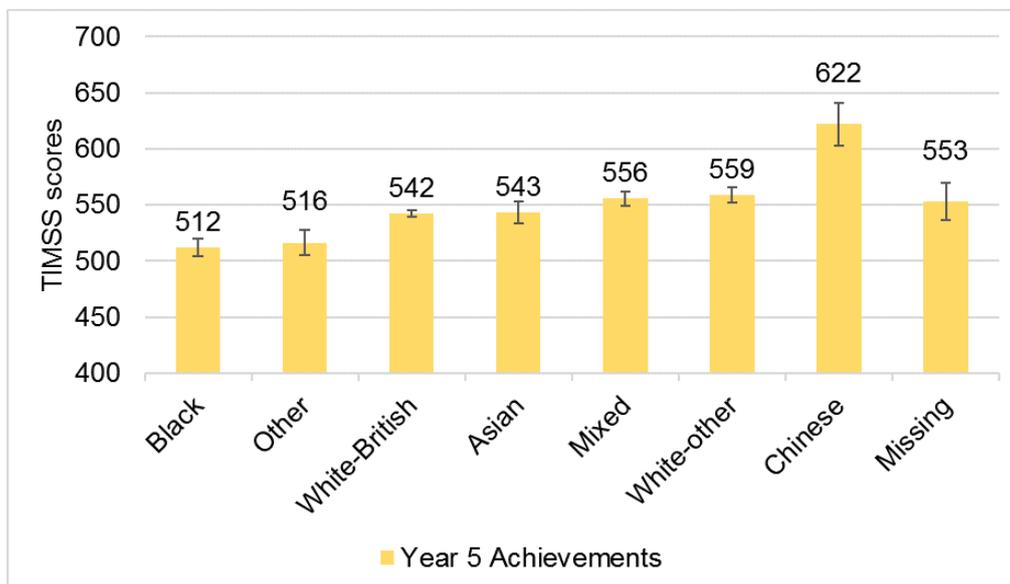
While there are no international comparisons for ethnicity, the National Pupil Database has been matched with TIMSS achievement data to provide comparisons between the achievement of ethnic groups in England. The five groups are those used by the Department for Education in its statistical releases. It should be noted that some sub-groups within these broader headings may, on average, achieve higher than others. For example, Indian pupils in England are included as a sub-group of the Asian group reported below, but performed only one per cent point below the Chinese group in 2015 Key Stage 2 assessments. Caution needs to be

exercised in drawing conclusions as sample sizes concerned are very small in some cases with very high levels of standard error⁶⁷.

Maths

Chinese pupils in England have the highest average achievement in both years 5 and 9 (see Figures 36 and 37 below), although the sample sizes are small with high s. In year 5, their average achievement is above the highest-performing country, Singapore (622 compared to 618). In both years 5 and 9 White-other, Asian and Mixed groups have higher average achievement than the White British, Other and Black groups. Pupils' average achievement in year 5 is higher for each group than in year 9 and all groups, on average, achieve above the international mean (500).

Figure 36: Year 5 pupils' average achievement in maths according to their ethnicity (England)



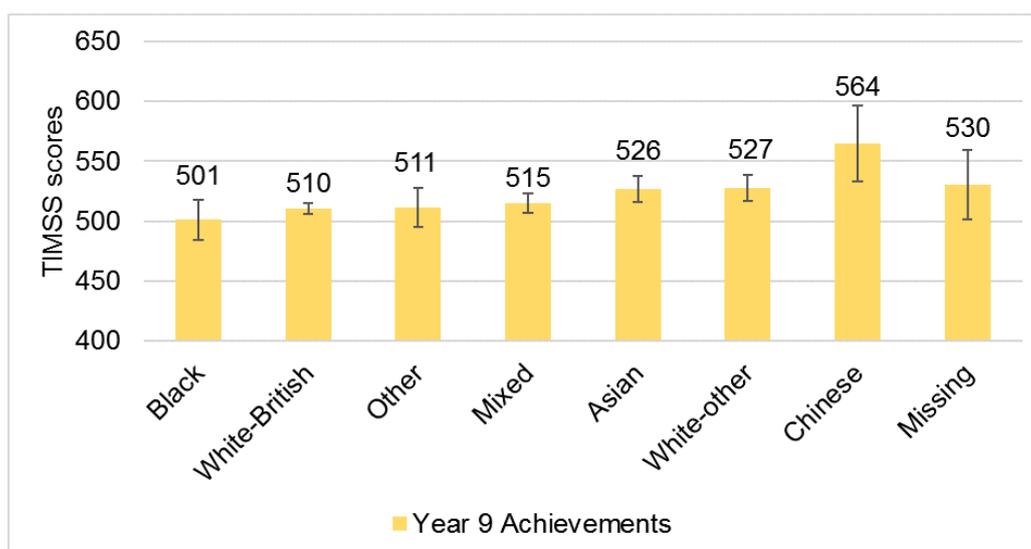
Source: TIMSS 2015 and National Pupil Database.

Note 1: Standard error sizes are shown for each bar. The smaller the standard error, the more accurate a statistic is.

Note 2: The standard error size for the Chinese group is large.

⁶⁷ A standard error is a statistical term that measures the accuracy with which a sample represents its parent population. The smaller the standard error, the more accurate a statistic is. The reverse is also true.

Figure 37: Year 9 pupils' average achievement in maths according to their ethnicity (England)



Source: TIMSS 2015 and National Pupil Database.

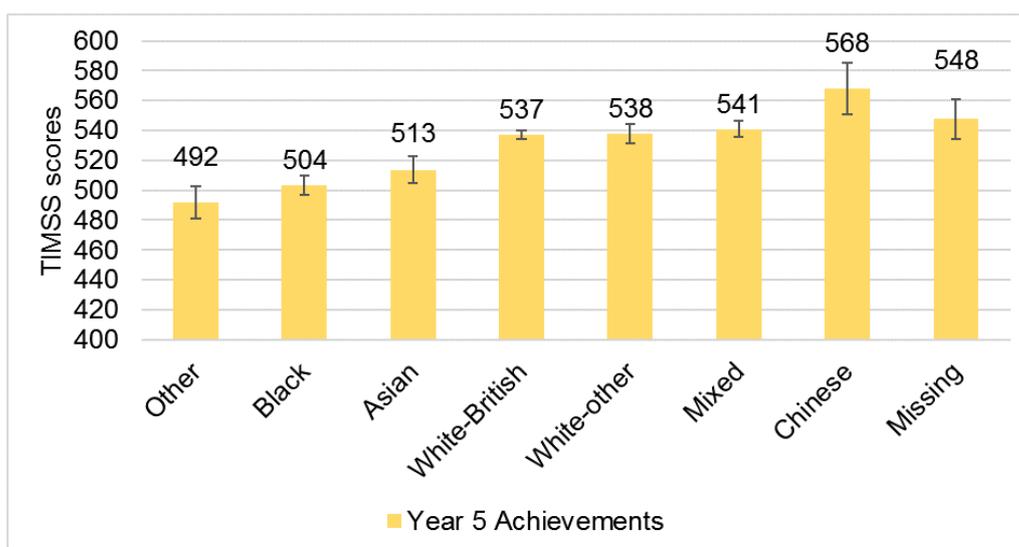
Note 1: Standard error sizes are shown for each bar. The smaller the standard error, the more accurate a statistic is.

Note 2: The standard error size for the Chinese group is large.

Science

As shown in Figures 38 and 39, Chinese pupils in England, as in maths, have the highest average science achievement in both years 5 and 9 (although bear in mind the very high level of standard error). Their average achievement is comparable to pupils in the highest-performing group of countries for both year 5 and 9 science. In contrast to maths, White British pupils' achievement is higher, on average, than their Asian peers, while those from the Black and Other groups achieve below Asian pupils, on average. All pupil groups (except the Other group in year 5) performed, on average, above the international mean (500).

Figure 38: Year 5 pupils' average achievement in science according to their ethnicity (England)



Source: TIMSS 2015 and National Pupil Database.

Note 1: Standard error sizes are shown for each bar. The smaller the standard error, the more accurate a statistic is.

Note 2: The standard error size for the Chinese group is large.

Figure 39: Year 9 pupils' average achievement in science according to their ethnicity (England)

Source: TIMSS 2015 and National Pupil Database.

Note 1: Standard error sizes are shown for each bar. The smaller the standard error, the more accurate a statistic is.

Note 2: The standard error size for the Chinese group is large.

6.4 Does performance in maths and science differ by first language?

All pupils in England took the TIMSS assessments in the English language, as is the case for national assessments and exams. Nationally, it is known that the performance of pupils with English as an additional language (EAL) varies considerably. Pupils perform worse, on average, if English is not the language usually spoken at home. Ethnicity and first language, as well as length of residency in the United Kingdom, are important factors affecting the educational attainment of EAL students.

In England, the achievement gap between EAL pupils and those for whom it is their first language remains evident both at Key Stages 2 and 4. In 2015, at Key Stage 4, 54.6 per cent of EAL pupils achieved five or more GCSEs at grades A* – C (including English and maths), compared to 57.5 per cent of non-EAL pupils⁶⁸. At the end of Key Stage 2 in 2015, 77 per cent of EAL pupils achieved Level 4 or above in reading, writing and maths, compared to 81 per cent of non-EAL pupils⁶⁹. Across both Key Stages therefore, the gap is around three to four percentage points.

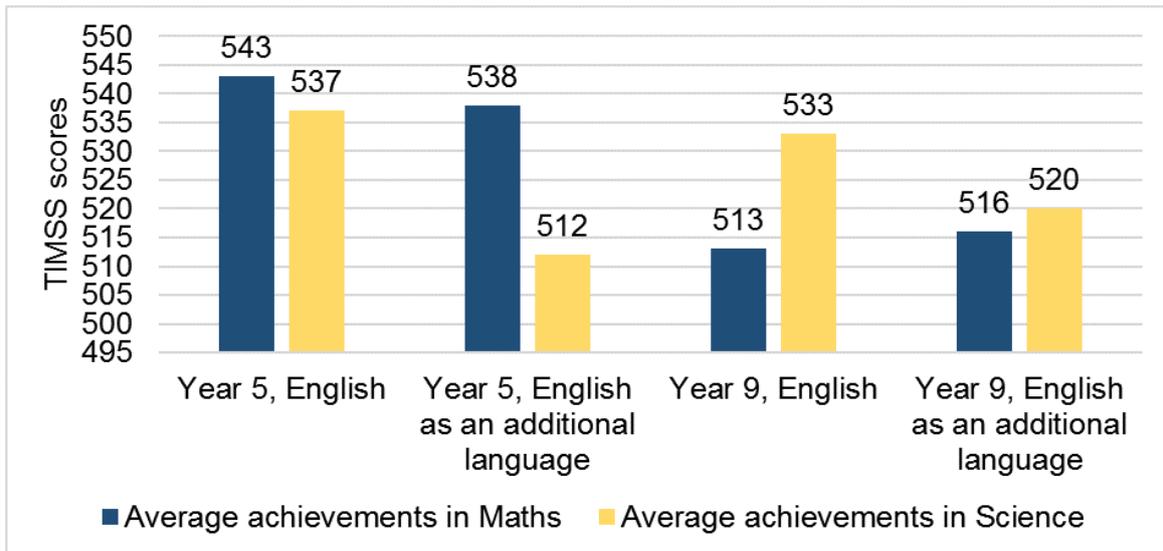
In this section, analyses are presented of how the achievements of these two groups of pupils compared in TIMSS. In England, 20 per cent of year 5 pupils and 13 per cent of year 9 pupils had EAL.

As shown in Figure 40 below, there are gaps between pupils in England who have English as a first language and their EAL peers in maths, but these are not as large as the gaps in science. There is a 25 point gap between the average achievement of year 5 pupils in science, and a 13 point gap in year 9.

⁶⁸ DfE (2016) Revised GCSE and equivalent results in England, 2014-15.

⁶⁹ DfE (2015) National curriculum assessments at Key Stage 2 in England, 2015 (revised).

Figure 40: Average achievement in maths and science for year 5 and 9 pupils who have English as their first or an additional language (England)



Source: TIMSS 2015 and National Pupil Database.

Year 9 EAL pupils in England scored three points higher than their English-speaking peers in maths. This gap can be investigated further using pupils' responses to the question from the TIMSS pupil questionnaire: 'How often do you speak English (or other language depending on the country) at home?'⁷⁰ This shows that in maths, on average, the 85 per cent of year 9 pupils in England who 'always' spoke English at home had lower average achievement than the nine per cent of pupils who 'almost always' spoke English at home (517 compared to 536). However, they had higher average achievement than the four per cent of pupils who 'sometimes' spoke English at home (517 compared to 514).

Pupils in the other English-speaking countries who almost always spoke the language of the assessments at home tended, on average, to perform better in maths than those who did not (six of the seven countries in year 5 and three of the six in year 9). The higher maths performance of year 9 EAL pupils in England is similar to that of year 9 pupils in Australia and Canada, where, on average, those who always spoke English at home had lower average achievement in maths than both those who 'almost always' and 'sometimes' spoke English at home (Australia: 504 compared to 514 and 516 respectively and Canada: 524 compared to 536 and 534 respectively).

⁷⁰ The TIMSS pupil questionnaire asked pupils to state whether they always, almost always, sometimes or never spoke the language of the test at home. A response of almost always, sometimes or never indicates the language of the test is not their native language.

6.6 What does TIMSS tell us about the characteristics of pupils reaching the Advanced and High international benchmarks in England?

6.6.1 What do we know about the characteristics of pupils performing at the Advanced TIMSS benchmark in 2015?

As shown in Tables 11 and 12 below, three-times as many non-FSM pupils achieved the Advanced benchmark compared to their FSM peers in science across both year groups, and in year 5 maths. In year 9 maths, non-FSM pupils were four-times more likely to achieve this benchmark.

More boys achieved the Advanced benchmark in year 5 maths than girls, but otherwise there were minimal or no gender differences. This would accord with the provisional year 6 national assessment data which shows 18 per cent of boys compared to 15 per cent of girls achieving a higher score/working at greater depth standard in the 2016 Key Stage 2 assessments⁷¹. While there was little difference between the proportion of EAL pupils reaching the benchmark compared to their non-EAL peers in maths, more non-EAL pupils reached the benchmark in science.

In both maths and science and across years 5 and 9, a higher proportion of Chinese pupils in England reached the Advanced benchmark than pupils in other ethnic groups (although bear in mind the very high level of standard error⁷²). White-other and Mixed groupings performed higher than White British pupils in both year groups and subjects. Overall, Black pupils were least represented in groups reaching the Advanced benchmark.

⁷¹ DfE (2016) National curriculum assessments at Key Stage 2 in England, 2016 (provisional). Note the TIMSS 2015 cohort of year 5 pupils formed part of national set of year 6 pupils that took end of Key Stage 2 assessments in 2016.

⁷² A standard error is a statistical term that measures the accuracy with which a sample represents its parent population. The smaller the standard error, the more accurate a statistic is. The reverse is also true.

Table 11: Characteristics of year 5 and 9 pupils achieving the Advanced benchmark in maths (England)

Group		Year 5		Year 9	
		Percentage of pupils	(SE)	Percentage of pupils	(SE)
Gender	Female	14	(1.4)	7	(1.4)
	Male	17	(1.3)	7	(1.2)
FSM	Not eligible	17	(1.3)	8	(1.0)
	Eligible	6	(1.2)	2	(0.8)
Ethnic Group	White-British	15	(1.3)	7	(1.0)
	White-other	21	(3.4)	12	(4.5)
	Mixed	18	(4.1)	10	(3.4)
	Asian	20	(3.9)	7	(2.0)
	Black	7	(2.3)	5	(2.7)
	Chinese	50	(15.8)	22	(14.1)
	Other	7	(4.3)	8	(5.0)
	missing	18	(9.9)	18	(11.2)
Language group	English	15	(1.1)	7	(1.0)
	Other	16	(2.5)	6	(1.4)

Source: TIMSS 2015 and National Pupil Database.

Note 1: Percentages have been rounded.

Table 12: Characteristics of year 5 and 9 pupils achieving the Advanced benchmark in science (England)

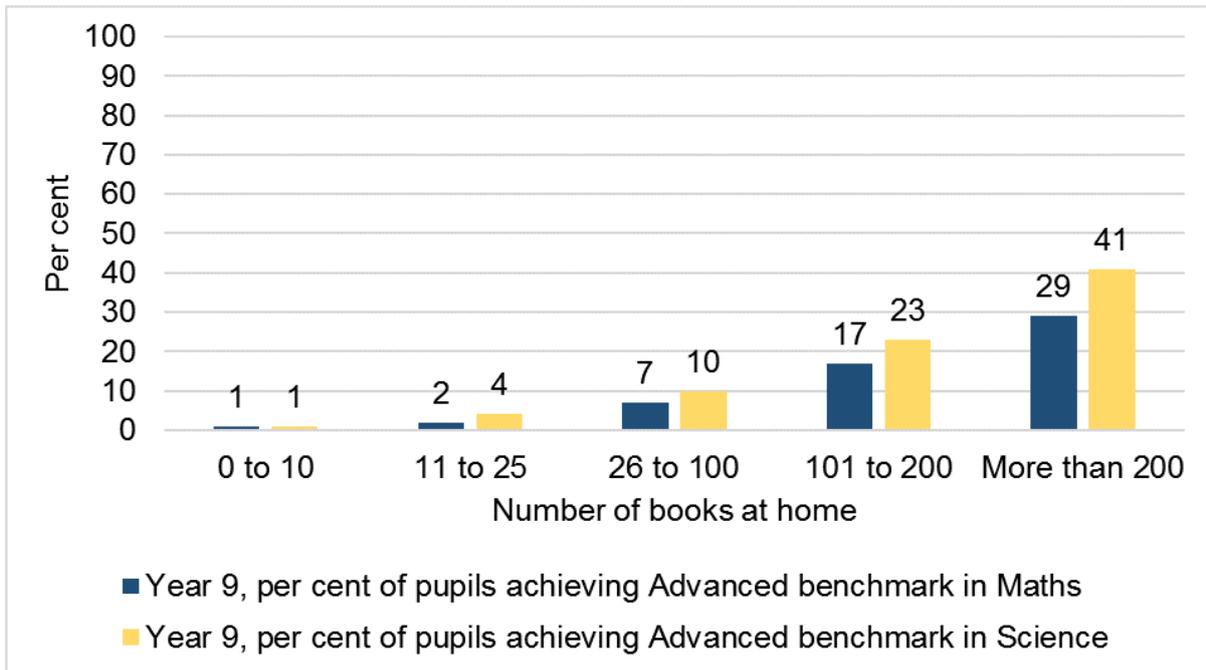
Group		Year 5		Year 9	
		Percentage of pupils	(SE)	Percentage of pupils	(SE)
Gender	Female	9	(1.0)	11	(1.6)
	Male	8	(1.0)	11	(1.4)
FSM	Not eligible	9	(0.9)	12	(1.3)
	Eligible	3	(1.1)	4	(1.2)
Ethnic Group	White-British	9	(0.9)	11	(1.3)
	White-other	10	(2.6)	16	(4.4)
	Mixed	10	(3.0)	12	(3.2)
	Asian	7	(1.9)	9	(2.5)
	Black	3	(1.3)	5	(2.6)
	Chinese	15	(9.9)	37	(19.5)
	Other	3	(2.5)	11	(5.3)
	Missing	10	(8.2)	18	(9.9)
Language group	English	9	(0.9)	12	(1.3)
	Other	6	(1.3)	7	(1.6)

Source: TIMSS 2015 and National Pupil Database.

Note 1: Percentages have been rounded

Using the TIMSS 'books at home' measure, the findings support the FSM/non-FSM findings identified above on the impact of socio-economic disadvantage on reaching the Advanced benchmark. As shown in Figure 41 below, only one per cent of pupils in England with 0-10 books at home achieved the maths and science Advanced benchmarks in 2015, compared with 29 and 41 per cent respectively of peers with 200 or more books.

Figure 41: Percentage of year 9 pupils achieving the Advanced benchmark in maths and science in relation to the number of books at home reported by pupils (England)



Source: TIMSS 2015.

6.7.2 What do we know about the characteristics of pupils performing at the High TIMSS benchmark in 2015?

As shown in Tables 13 and 14 below, at least twice as many non-FSM pupils achieved the High benchmark than their FSM peers in science across both year groups, and in year 9 maths. In year 5 maths, the difference was less (50% compared to 30%). These gaps are not as wide as for the Advanced benchmark.

More year 5 boys achieved the High benchmark than girls in maths⁷³, while the reverse was the case in year 9, and there were minimal gender differences in science. More non-EAL year 5 pupils achieved the High benchmark in maths, while the reverse was the case in year 9. More non-EAL pupils reached the benchmark in science, with the differences being higher than for maths. These results might indicate that while language becomes less of a barrier in maths as pupils reach the secondary years, it retains this status more in science.

As was the case for the Advanced benchmark, in both maths and science and across year 5 and 9, a higher proportion of Chinese pupils in England reached the High benchmark than pupils in other ethnic groups (although bear in mind the very high level of standard error). White-other and Mixed groupings performed higher

⁷³ See the analysis of the Advanced benchmark regarding this finding according with end of Key Stage 2 national assessments in 2016.

than White British pupils in both years 5 and 9 in maths, and in year 5 science, as in the Advanced benchmark. However, in year 9, White British pupils performed higher in science than peers from the Mixed group and the same as those from the Asian group. As with the Advanced benchmark findings, overall, Black pupils were least represented in groups reaching the High benchmark.

Table 13: Characteristics of year 5 and 9 pupils achieving the High benchmark in maths (England)

Group		Year 5		Year 9	
		Percentage of pupils	(SE)	Percentage of pupils	(SE)
Gender	Female	46	(2.0)	34	(2.6)
	Male	49	(1.6)	32	(2.1)
FSM	Not eligible	50	(1.5)	36	(2.2)
	Eligible	30	(2.6)	15	(2.2)
Ethnic Group	White-British	48	(1.4)	32	(2.2)
	White-other	54	(5.7)	37	(4.5)
	Mixed	53	(6.2)	33	(4.5)
	Asian	47	(3.4)	42	(7.3)
	Black	32	(3.6)	29	(7.1)
	Chinese	80	(15.1)	70	(16.8)
	Other	33	(7.8)	38	(6.5)
	missing	59	(11.3)	40	(5.0)
Language group	English	48	(1.4)	33	(2.1)
	Other	44	(2.7)	35	(4.8)

Source: TIMSS 2015 and National Pupil Database.

Note 1: Percentages have been rounded

Table 14: Characteristics of year 5 and 9 pupils achieving the High benchmark in science (England)

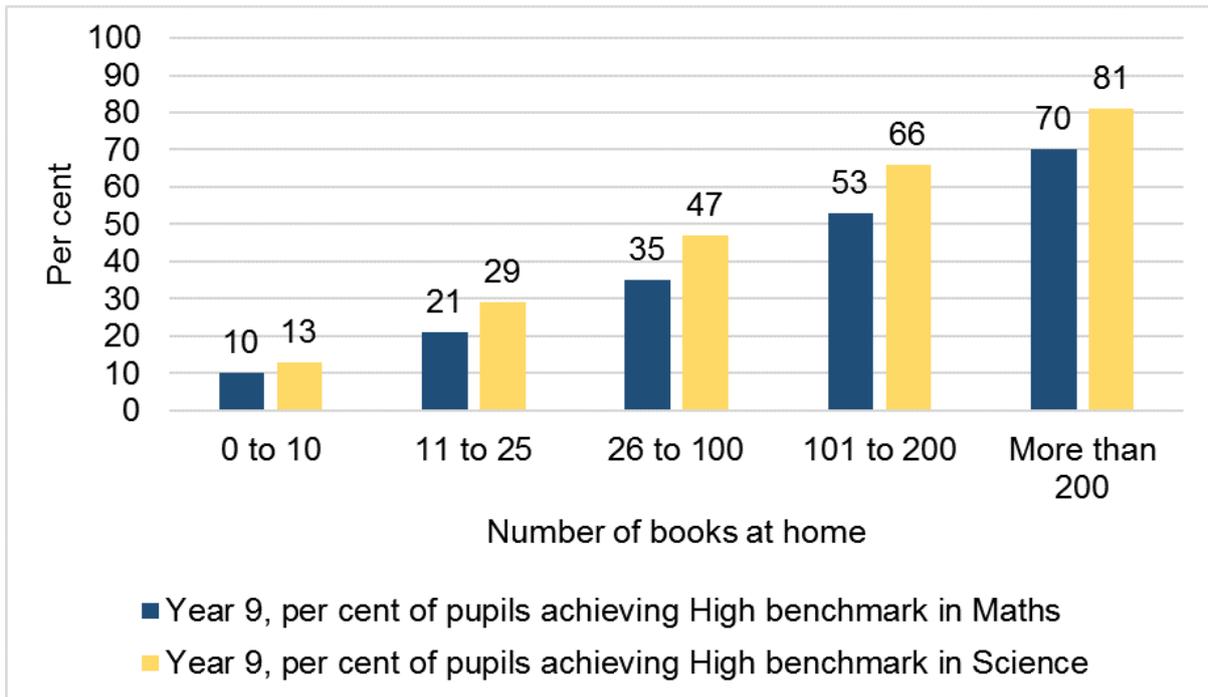
Group		Year 5		Year 9	
		Percentage of pupils	(SE)	Percentage of pupils	(SE)
Gender	Female	41	(1.8)	43	(2.1)
	Male	40	(1.7)	42	(1.9)
FSM	Not eligible	44	(1.5)	46	(1.6)
	Eligible	22	(2.1)	21	(2.6)
Ethnic Group	White-British	43	(1.7)	43	(1.8)
	White-other	44	(4.4)	46	(5.5)
	Mixed	45	(5.1)	41	(4.8)
	Asian	32	(3.7)	43	(5.1)
	Black	24	(3.5)	34	(7.1)
	Chinese	58	(14.4)	70	(19.6)
	Other	20	(5.3)	37	(7.7)
	missing	55	(13.8)	52	(7.7)
Language group	English	43	(1.5)	44	(1.7)
	Other	31	(2.6)	37	(3.6)

Source: TIMSS 2015 and National Pupil Database.

Note 1: Percentages have been rounded

Using the TIMSS 'books at home' measure supports the previous findings using FSM on the impact of socio-economic disadvantage on reaching the High benchmark. Figure 42 shows gaps of 60 per cent points in maths (10% compared to 70%) and 68 per cent points in science in the proportion of year 9 pupils with 0-10 books at home reaching the High benchmark compared to those with more than 200.

Figure 42: Percentage of year 9 pupils achieving the High benchmark in maths and science in relation to the number of books at home (England)



Source: TIMSS 2015.

Chapter 7. Pupil engagement and confidence in maths and science

This chapter uses responses from the pupil questionnaires to set out the extent to which pupils in England say they find maths and science lessons engaging; that they are confident in their ability in these subjects; and whether or not they value⁷⁴ and like learning these subjects. It compares the attitudes of pupils in England to those of their peers in other countries.

The chapter also describes whether or not these attitudinal factors are associated with higher or lower performance in the TIMSS assessments, although it is important to note that an association (or correlation) between two variables (such as level of engagement and average achievement) is not the same as causation (i.e. that one thing causes the other).

⁷⁴ Year 9 only.

7.1 Main Findings

Maths

- **Almost all (97%) year 5 pupils and 80 per cent of year 9 pupils in England reported that maths teaching was either engaging or very engaging. The proportion of year 9 pupils that found maths to be very engaging in England was about half the year 5 proportion: this pattern is also found in other countries.**
- **More year 5 and 9 pupils in England viewed teaching as being very engaging than their peers in the five countries that were highest-performing at year 5 and year 9: Singapore, Hong Kong, South Korea, Taiwan and Japan.**
- **In year 5, 80 per cent of pupils in England were either very confident or confident in maths; whereas 65 per cent reported they were in year 9. In both years 5 and 9, none of the highest-performing group of countries (including the five from East Asia) had larger proportions of very confident pupils than England.**
- **Forty-six per cent of year 9 pupils in England pupils strongly valued maths: more than their peers in the five highest-performing countries.**
- **Half (50%) of year 5 pupils in England very much liked learning maths compared to only 14 per cent of year 9s. In both years 5 and 9, three of the highest-performing countries – Japan, Taiwan and South Korea – had smaller proportions of pupils who liked learning maths than in England.**
- **In both years 5 and 9 in England, and across all countries, on average, there is an association between all attitudinal factors and average achievement. For example, the more pupils feel confident in their maths ability; the higher their average achievement.**

Science

- **Ninety-four per cent of year 5 pupils in England viewed teaching in science to be either engaging or very engaging, compared to 80 per cent of year 9 pupils. Almost double the number of year 5 pupils (70%) viewed science to be very engaging compared to year 9 pupils (38%). This difference is similar to that found in other countries, for example, Norway (72% compared to 35%).**
- **As with maths, more year 5 and 9 pupils in England viewed teaching as very engaging compared to their peers in the East Asian group (Singapore, Hong Kong, South Korea, Taiwan and Japan).**
- **Three quarters of year 5 pupils and three-fifths (62%) of year 9 pupils in England were either very confident or confident in science. In years 5 and 9, fewer pupils from the highest-performing countries were very confident in their science abilities compared to their peers in England.**
- **Thirty-nine per cent of year 9 pupils in England strongly valued science, while 46 per cent strongly valued maths. However, they valued science more than their peers in the six top-performing countries.**
- **Eighty-three per cent of year 5 pupils and 75 per cent of year 9 pupils in England either liked or very much liked learning science. In year 9, all five of the highest-performing countries, except Singapore, had smaller proportions of pupils that very much liked learning science than England.**
- **In both years 5 and 9 in England, there is an association between all attitudinal factors and average achievement, as is also the case across all other countries, on average. For example, the more pupils like learning science, the higher their average achievement. However, there was an exception in year 5 science with respect to the extent to which pupils found teaching engaging, where no such association was found; this was also found in some other comparator group countries.**

Overall

- **Average pupil achievement varies most widely in relation to confidence in the subject and, to a lesser extent, liking the subject. This suggests that these factors may have a greater impact on pupil outcomes than either engaging teaching or valuing the subject. This is true for England and internationally.**

7.2 To what extent do pupils in England view teaching as engaging in their maths and science lessons?

In both maths and science, there is an association between the extent to which pupils in England find their teaching engaging and average achievement in both subjects and across both year groups, except in one instance (year 5 science, where no association was identified). Generally, the more engaging pupils found teaching, the higher their average achievement.

Pupils' views on the extent to which the teaching they receive in maths and science is engaging was assessed through a questionnaire comprising 10 statements (see Figure 43 below). This was the same for both subjects but with question six adjusted according to the subject. Based on their degree of agreement with these statements, pupils were assigned to one of three categories: very engaging; engaging and less than engaging⁷⁵.

Figure 43: TIMSS questionnaire assessing pupils' views on how engaging the teaching they receive is (maths version)

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

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
1) I know what my teacher expects me to do -----	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) My teacher is easy to understand -----	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) I am interested in what my teacher says -----	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) My teacher gives me interesting things to do -----	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) My teacher has clear answers to my questions ----	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) My teacher is good at explaining mathematics ----	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) My teacher lets me show what I have learned-----	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) My teacher does a variety of things to help us learn -----	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9) My teacher tells me how to do better when I make a mistake -----	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10) My teacher listens to what I have to say -----	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Very Engaging Teaching 9.0 Engaging Teaching 7.0 Less than Engaging Teaching

Source: TIMSS 2015.

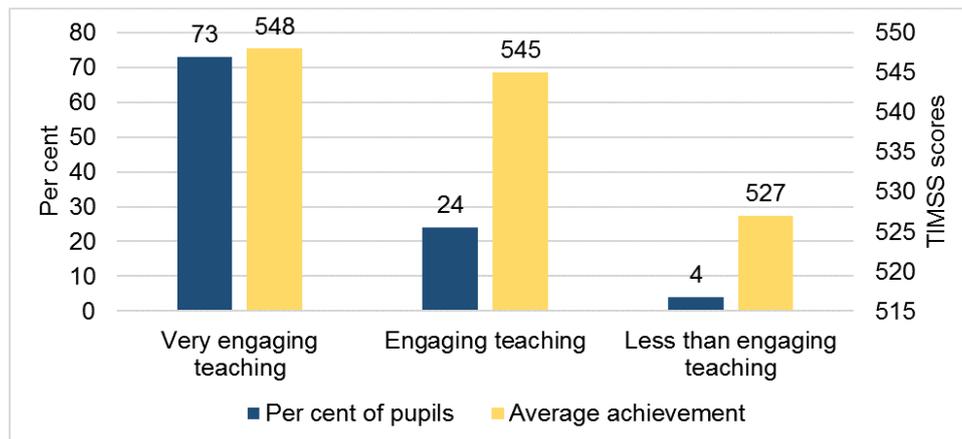
⁷⁵ See [Appendix E Tables E1 and E2](#) for an explanation of how categories were determined from questionnaire responses.

7.2.1 To what extent do pupils in England view teaching as engaging in their maths lessons?

As shown in Figure 44 below, 97 per cent of year 5 pupils in England viewed teaching to be either engaging or very engaging in maths. The proportion of pupils perceiving it to be very engaging (73%) was above the international mean (68%).

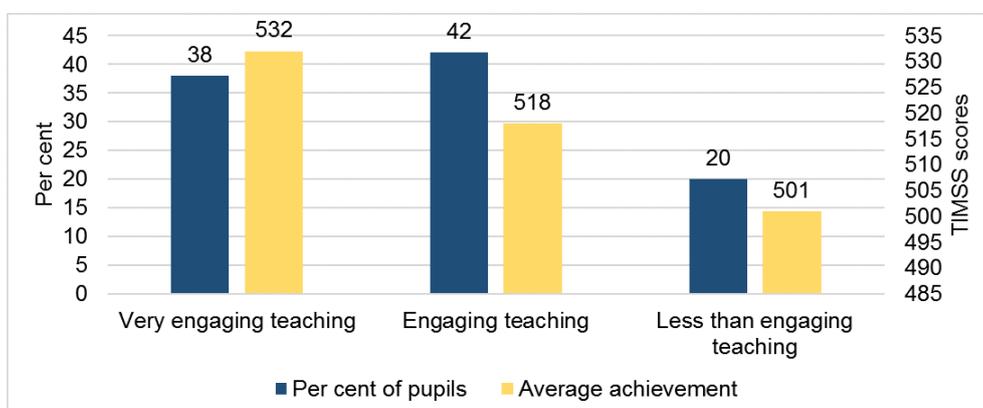
The proportion of year 9 pupils in England that found maths to be very engaging was 38 per cent, as shown in Figure 45, below the international mean (43%). This proportion was also about half of that of their year 5 peers (73%). This relative difference in proportions can also be found in other countries, such as Ireland, New Zealand and Norway (for example, 35% compared to 72% in Norway). In both years 5 and 9 in England and, on average, across all countries, there is an association between higher levels of teaching perceived (by pupils) to be engaging in maths and higher average achievement.

Figure 44: The extent to which year 5 pupils viewed their teaching in maths to be engaging in 2015, by percentage and average achievement (England)



Source: TIMSS 2015.

Figure 45: The extent to which year 9 pupils viewed their teaching in maths to be engaging in 2015, by percentage and average achievement (England)



Source: TIMSS 2015.

Greater proportions of year 5 and 9 pupils in England viewed teaching to be very engaging than their peers in the five countries that were highest-performing at year 5 and year 9: Singapore, Hong Kong, South Korea, Taiwan and Japan. The proportions of pupils in these countries who viewed teaching in maths to be very engaging were five of the lowest 10 across all countries.

The only year 5 pupils from English-speaking countries who viewed more of their teaching to be very engaging than pupils in England were from Northern Ireland and Ireland. In year 9 only pupils in Canada and the United States viewed their teaching to be more engaging than peers in England⁷⁶.

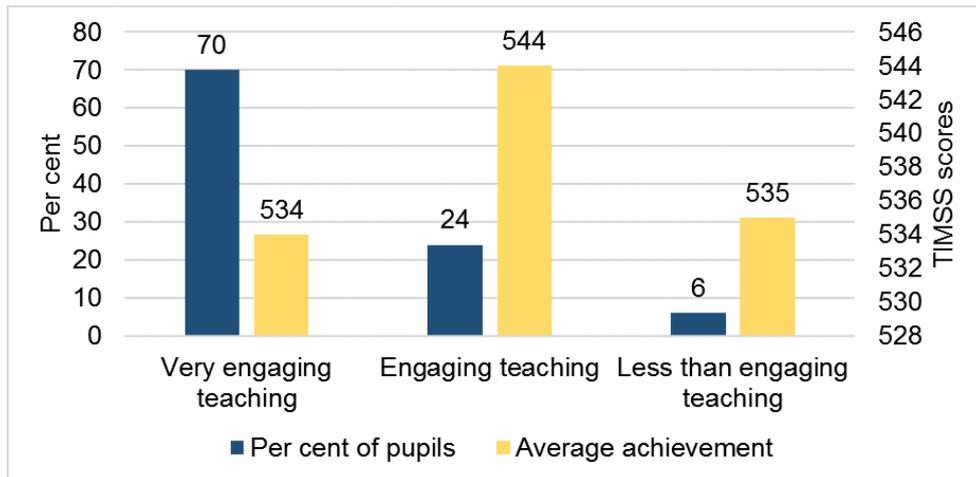
7.2.2 To what extent do pupils in England view teaching as engaging in their science lessons?

Ninety-four per cent of year 5 pupils in England viewed teaching in science to be either engaging or very engaging (see Figure 46). The proportion perceiving it to be very engaging is similar to the international mean (70% compared to 69%). Similarly, 80 per cent of year 9 pupils viewed science teaching to be either engaging or very engaging. The proportion of year 9 pupils in England that found science to be very engaging was below the international mean (38% compared to 47%). As in maths, it was also about half of the year 5 proportion (38% compared to 70%). Norway had a similar difference between the relative proportions of year 5 and 9 pupils that found science teaching to be very engaging.

In England, there is an association between how engaging year 9 pupils perceive their science teaching to be and average achievement; in year 5 there is no such association. Year 5 pupils in England who viewed teaching as very engaging did not perform better than those who viewed teaching as engaging; this was also evident in some other countries from the comparator groups: New Zealand, Poland and Australia.

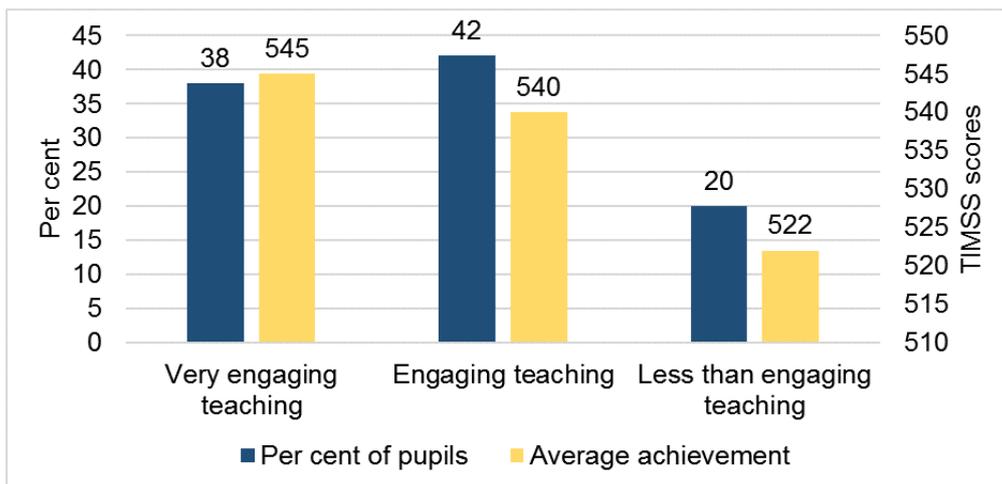
⁷⁶ Ireland participated in the year 9 maths study but Northern Ireland did not.

Figure 46: The extent to which year 5 pupils viewed their teaching in science to be engaging in 2015, by percentage and average achievement (England)



Source: TIMSS 2015.

Figure 47: The extent to which year 9 pupils viewed their teaching in science to be engaging in 2015, by percentage and average achievement (England)



Source: TIMSS 2015.

As with maths, a greater proportion of year 5 and 9 pupils in England viewed teaching in science as very engaging compared to their peers in the East Asian group (Singapore, Hong Kong, South Korea, Taiwan and Japan). These five countries (alongside Denmark in year 5 and Norway in year 9) had the smallest proportions across all participating countries of pupils who viewed teaching in science to be very engaging.

In both years 5 and 9, a greater proportion of pupils from most of the English-speaking countries viewed their teaching as very engaging compared to their peers in England. In year 5, a greater proportion of pupils in the United States, Northern Ireland, Canada and Ireland viewed their teaching as very engaging, than in

England, while a greater proportion of pupils in England viewed their teaching to very engaging in comparison with the other two English-speaking countries, Australia and New Zealand. In year 9, a greater proportion of pupils from all of the aforementioned countries viewed their teaching to be very engaging than their peers in England, with the exception of Northern Ireland which did not participate in 2015.

Although across all countries, average achievement increased in line with higher levels of teaching perceived to be engaging; as with year 5 pupils in England, this was not consistently the case. For example, in both Northern Ireland and Ireland, pupils who viewed their teaching to be engaging rather than very engaging performed marginally higher, while those from Sweden had a difference of 11 scale points between these categories, similar to England's 10 scale points. For data from all participating countries, please see the TIMSS International Report 2015⁷⁷.

7.3 To what extent are pupils in England confident about their maths and science abilities?

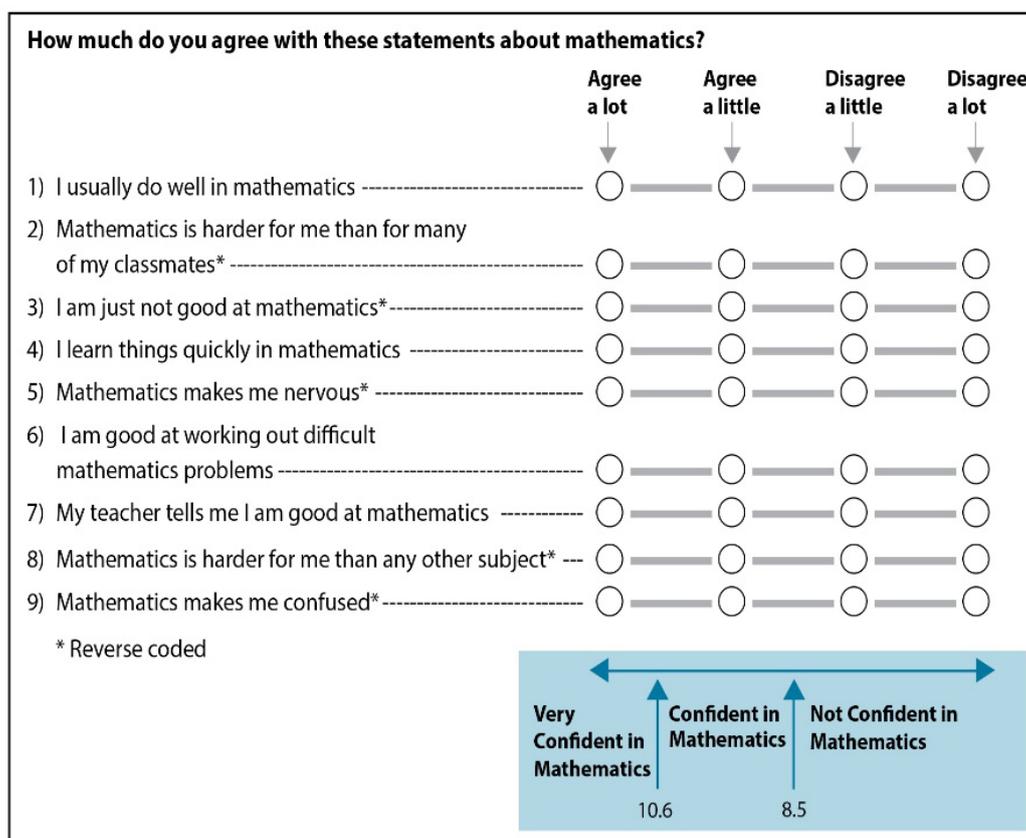
Greater levels of pupil confidence in their abilities in maths and science were associated with higher average achievement. In both maths and science, the difference in average achievement between very confident and not confident pupils in England was greater for year 9 pupils than their year 5 peers. Both these findings are mirrored in the 2011 study findings for England and, on average, across all countries participating in TIMSS.

Year 5 and 9 pupils' confidence in maths was assessed through a questionnaire comprising nine statements relating to maths (see Figure 48 below). In science, at year 5, the same statements were used with the subject name changed, but with the exclusion of statements 5 and 6 (seven statements used in total). In year 9 science, only statement 5 was excluded (eight statements in total). There were minor variations in how some questions were phrased for year 5 pupils compared to year 9 pupils, for example in year 5 the statement 'I am just not good at mathematics' was replaced with 'mathematics is not one of my strengths' in year 9.

In 2011, the category descriptors were different (confident, somewhat confident and not confident) as were some statements to which pupils responded. However, as the IEA has compared scale scores between 2011 and 2015, these comparisons are shown in Figures 49 and 50 below.

⁷⁷ <http://timssandpirls.bc.edu/timss2015/international-results/>

Figure 48: TIMSS questionnaire assessing how confident pupils are in a subject (maths year 5 version)



Source: TIMSS 2015.

Based on how much they agreed with these statements, pupils were given a scale score and included within one of three categories: very confident, confident or not confident⁷⁸. The average achievement in the assessments of pupils in each of these categories was then calculated so that any association between confidence and achievement could be identified.

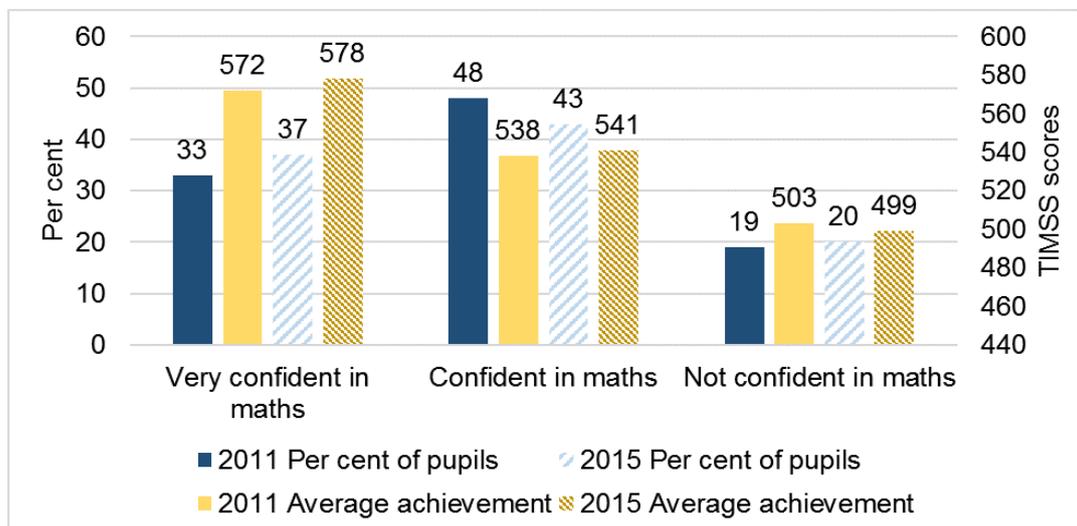
7.3.1 To what extent are pupils in England confident about their maths abilities?

The association between confidence in mathematical ability and average achievement, as shown in Figures 49 and 50 below, is also represented in the 2011 findings. In 2015, very confident year 5 pupils in England scored 79 scale points higher, on average, than their not confident peers. In year 9, this difference was even greater at nearly 100 scale points. However, in comparison with year 9 in 2011,

⁷⁸ See [Appendix E Tables E3 and E4](#) for an explanation of how categories were determined from questionnaire responses.

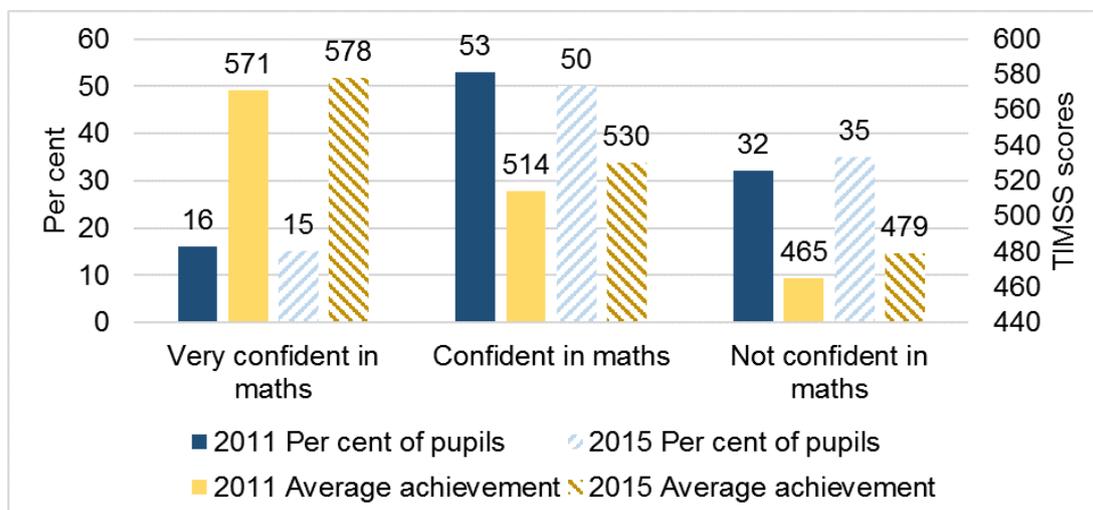
although the number of not confident pupils is slightly higher, their average achievement was 14 points higher in 2015 (479 compared to 465).

Figure 49: The extent to which year 5 pupils were confident in their maths ability in 2015, by percentage and average achievement, compared to 2011 (England)



Source: TIMSS 2015.

Figure 50: The extent to which year 9 pupils were confident in their maths ability in 2015, by percentage and average achievement, compared to 2011 (England)



Source: TIMSS 2015.

The proportion of year 5 pupils in England that were very confident (37%) is above the international mean (32%), while the proportion of year 9 pupils that were very confident (15%) is similar to the international mean (14%). In both years 5 and 9, more pupils in England viewed themselves as being very confident than their peers from the seven highest-performing countries (including the five East Asian countries). In year 5, of the seven countries that had similar average achievement to

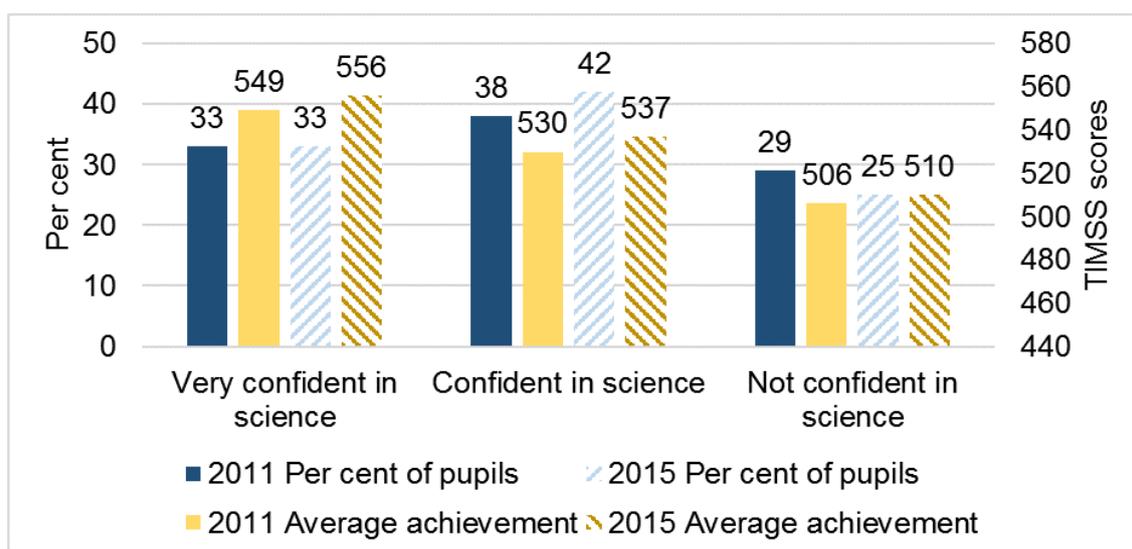
England, only Kazakhstan had a greater proportion of very confident pupils than England, while Ireland had the same proportion as England.

In year 9, of the nine countries that had similar average achievement to England, five had greater proportions of very confident pupils in maths, including Canada, Norway and the United States.

7.3.2 To what extent are pupils in England confident about their science abilities?

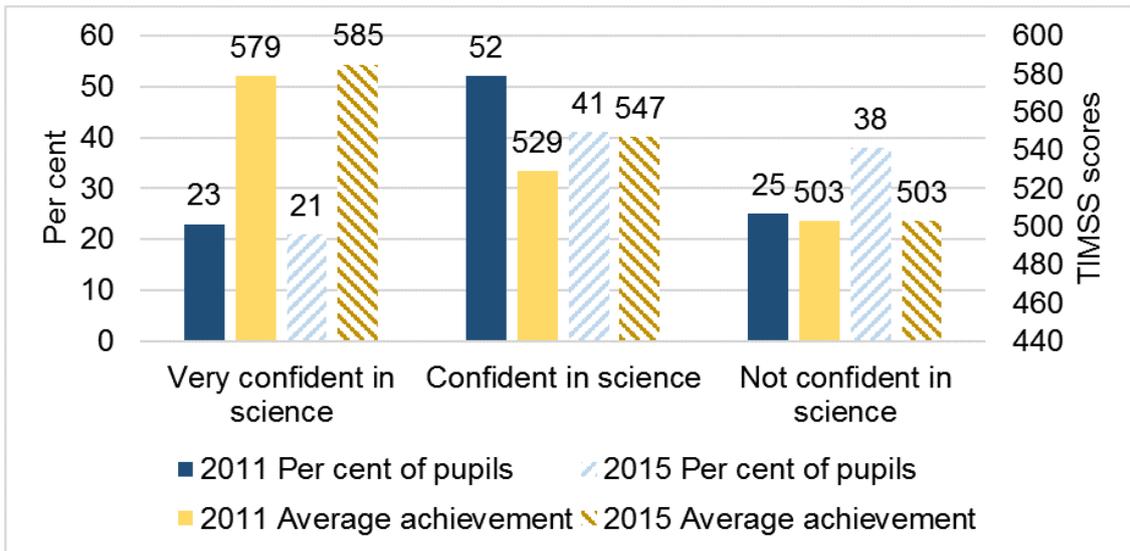
As with maths, the association between year 5 and 9 pupils' confidence in their science abilities and their average achievement mirrors the 2011 study findings (see Figure 51 below). In 2015, very confident year 5 pupils achieved a scale score 46 points higher than their not confident peers, while in year 9 this difference was even greater at 82 scale points. There is a notable increase in the proportion of year 9 pupils in the not confident category compared to 2011, although their average achievement is the same and still above the international mean (500).

Figure 51: The extent to which year 5 pupils were confident in their science ability in 2015, by percentage and average achievement, compared to 2011 (England)



Source: TIMSS 2015.

Figure 52: The extent to which year 9 pupils were confident in their science ability in 2015, by percentage and average achievement, compared to 2011 (England)



Source: TIMSS 2015.

The proportion of year 5 pupils in England that were very confident in science was below the international mean for this measure across all countries (33% compared to 40%). In year 9, the proportion was similar to the international mean (21% compared to 22%).

Notably, more year 5 pupils in England were very confident in their science abilities than their peers from four of the six highest-performing countries (Singapore, Hong Kong, Japan and the South Korea). In fact, these countries had four of the five smallest proportions of very confident pupils across all countries. This was similar to year 9: the entire East Asian group had smaller proportions of very confident pupils compared to England. Of the six smallest proportions of very confident pupils across all countries, four were from this group: Hong Kong, Japan, Taiwan and South Korea.

In year 5, of the ten countries that had the greatest proportions of very confident pupils in science, only Kazakhstan was also in the top ten for average achievement. In year 9, only the United States was in the top 12 countries for both average achievement and the proportion of year 9 pupils very confident in science.

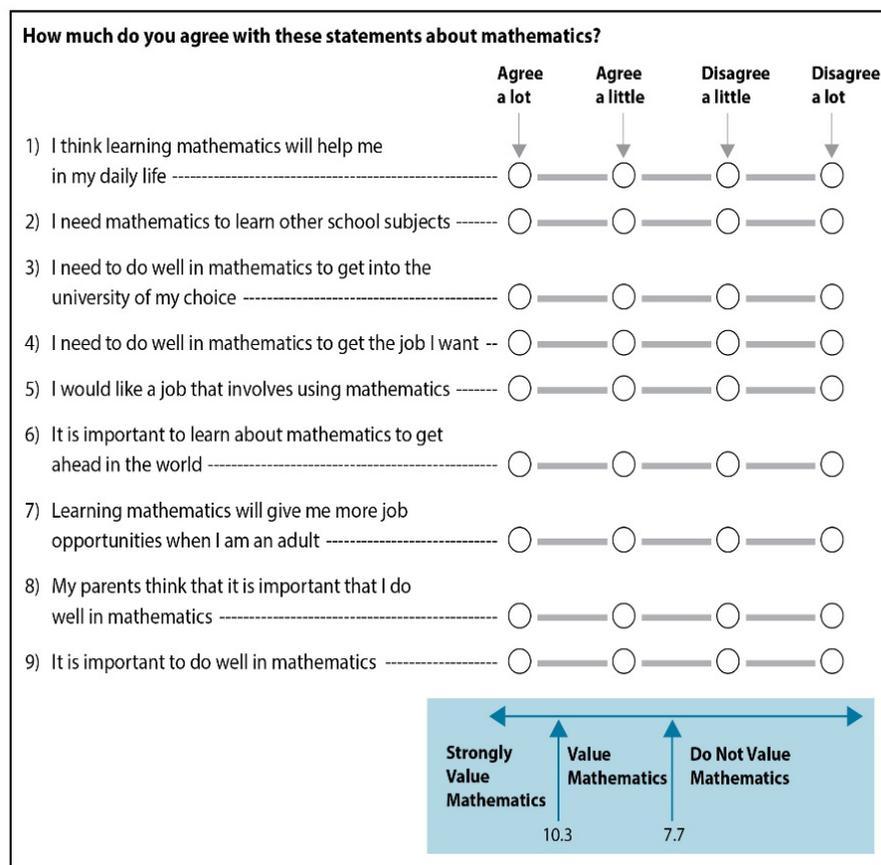
7.4 To what extent do year 9 pupils in England value maths and science?

In both maths and science, the difference in average achievement between year 9 pupils in England who strongly valued the subject compared with those who did not

value it was greater in 2015 than 2011. More year 9 pupils valued maths than science.

In 2015, the extent to which year 9 pupils⁷⁹ value maths and science was assessed through a questionnaire comprising nine statements. These were the same in both subjects with just the subject title changed (see Figure 53 below)⁸⁰. Based on how much pupils agreed with these statements, they were given a scale score and included within one of three categories: strongly value, value or do not value⁸¹. The average achievement in the assessments of pupils in each of these categories was then calculated so that any association between valuing the subject and achievement could be identified.

Figure 53: TIMSS questionnaire assessing how much year 9 pupils value maths



Source: TIMSS 2015.

⁷⁹ There was no equivalent data collected for year 5 pupils.

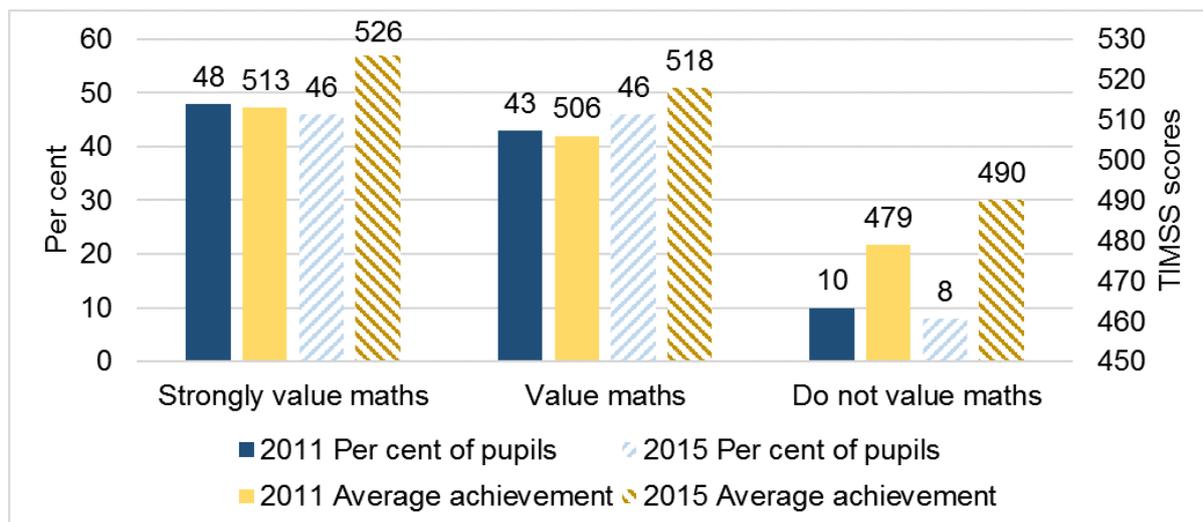
⁸⁰ In 2011, two of the three category descriptors were different (value, somewhat value and do not value) and there were three additional statements. However, as the IEA has compared scale scores between 2011 and 2015, these comparisons have also been provided in this section.

⁸¹ See [Appendix E Table E5](#) for an explanation of how categories were determined from questionnaire responses.

7.4.1 To what extent do year 9 pupils value maths?

As shown in Figure 54 below, in 2015, the great majority (92%) of year 9 pupils in England either strongly valued or valued maths. In 2015, as in 2011, there is an association between the extent to which year 9 pupils valued maths and average achievement. This association was also found, on average, across all participating TIMSS countries.

Figure 54: The extent to which year 9 pupils valued maths in 2015 by percentage and average achievement, compared to 2011 (England)



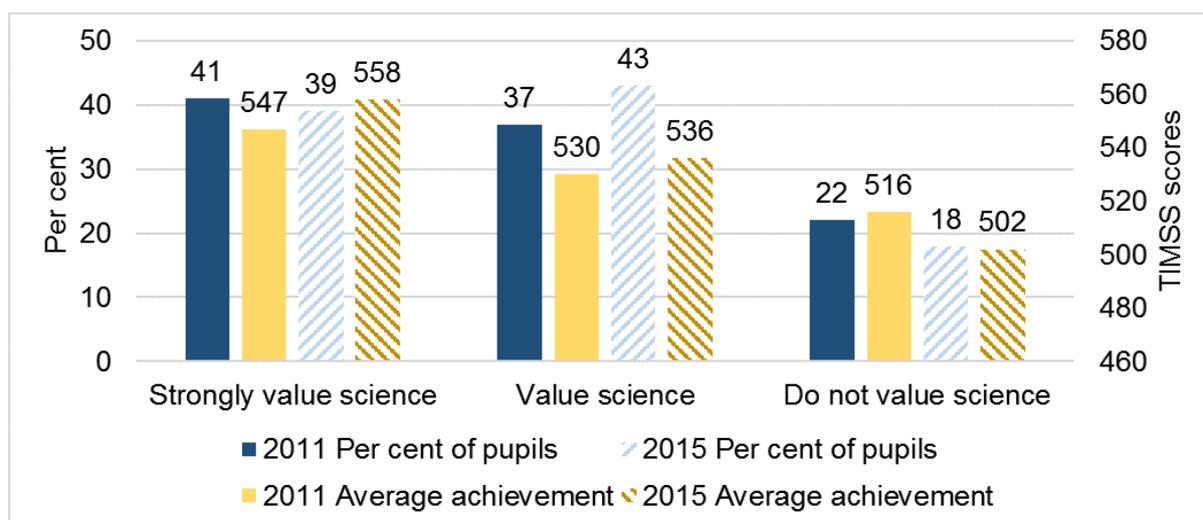
Source: TIMSS 2015.

Both the extents to which year 9 pupils in England strongly valued (46%) and valued (46%) maths were above the international mean (42% and 45% respectively). Pupils in England strongly valued maths more than their peers in the five highest-performing countries: the East Asian group. All, apart from Singapore, had the smallest proportions of pupils who strongly valued maths across all countries. A higher proportion of pupils in England strongly valued maths than their peers from all participating English-speaking countries, apart from those from Canada.

7.4.2 To what extent do year 9 pupils value science?

As shown in Figure 55 below, 82 per cent of year 9 pupils in England either strongly valued or valued science, although this percentage was not as high as for maths (92%). In 2015, as in 2011, there is an association between the extent to which year 9 pupils value science and average achievement.

Figure 55: The extent to which year 9 pupils valued science in 2015 by percentage and average achievement, compared to 2011 (England)



Source: TIMSS 2015.

Both the extents to which they strongly valued (39%) and valued (43%) maths were close to the international means (40% and 41% respectively). Pupils in England valued science more than their peers in the six highest-performing countries: the East Asian group and Slovenia. Apart from Singapore and Hong Kong, these countries had four of the five smallest proportions of pupils that strongly valued science across all countries. A greater proportion of pupils in England strongly valued science than their peers from all other participating English-speaking countries.

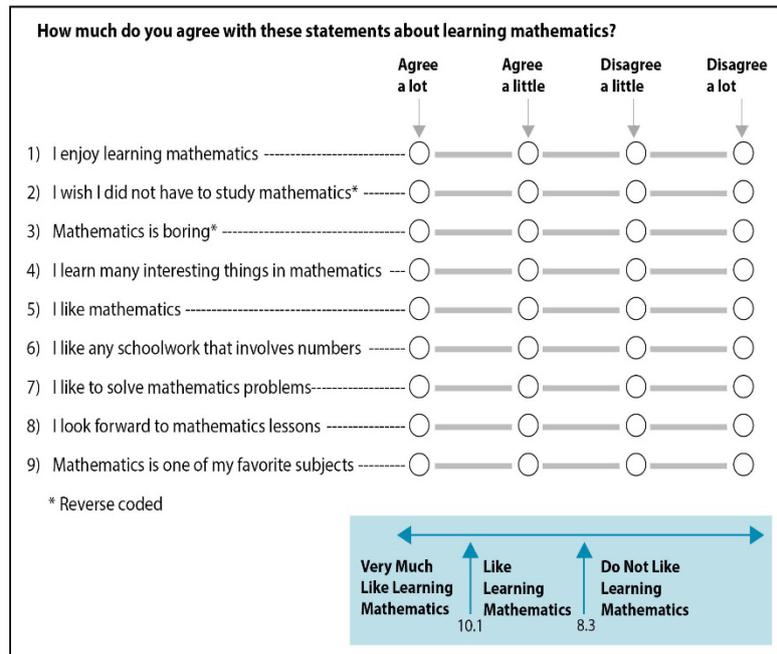
7.5 To what extent do pupils in England like learning maths and science?

In 2015, in both maths and science, the extent to which year 5 and 9 pupils in England liked learning the subject was associated with average achievement. In both subjects, the difference in average achievement between pupils that very much liked learning the subject and those that did not is greater for year 9 pupils than their year 5 peers. Both these findings are mirrored in the 2011 study findings for England and, on average, across all countries participating in TIMSS. In 2015, while the proportion of year 5 pupils that very much liked learning maths and science was almost the same (50% and 49% respectively), more than twice the proportion of year 9 pupils very much liked learning science (31%), compared to maths (14%).

In 2015, the extent to which pupils liked maths and science was assessed through a questionnaire comprising nine statements. There were minor variations in the way statements were phrased between year groups and subjects. For example, in

science, the statement ‘Science teaches me how things in the world work’ was used in place of the statement ‘I like any schoolwork that involves numbers’ in the maths questionnaire shown as figure 56 below⁸².

Figure 56: TIMSS questionnaire assessing the extent to which pupils like learning maths (year 5 version)



Source: TIMSS 2015.

Based on how much they agreed with these statements, pupils were assigned to one of three categories: very much like learning; like learning and do not like learning (maths or science)⁸³. These category titles replaced the 2011 titles: like, somewhat like and do not like. The average achievement in the assessments of pupils in each of these categories was then calculated so that any association between liking the subject and achievement could be identified.

7.5.1 To what extent do year 5 and year 9 pupils like learning maths?

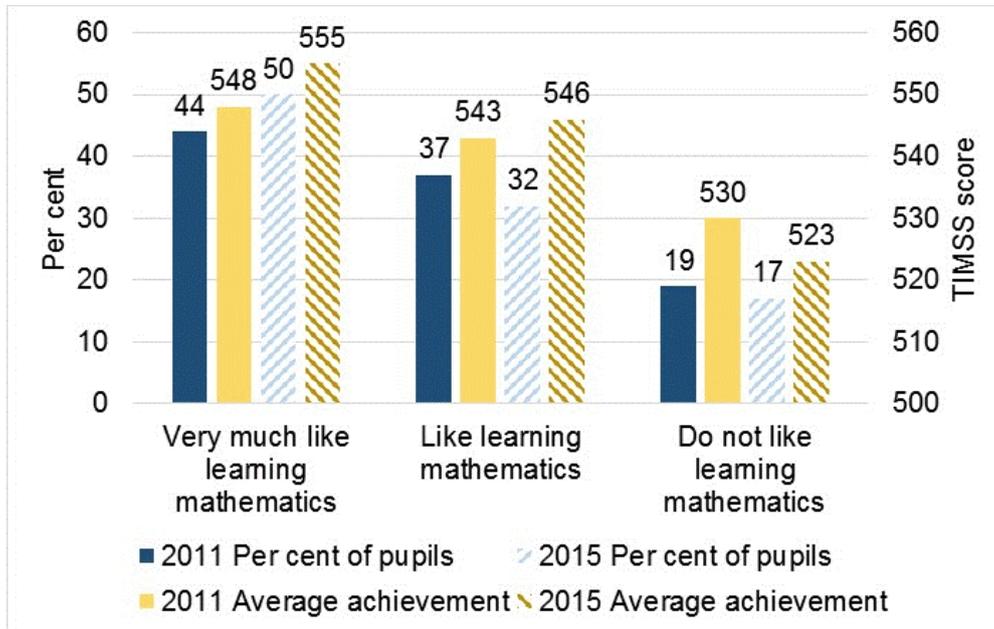
As shown in Figures 57 and 58 below, half of all year 5 pupils very much liked learning maths; more than three-times the proportion of their year 9 peers (14%). Nearly half (48%) of year 9 pupils did not like learning maths, an increase from 2011 (42%). In both years 5 and 9, there is an association between the extent to which

⁸² There were more statements in 2015 than 2011; however, the focus is the same overall and the IEA has compared the two.

⁸³ See [Appendix E Tables E6 and E7](#) for an explanation of how categories were determined from questionnaire responses.

pupils like maths and average achievement. This association is mirrored in the 2011 study and, on average, across all participating TIMSS countries.

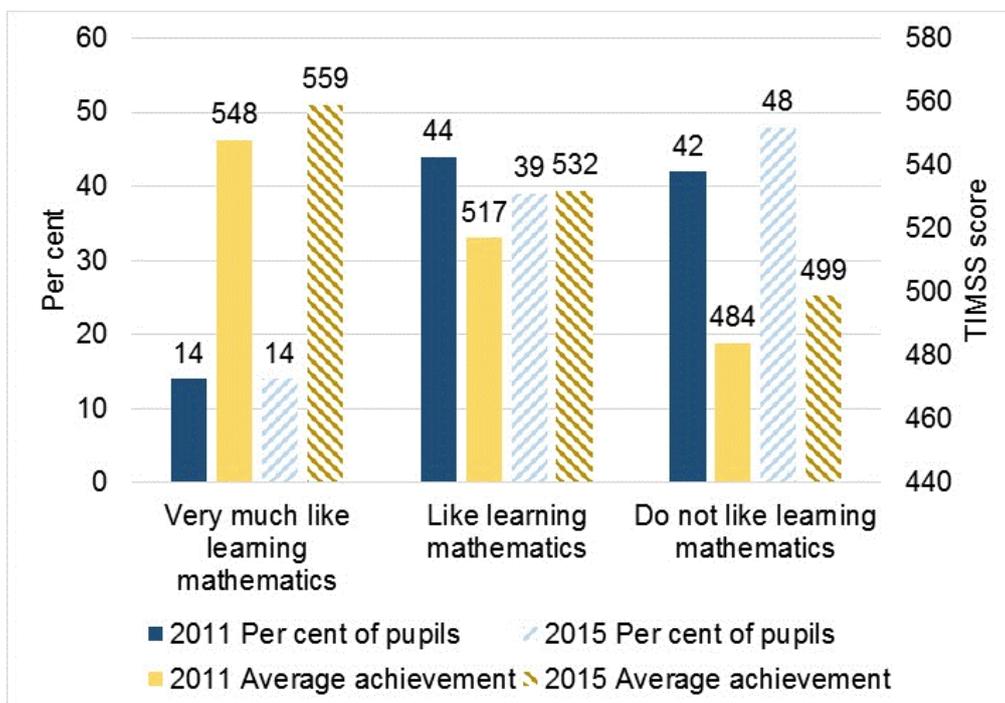
Figure 57: The extent to which year 5 pupils liked learning maths in 2015 by percentage and average achievement, compared to 2011 (England)



Source: TIMSS 2015.

Note 2: Percentages may not total 100% due to rounding

Figure 58: The extent to which year 9 pupils liked learning maths in 2015 by percentage and average achievement, compared to 2011 (England)



Source: TIMSS 2015.

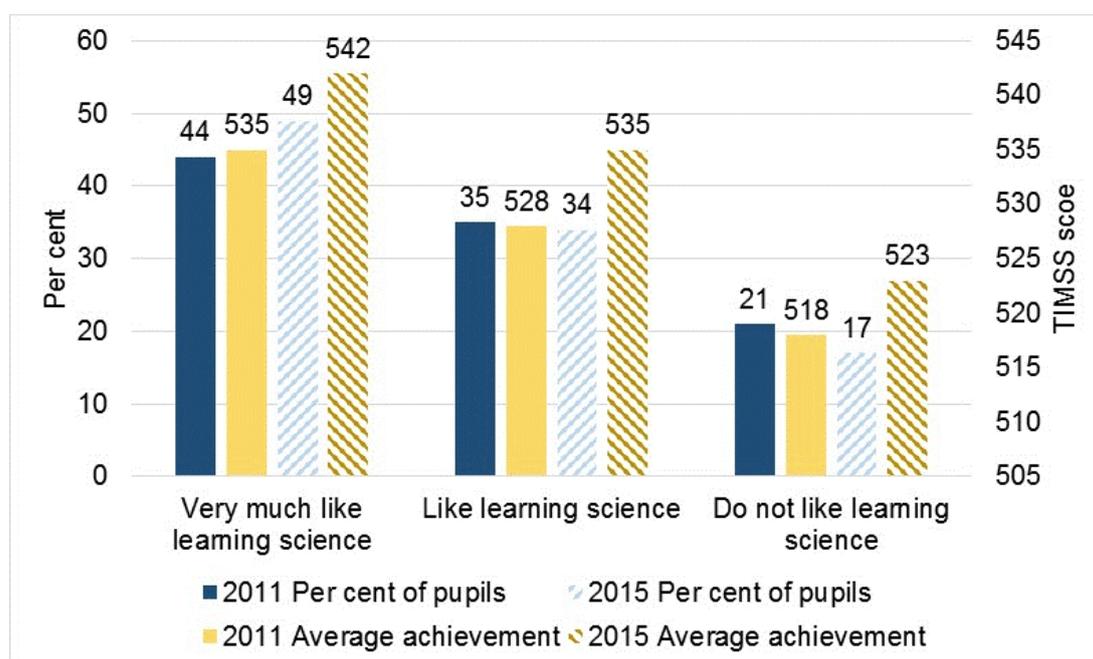
The proportion of year 5 pupils in England that very much liked learning maths (50%) is just above the international mean (46%), while in year 9, this proportion (14%) was notably lower than that for their year 5 peers and the international mean (22%).

More year 5 pupils in England very much liked learning maths than their peers in all of the seven highest-performing countries, except those from Russia. The proportions of pupils who very much liked learning maths in three of these highest-performing countries – Japan, Taiwan and South Korea – were the smallest across all participating countries.

7.5.2 To what extent do year 5 and year 9 pupils like learning science?

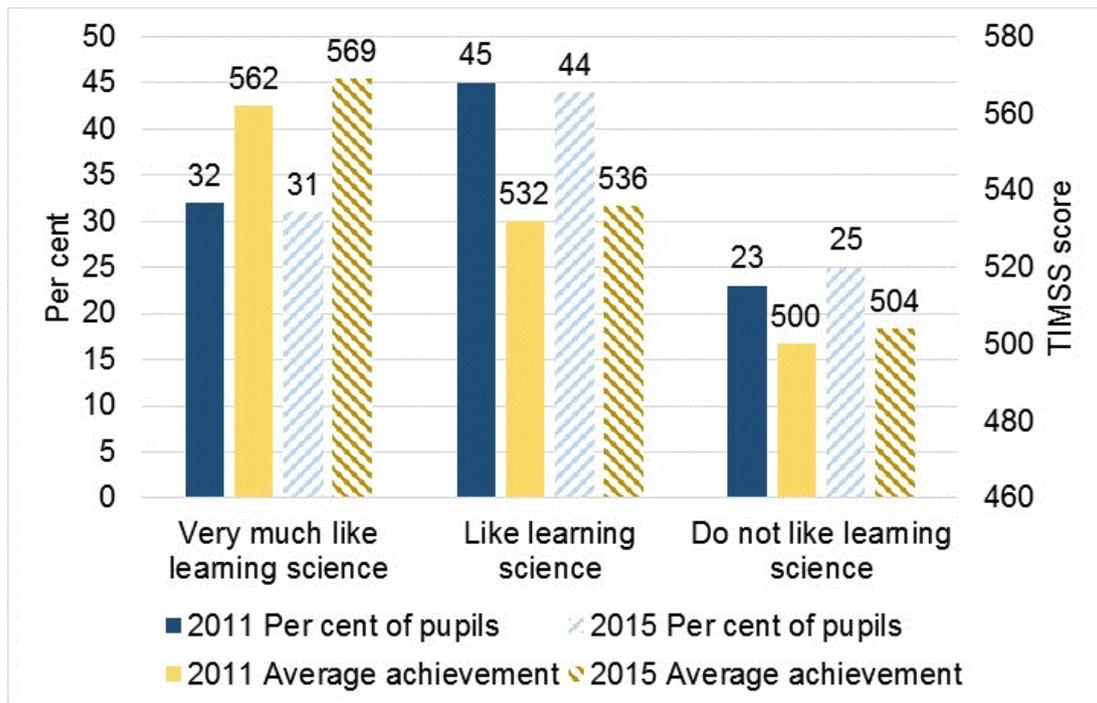
The majority of year 5 and 9 pupils (83% and 75% respectively) either very much liked or liked learning science. A greater proportion (49%) of year 5 pupils was in the former category compared to their year 9 peers (31%). These findings largely mirror those of the 2011 study. The association between the extent to which pupils liked science and average achievement mirrors what was found in the 2011 study.

Figure 59: The extent to which year 5 pupils liked learning science in 2015 by percentage and average achievement, compared to 2011 (England)



Source: TIMSS 2015.

Figure 60: The extent to which year 9 pupils liked learning science in 2015 by percentage and average achievement, compared to 2011 (England)



Source: TIMSS 2015.

The proportions of year 5 and 9 pupils in England that very much liked learning science are below the international mean (49% compared to 56%, and 31% compared to 37% respectively).

In seven of the 10 countries that performed significantly higher than England, a greater proportion of year 5 pupils very much liked learning science than their peers in England. Correspondingly, a greater proportion of pupils in England very much liked learning science than peers in the three remaining highest-performing countries (Poland, South Korea and Finland). Of these, South Korea and Finland had the smallest proportions of pupils who very much liked science across all countries. Of the 10 highest-performing countries, only Kazakhstan had one of the 10 highest proportions of year 5 pupils who very much liked learning science.

In year 9, pupils in England very much liked learning science more than all of the highest-performing countries that participated in this measure⁸⁴, except Singapore. The other countries – Japan, Taiwan and South Korea – had the smallest proportions of pupils that very much liked learning science across all participating countries.

⁸⁴ Slovenia did not participate in the Students value science measure.

7.6 How do the four pupil attitude factors compare in terms of their impact on outcomes?

Across all these attitudinal factors – engaging teaching; confidence in ability; valuing the subject and liking the subject – confidence is associated with the widest range of pupils' average achievement scores, indicating that it may have the greatest influence on achievement. This can be illustrated by comparing the difference between the average achievement of pupils in the highest category (for example, very confident) with those in the lowest category (for example, not confident) in each year and subject (see Table 15). This finding is true in England and across participating countries as a whole, although it is noted above that pupils in the highest-performing countries generally score low in these four areas by international standards, indicating the difficulties involved in benchmarking pupil attitudes between cultures.

As shown in Table 15 below, both for pupils in England and across all participating countries, the differences are highest for pupils' confidence in their subject ability. This is most evident in year 9 maths; where pupils in England who were very confident score 99 scale points higher in terms of average achievement than their not confident peers: about three-times greater than for engaging teaching (31 scale points). The second largest differences, both for England and internationally, relate to liking learning the subject: where the gap in England is around twice as great as for engaging teaching for year 9 maths (60% compared to 31%). This might indicate that pupil confidence and, to a lesser extent, a liking for learning the subject (and the statements related to these overarching categories in the TIMSS questionnaires) are relatively influential on average achievement at the higher and lower levels, compared to the other two factors.

Table 15: Comparison of the average achievement differences between the highest and lowest category scores in the four pupil attitude factors (England with all participating TIMSS countries in parentheses)

	The extent to which pupils view teaching as engaging	The extent to which pupils are confident in their ability in the subject	The extent to which pupils value the subject	The extent to which pupils like learning the subject
	Average achievement difference between the highest and lowest groups in TIMSS scale points	Average achievement difference between the highest and lowest groups in TIMSS scale points	Average achievement difference between the highest and lowest groups in TIMSS scale points	Average achievement difference between the highest and lowest groups in TIMSS scale points
Year 5 maths	21 (29)	79 (86)		32 (38)
Year 9 maths	31 (30)	99 (105)	36 (49)	61 (56)
Year 5 science	-1 (21)	46 (68)		19 (35)
Year 9 science	23 (34)	82 (86)	56 (46)	65 (63)

Chapter 8. School Environment, Leadership and Resources

This chapter draws on responses from the headteacher and teacher questionnaires to draw out key messages about the teaching of maths and science in England's schools, and how these compare internationally, these include:

- The extent to which schools in England emphasise academic success;
- The extent to which teaching is affected by resource shortages or teacher recruitment challenges; and
- Whether or not schools are safe and orderly.

The TIMSS teacher and headteacher samples are small. For this reason a number of findings may not be statistically significant despite appearing large. Comparisons with other countries are provided where relevant. Where appropriate, variables presented in this chapter are correlated with TIMSS performance. As noted previously, any association or correlation between two factors does not imply causation.

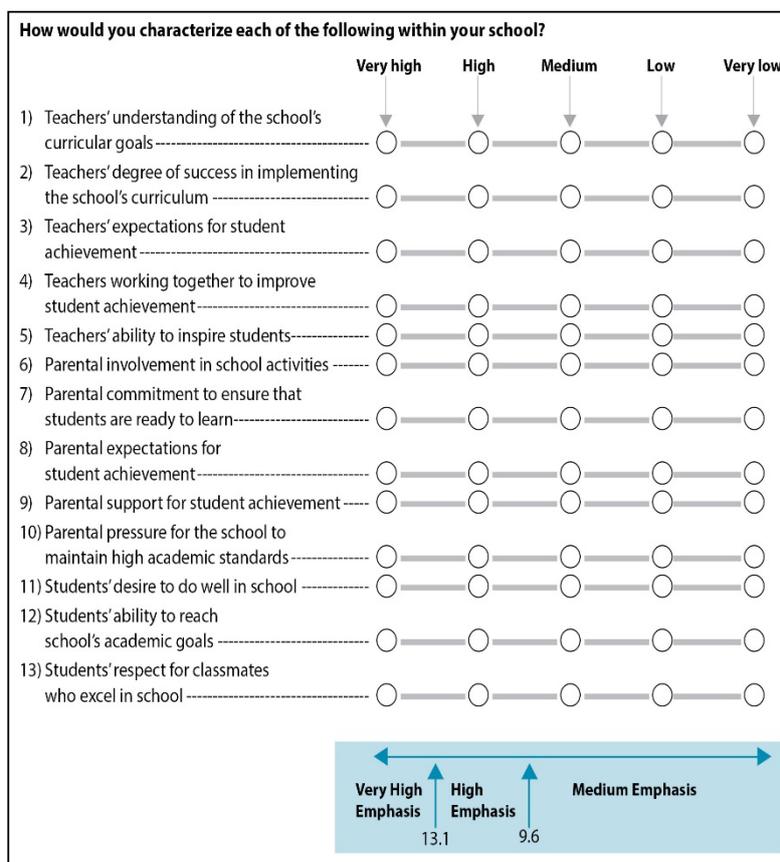
8.1 Main findings

- In maths and science in both years 5 and 9, there is an association between the level of emphasis a school puts on academic success and the performance of pupils. This is true both in England and across participating countries as a whole. Year 5 pupils in England were twice as likely, and year 9 pupils three times as likely, to attend a school that puts a very high emphasis on academic success compared with their peers in other participating countries.
- Pupils in England were taught in schools with fewer problems with poor conditions and resource shortages than their peers in most other TIMSS countries. There is an association between poor conditions and resource shortages and pupils' average achievement across all countries, but this is not consistently the case for pupils in England.
- Headteachers in England were more likely to report teacher recruitment difficulties and/or finding it hard to fill vacancies than in most other comparator group countries. About half of year 9 pupils were taught in schools with shortages in both subjects, while two-thirds (67%) of headteachers found their year 9 science vacancies somewhat or very hard to fill.
- The vast majority of pupils in England were taught in schools where headteachers reported hardly any problems with school discipline and which teachers reported to be safe and orderly. This compared relatively favourably against most other TIMSS countries. However, six per cent of year 9 pupils attended schools which teachers reported to be less than safe and orderly.
- The proportion of year 5 pupils in England who report experiencing bullying behaviours is around the international mean, with 15 per cent saying that they experience these about weekly and 32 per cent about monthly. This situation improves somewhat in year 9, with six per cent experiencing bullying behaviours about weekly and 31 per cent about monthly. Pupils in England, and internationally, who experience bullying behaviours perform lower than peers who do not.
- Across all aspects of discipline, safety and orderliness, and bullying, there is an association with pupils' average achievement: the less that pupils are adversely impacted, the higher their average achievement. This is true across year groups and subjects, both in England and internationally.

8.1 What proportion of pupils are taught in schools with a high emphasis on academic success?

The extent to which year 5 and year 9 pupils were taught in schools that emphasise academic success was established using attitudinal questionnaires which assessed the views of headteachers and teachers separately. These both comprised the 13 statements in Figure 61 below, with the teacher questionnaire including an additional statement: ‘Collaboration between school leadership and teachers to plan instruction’.

Figure 61: TIMSS questionnaire assessing headteachers’ views on their schools’ emphasis on academic success



Source: TIMSS 2015.

Based on headteachers’ and teachers’ responses to these statements, their pupils were assigned to one of three categories: very high emphasis, high emphasis or medium emphasis⁸⁵.

The findings from the headteachers’ questionnaires are presented in this section with reference to the findings from the teachers’ questionnaires included where they are

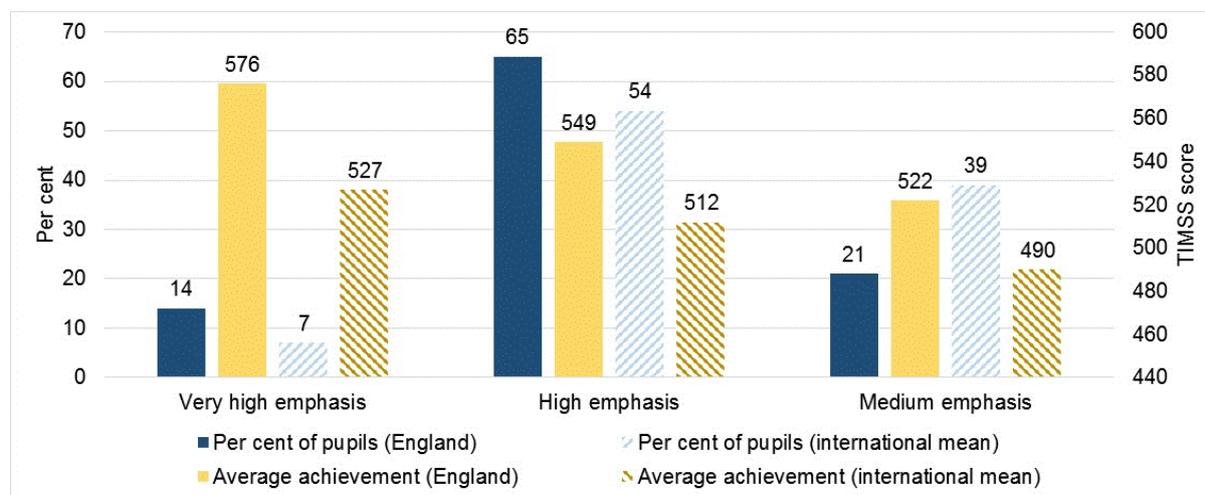
⁸⁵ See [Appendix E Tables E8 and E9](#) for an explanation of how categories were determined from questionnaire responses.

notably different. Due to limitations of space, this section focuses on maths, making reference to science only where there are notable differences between the two subjects. Full findings can be found in the TIMSS International Report 2015⁸⁶.

8.1.1 What proportion of year 5 pupils are taught in schools with a high emphasis on academic success?

As shown in Figure 62 below, based on headteachers' views, 79 per cent of year 5 pupils in England were taught maths in schools that place a high or very high emphasis on academic success. There is an association between an emphasis on academic success and average achievement, both in England and, on average, across all participating countries: the greater the emphasis on academic success, the higher pupils' achievement. The difference in average achievement between year 5 pupils taught in schools that have a very high emphasis on academic success and a medium emphasis is greater in England than across participating countries as a whole (54 scale points compared to 37).

Figure 62: Year 5 pupils' maths achievement according to the extent to which they are taught in schools emphasising academic success (England and international comparison using headteacher data)



Source: TIMSS 2015.

Of the highest-performing countries (the East Asian group and Northern Ireland), only South Korea and Northern Ireland had a larger proportion of year 5 pupils than England who were taught maths in schools with a very high emphasis on academic success. Ireland also had a larger proportion than England but performed at a similar level. Larger proportions of year 5 pupils in Canada, New Zealand and the United States were also taught in schools with a very high emphasis on academic success compared to England, while Australia's proportion was slightly smaller. Only three

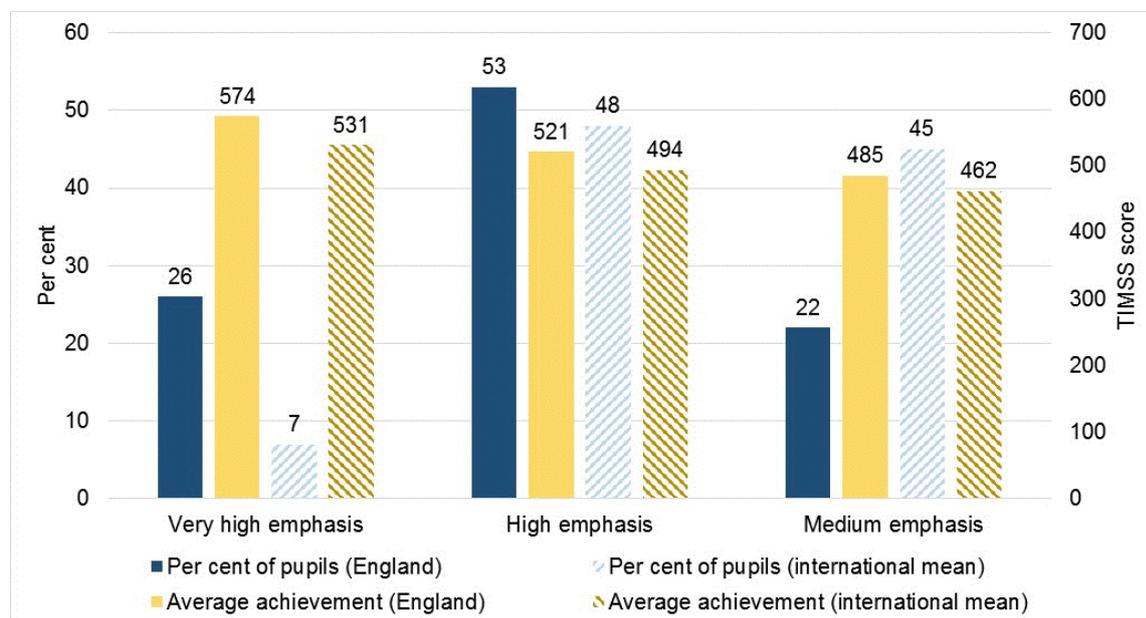
⁸⁶ <http://timssandpirls.bc.edu/timss2015/international-results/>

countries had higher proportions of year 5 pupils taught maths in schools with a very high emphasis on academic success compared to the seven English-speaking countries. Of these, only South Korea was from the comparator groups.

8.1.2 What proportion of year 9 pupils are taught in schools with a high emphasis on academic success?

The proportion of year 9 pupils in England taught in schools with a high emphasis on academic success was similar, according to both headteacher and teacher questionnaire responses. However, fewer pupils were taught in schools with a very high emphasis on academic success according to their teachers, compared to their headteachers (9% compared to 26%). As in year 5, there is an association between an emphasis on academic success and average achievement, both in England and, on average, across all participating countries. Also, as in year 5, the difference in average achievement between year 9 pupils in England that were taught maths in schools with a very high emphasis on academic success and those with a medium emphasis is larger than across all participating countries, on average (89 scale points compared to 69). This is shown in Figure 63 below.

Figure 63: Year 9 pupils' maths achievement according to the extent to which they are taught in schools emphasising academic success (England and international comparison using headteacher data)



Source: TIMSS 2015.

The proportion of year 9 pupils in England taught in schools with either a high or very high emphasis on academic success is larger than those found in all other countries on average. However, it is important to note that based on the corresponding responses from teachers, seven countries had larger proportions. Of these, only

South Korea had significantly higher average achievement in year 9 maths. Three other countries (Ireland, Canada and Kazakhstan) performed similarly to England, while the remaining three countries (which were not from the comparator groups) performed significantly lower.

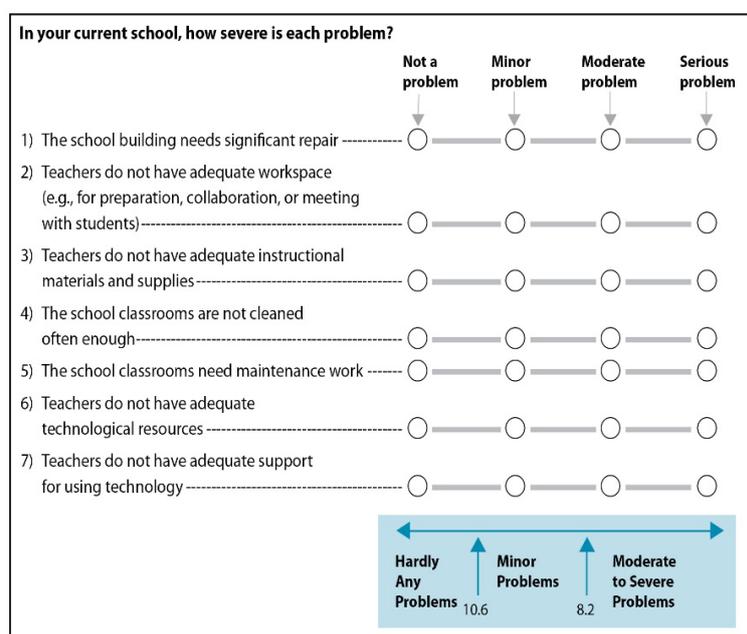
8.2 What proportion of pupils are taught in schools where there are problems with school conditions and resources?

In this section, resources are defined as encompassing:

- school buildings and ground and services related to these
- instructional materials and supplies
- staff
- audio-visual resources and computer technology

Teachers reported their views on the levels of school conditions and resource problems using a questionnaire (see Figure 64 below).

Figure 64: TIMSS questionnaire assessing teachers' views on school conditions and resource problems



Source: TIMSS 2015.

Based on teachers' responses to these statements, the year 5 or year 9 pupils they taught were assigned to one of three different categories; those that were taught in

schools with: hardly any problems, minor problems, or moderate to severe problems. The same criteria and scale scores were used for both maths and science⁸⁷. This section focuses on maths, making reference to science only where there are notable differences between responses for the two subjects. Full findings can be found in the TIMSS International Report 2015⁸⁸.

8.2.2 What proportion of year 5 pupils are taught in schools where there are problems with school conditions and resources?

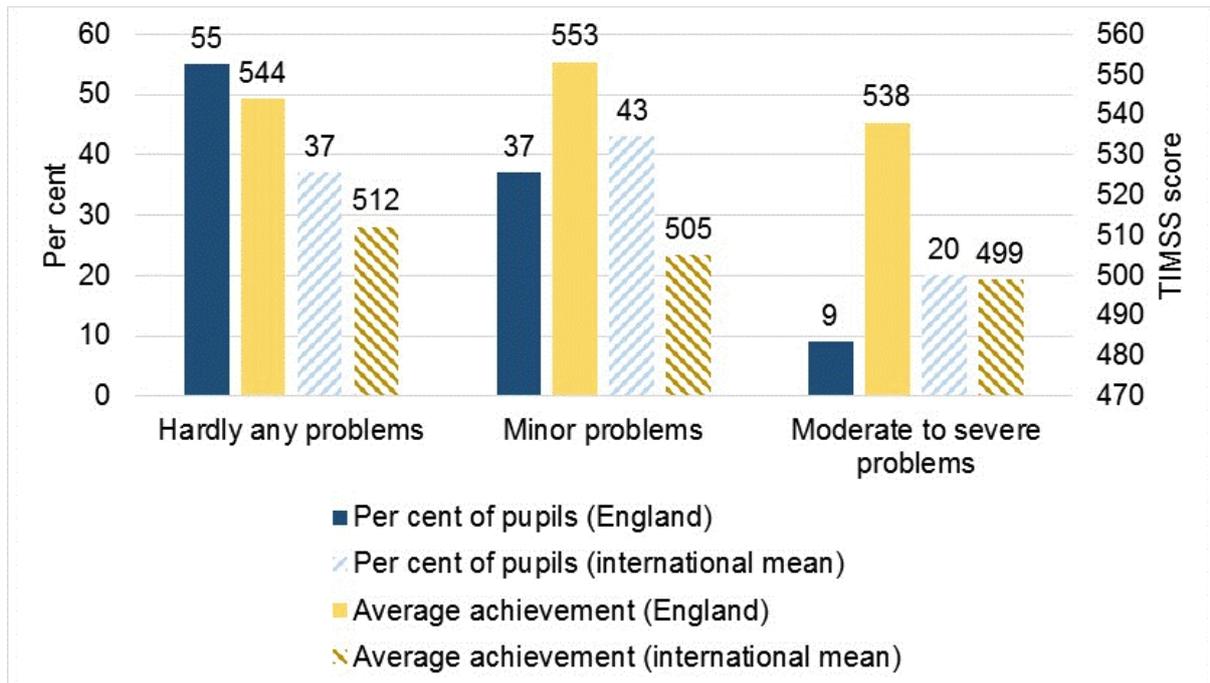
As shown in Figure 65 below, just over half (55%) of year 5 pupils in England were taught maths in schools with hardly any problems with school conditions and resources, according to their teachers, above the international mean (37%). Only nine per cent of year 5 pupils in England were taught maths in schools in which teachers reported moderate to severe problems, below the international mean of 20 per cent.

Across all participating countries as a whole, there is an association between levels of resources and average pupil achievement: the fewer the problems, the higher pupils' average achievement. . England's profile looks different: year 5 pupils in schools where there were hardly any problems scored lower, on average, than pupils in schools where there were minor problems, and while pupils in schools with moderate to severe problems scored lower than either of the other two groups, they scored notably higher, on average, than their peers across all participating countries as a whole.

⁸⁷ See [Appendix E Table E10](#) for an explanation of how categories were determined from questionnaire responses.

⁸⁸ <http://timssandpirls.bc.edu/timss2015/international-results/>

Figure 65: Year 5 pupils' maths achievement according to the extent to which they are taught in schools that have problems with school conditions and resources according to teachers (England and international comparison)



Source: TIMSS 2015.

Of the five countries with larger proportions of year 5 pupils taught maths in schools with hardly any problems with school conditions and resources, both South Korea and Northern Ireland also performed significantly higher than England. The remaining three, including the Czech Republic from the comparator groups, performed significantly lower than England. Japan (one of the highest-performing countries) and Denmark (which performed at a similar level to England) had relatively small proportions of year 5 pupils taught in schools with hardly any problems with school conditions and resources, compared to the other higher-performing countries, including England.

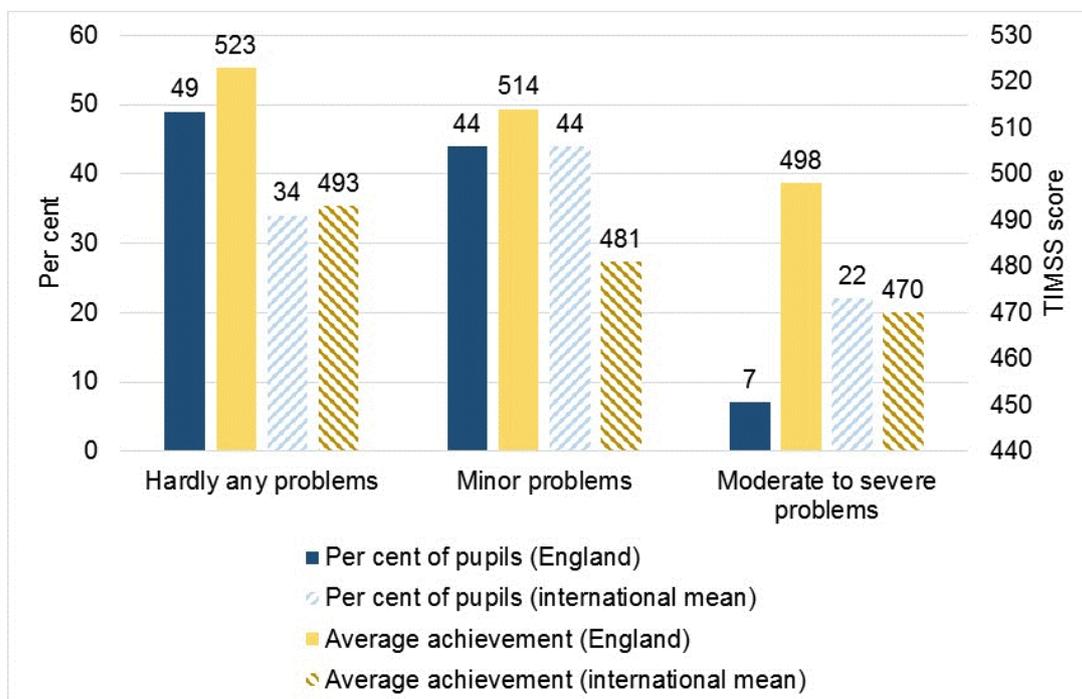
In science, of the five countries with larger proportions of year 5 pupils taught in schools with hardly any problems with school conditions and resources than England, only South Korea performed significantly higher. The Czech Republic performed similarly to England and the remaining three countries performed significantly lower.

8.2.3 What proportion of year 9 pupils are taught in schools where there are problems with school conditions and resources?

Just under half (49%) of year 9 pupils in England were taught maths in schools in which there were hardly any problems with school conditions and resources, according to their teachers (see Figure 66 below). This proportion was above the international mean (34%). Only seven per cent of year 9 pupils in England were taught maths in schools in which teachers reported moderate to severe problems, although this figure was higher in science (13%). These proportions are below the international means (22% and 23% respectively). The difference in average achievement between year 9 pupils taught in schools where there are hardly any problems with school conditions and resources and those where there are moderate to severe problems is similar to pupils across all participating countries (25 scale points compared to 23).

In England, there is an association between problems with school conditions and resources and year 9 pupils' average achievement in maths – average achievement increases as the level of problems decreases – but this is not evident in science. Across participating countries as a whole there is an association for both subjects between fewer problems and higher average achievement.

Figure 66: Year 9 pupils' maths achievement according to the extent to which they are taught in schools that have problems with school conditions and resources according to teachers (England and international comparison)



Source: TIMSS 2015.

Of the five countries with higher proportions of year 9 pupils taught in schools with hardly any problems with school conditions and resources, only Singapore had significantly higher average maths achievement than England. The remaining four – which included Australia from the comparator groups – all performed significantly lower than England. All of the remaining English-speaking countries (the United States, Ireland and New Zealand) had smaller proportions of pupils taught in schools with hardly any problems than England. However, all of these countries had higher proportions than the six highest-performing countries, except Singapore.

8.3 What proportion of pupils are taught in schools affected by maths and science resource shortages?

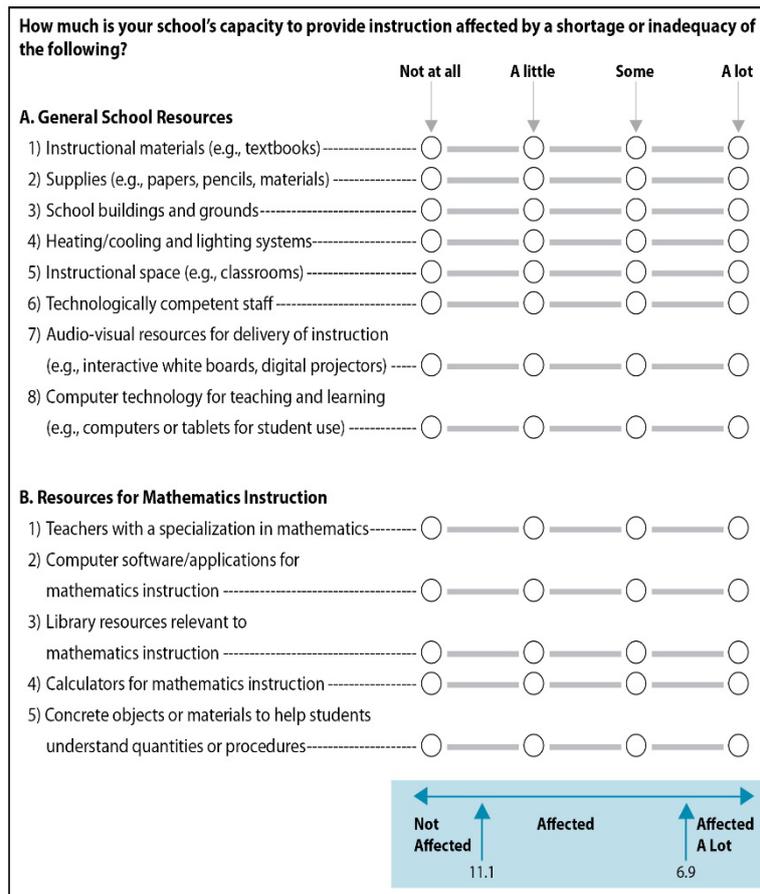
The headteacher questionnaire focuses on the extent to which the school's capacity to provide instruction is affected by a shortage or inadequacy of resources. For each subject, there is the same set of initial statements focused on general school resources and a second set focused specifically on the subject in question (see Figure 67 below). In science, the statements are the same for maths with just the subject name changed, except for year 9 for which there is an additional statement relating to the availability of calculators⁸⁹.

Based on headteachers' responses to these statements, pupils were assigned to one of three categories; those taught in schools in which the capacity to provide instruction was: not affected, affected or affected a lot by resource shortages⁹⁰.

⁸⁹ There have been some small changes to these statements since 2011, however the IEA has compared years.

⁹⁰ See [Appendix E Table E11 and E12](#) for an explanation of how categories were determined from questionnaire responses.

Figure 67: TIMSS questionnaire assessing headteacher views on whether school capacity to provide instruction is affected by resource shortages (maths version)

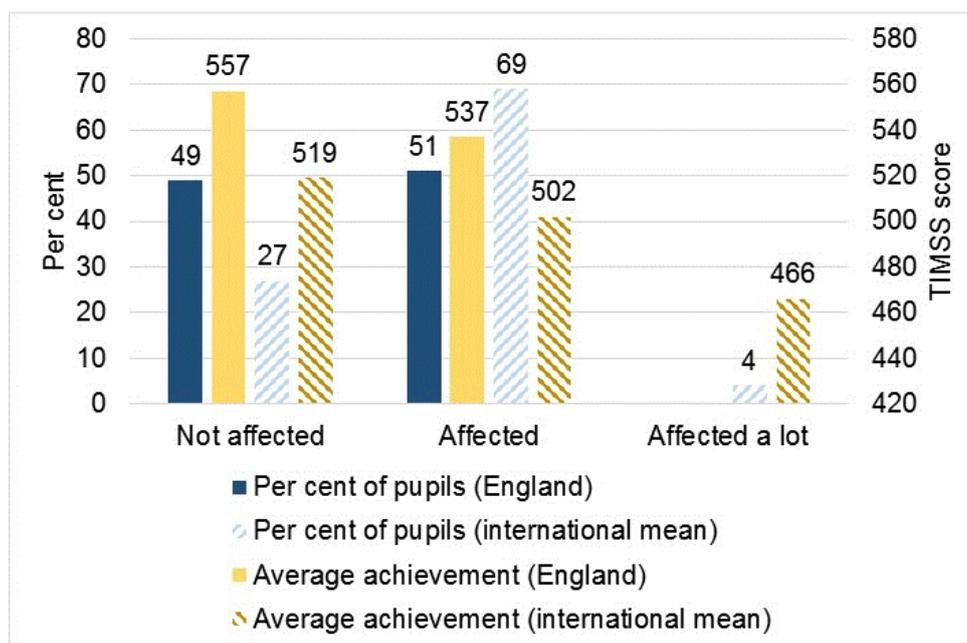


Source: TIMSS 2015.

8.3.1 What proportion of year 5 pupils are taught in schools affected by maths and science resource shortages?

Figure 68 below shows the extent to which year 5 pupils were affected by maths resource shortages. About half (51%) of year 5 pupils in England were taught in schools affected by resource shortages in maths, while the proportion was greater for science (60%). No pupils were affected a lot. The proportion of pupils in England not affected (49%) was higher than the international mean (27%). There is an association between year 5 pupils in England not being affected by resource shortages and higher achievement and this was also evident, on average, across all participating countries. The difference in average achievement between year 5 pupils taught in schools affected by subject resource shortages was similar to that found across participating countries as a whole, on average (about 20 scale points' difference between the not affected and affected category scores).

Figure 68: The extent to which year 5 pupils were affected by maths resource shortages (England and international comparisons)



Source: TIMSS 2015.

In maths, only South Korea (one of the highest-performing countries) and Slovenia had higher proportions of year 5 pupils not affected at all by resource shortages, while the same proportion of pupils in Singapore as in England were not affected (49%). All of the English-speaking countries except Ireland had proportions of year 5 pupils not affected at all by resource shortages that were above the international mean. Hong Kong, Japan and Russia had proportions of year 5 pupils not affected by shortages in maths that were approximately half those of England, but all performed significantly higher than England.

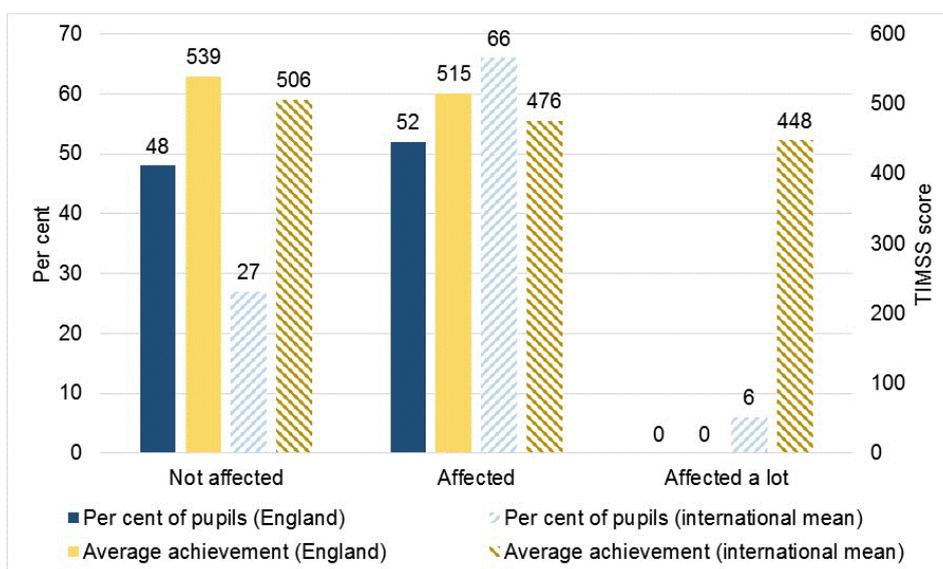
In science, of the six countries that had higher proportions of year 5 pupils not affected by resource shortages, three performed significantly higher than England (South Korea, Singapore and Poland), and one similarly to England (Slovenia). The remaining two countries, which were not from the comparator groups, performed significantly lower than England.

8.3.2 What proportion of year 9 pupils are affected by maths and science resource shortages?

As Figure 69 below shows, in year 9, slightly more pupils were affected (52%) than not affected (48%) by resource shortages; however this was below the international mean of 66 per cent for pupils affected. No pupils in England were affected a lot. This was the same in science, although average achievement was higher than in maths for both the not affected (552) and affected groups (536).

Overall, there is an association between headteachers' views on resource adequacy and average pupil achievement – the better schools were resourced, the higher pupils' average achievement, both in England and across participating countries as a whole, on average. The difference in average achievement between year 9 pupils taught in schools not affected and affected in England was slightly lower than that found across participating countries as a whole, on average (24 scale points compared to 30 scale points).

Figure 69: The extent to which year 9 pupils were affected by maths resource shortages (England and international comparisons)



Source: TIMSS 2015.

Of the five countries that had larger proportions of year 9 pupils not affected by maths resource shortages than England, two performed significantly higher (Singapore and South Korea), while one, Slovenia, performed at a similar level. Of the remaining two, only Australia was from the comparator groups and performed significantly below England. All of the highest-performing countries, those that performed similarly to England and the English-speaking countries were at, or above, the international mean for the percentage of pupils not affected, with the exceptions of Russia and Hungary.

8.4. To what extent are schools in England able to recruit the maths and science teachers they need?

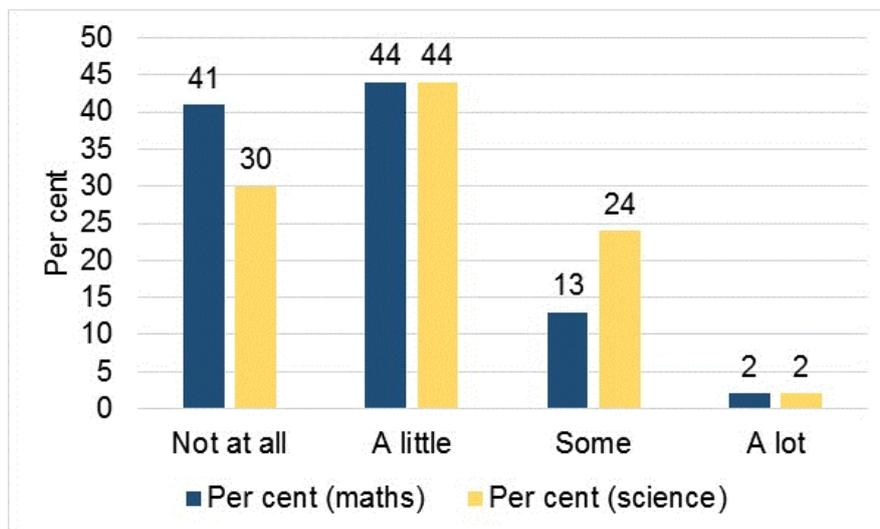
Headteachers of schools in England reported on the extent to which their schools faced shortages in their recruitment of maths and science teachers according to a four-point scale: not at all; a little; some; a lot.

8.4.1 What proportion of year 5 pupils were taught in schools with shortages of specialist maths and science teachers?

As shown in Figure 70, relatively few (15%) year 5 pupils were taught in schools that had ‘some’ or ‘a lot’ of maths teacher shortages, although this figure was higher in science (26%). However, 59 per cent of pupils were taught in schools that reported teacher shortages to some extent in maths and 70 per cent in science, although the majority of these (44%) were in schools where headteachers reported there to be few shortages (the ‘a little’ category).

It should be noted that in primary schools i.e. those in which year 5 pupils are taught, teachers are usually recruited as subject generalists rather than specialists. For year 5 subjects therefore, headteachers’ views on recruitment might be seen as representative of their ability to recruit teachers more generally. Nevertheless, it is notable that the reported challenges for science are more acute than for maths, indicating that the primary headteachers involved did observe differences in recruitment between these subjects.

Figure 70: Percentages of year 5 pupils taught in schools with different levels of maths and science teacher shortages (England)⁹¹



Source: TIMSS 2015.

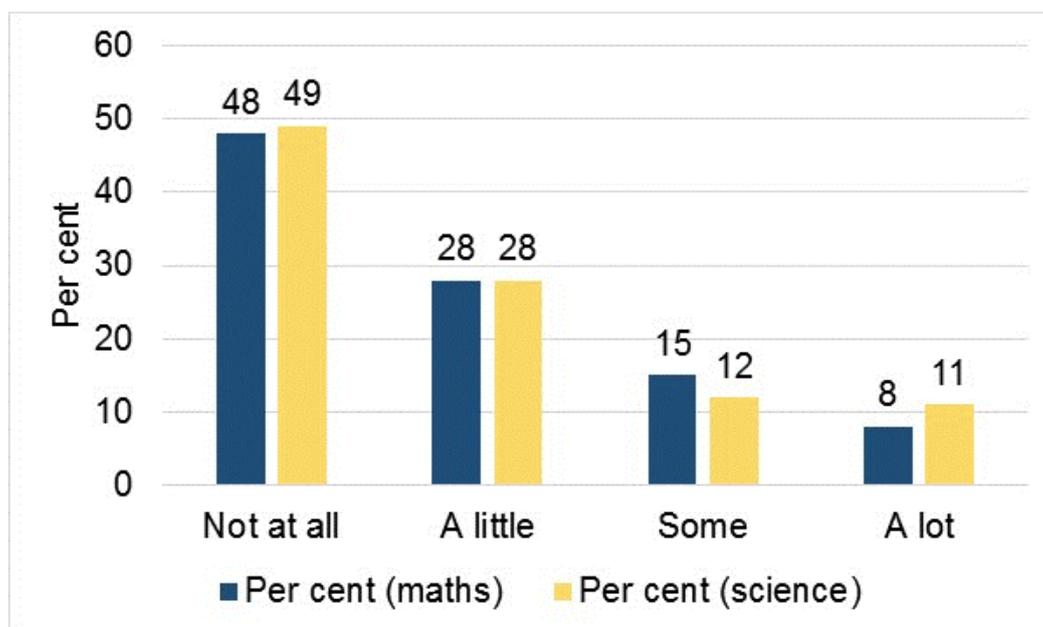
8.4.2 What proportion of year 9 pupils were taught in schools with shortages of specialist maths and science teachers?

Figure 71 below shows that about half of year 9 pupils were taught in schools that faced some level of teacher shortages in maths or science (52% and 51% respectively), which is similar to the proportions across all participating countries

⁹¹ Percentages may not total 100% due to rounding.

(54% in maths and 52% in science). Just under a quarter (23%) of year 9 pupils were taught in schools which had some, or a lot, of shortages in these subjects, which was smaller than the proportion across all participating countries in maths and science (36% and 35% respectively).

Figure 71: Percentages of year 9 pupils taught in schools with different levels of maths and science teacher shortages (England)⁹²

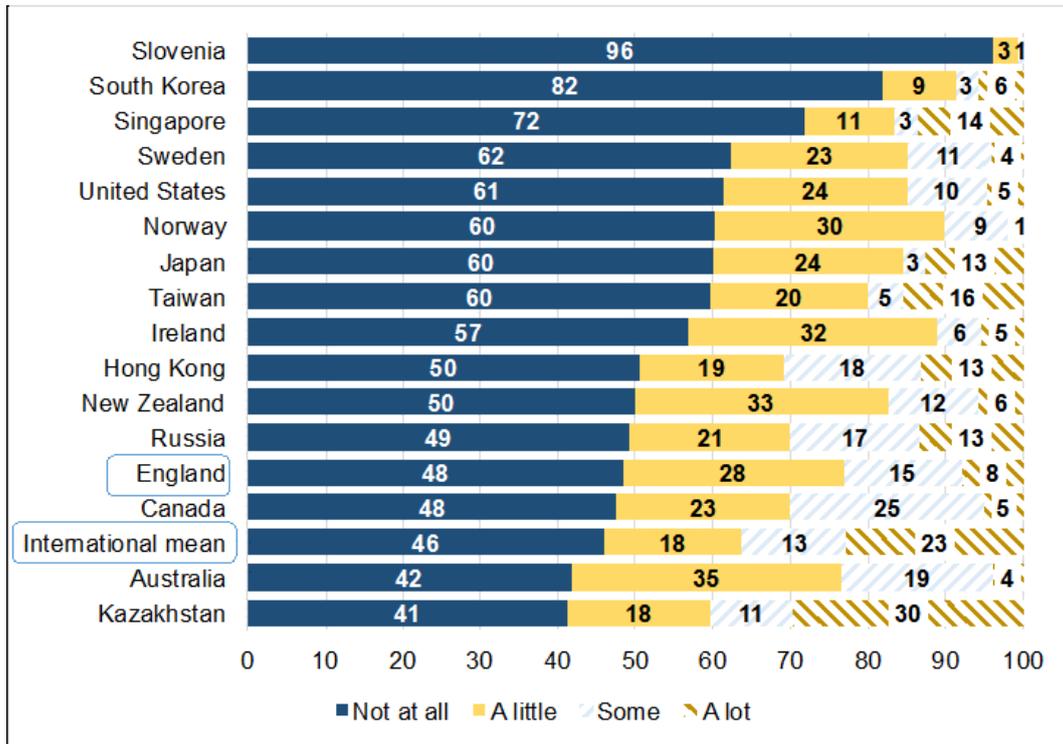


Source: TIMSS 2015.

However, compared to their peers from comparator group countries, (which are generally higher-performing than the average), most of these had much higher proportions of year 9 pupils not affected at all by teacher shortages in either subject (see Figures 72 and 73 below). Pupils in Slovenia were least affected by teacher shortages, both in maths and science. Kazakhstan had a smaller proportion of pupils not affected at all in science, while in maths, both Kazakhstan and Australia had smaller proportions not affected at all than England. Canada had the same proportions as England in both subjects. However, some comparator countries had a greater proportion of pupils affected a lot by maths and/or science teacher shortages than England, including four of the highest-performing countries: Singapore, Taiwan, Japan and Hong Kong.

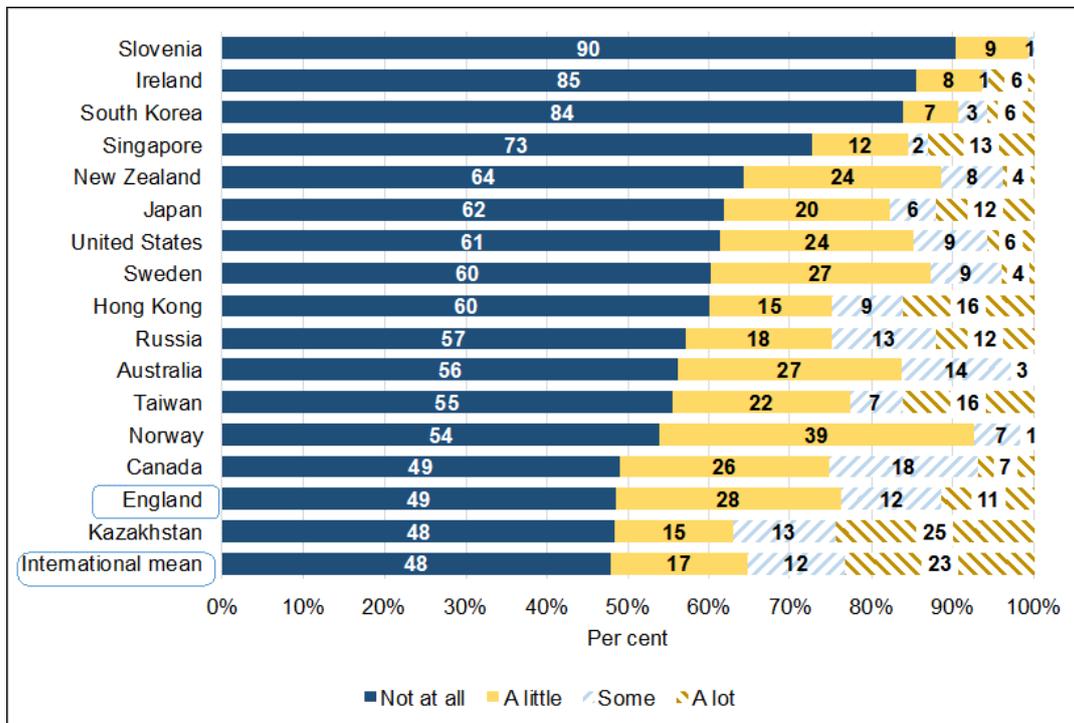
⁹² Percentages may not total 100% due to rounding.

Figure 72: Percentages of year 9 pupils taught in schools with different levels of maths teacher shortages (England and comparator group countries)



Source: TIMSS 2015.

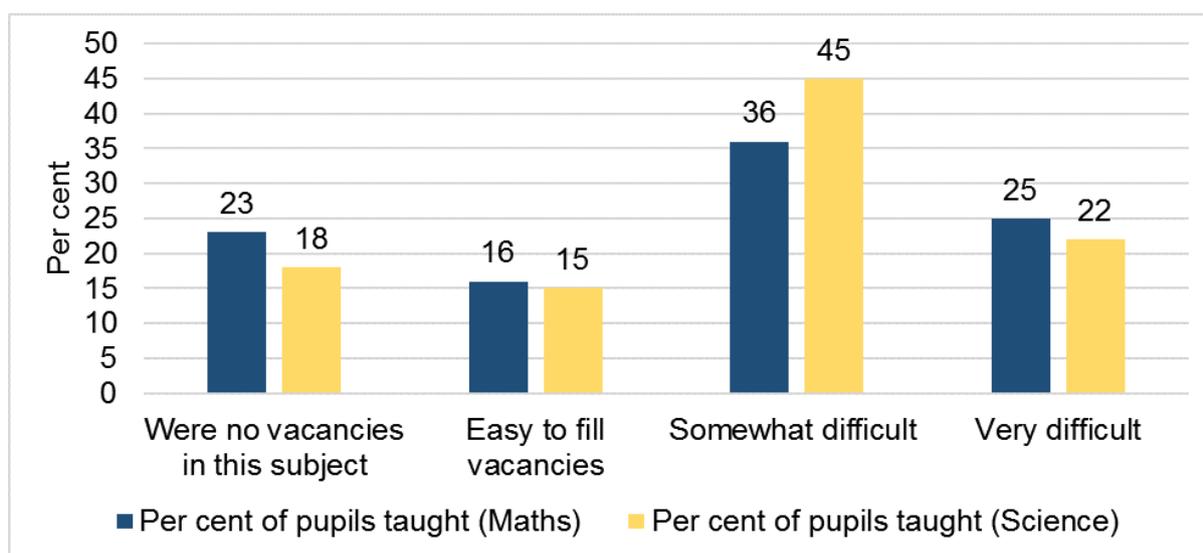
Figure 73: Percentages of year 9 pupils taught in schools with different levels of science teacher shortage (England and comparator group countries)



Source: TIMSS 2015.

Headteachers of schools with year 9 pupils were also asked to report on the level of difficulty in filling maths and science vacancies and, consequently, the extent to which pupils were affected by these, as shown in Figure 74 below. Just under two in five (39%) year 9 pupils in England were taught maths in schools that had no vacancies or had vacancies that were easy to fill, while a third (33%) were taught in schools that had no vacancies or easy to fill vacancies in science. A quarter (25%) of year 9 pupils in England were taught in schools in which it was very difficult to recruit maths specialists, while a smaller proportion of pupils (22%) were taught in schools in which it was very difficult to recruit science specialists.

Figure 74: Percentages of year 9 pupils taught in schools according to the level of difficulty in filling maths and science vacancies (England)



Source: TIMSS 2015.

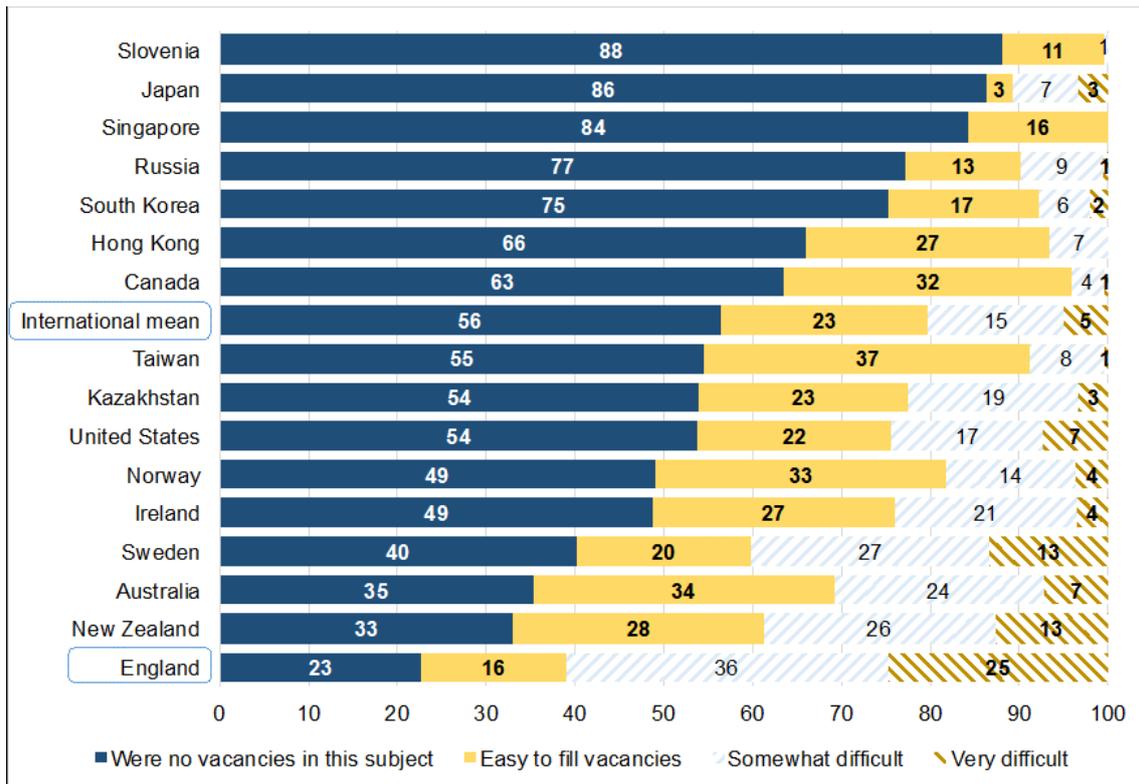
In relation to countries from the comparator groups, these data reflect higher rates of vacancies in England (see Figure 75 below). In both maths and science, all of the comparator group countries had larger proportions of year 9 pupils taught in schools where there were either no vacancies or vacancies that were easy to fill, than England. In Singapore, 100 per cent of pupils in maths and 97 per cent of pupils in science were taught in schools where there were either no vacancies or vacancies that were easy to fill.

In terms of vacancies that were very difficult to fill, the proportion of year 9 pupils in England taught in schools in which it was very difficult to recruit maths and/or science specialists was higher than the proportion in each of the comparator countries. Across both maths and science, Sweden and New Zealand had the next highest proportions of pupils taught in schools in which it was very difficult to recruit maths specialists, and in science, Sweden was again second-highest. The proportion of pupils taught in schools in which it was very difficult to recruit maths and/or science specialists in each of the other comparator countries was below ten

per cent. No pupils in Singapore, Hong Kong and Slovenia were taught maths in schools in which it was very difficult to recruit specialists, while in science pupils in these countries were joined by peers from South Korea and Canada.

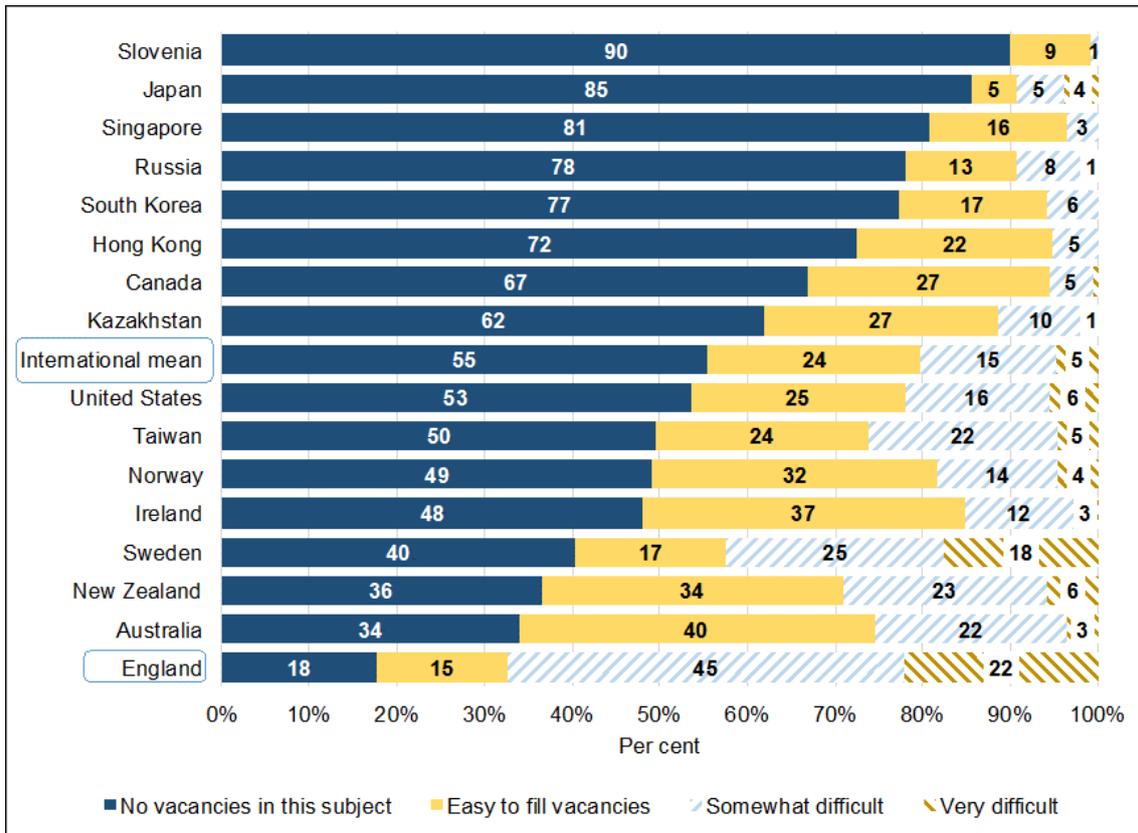
Across all participating countries, only South Africa had a higher proportion of year 9 pupils taught in schools in which it was very difficult to recruit maths specialists than England, while in science, this was true for only Israel and South Africa.

Figure 75: Percentages of year 9 pupils taught in schools according to the level of difficulty in filling maths vacancies (England and comparator group countries)



Source: TIMSS 2015.

Figure 76: Percentages of 9 pupils taught in schools according to the level of difficulty in filling science vacancies (England and comparator group countries)



Source: TIMSS 2015.

8.5 How do pupils and staff rate their school climates in terms of discipline, safety and orderliness, and bullying?

Pupils' behaviour and safety is measured using four sources of data:

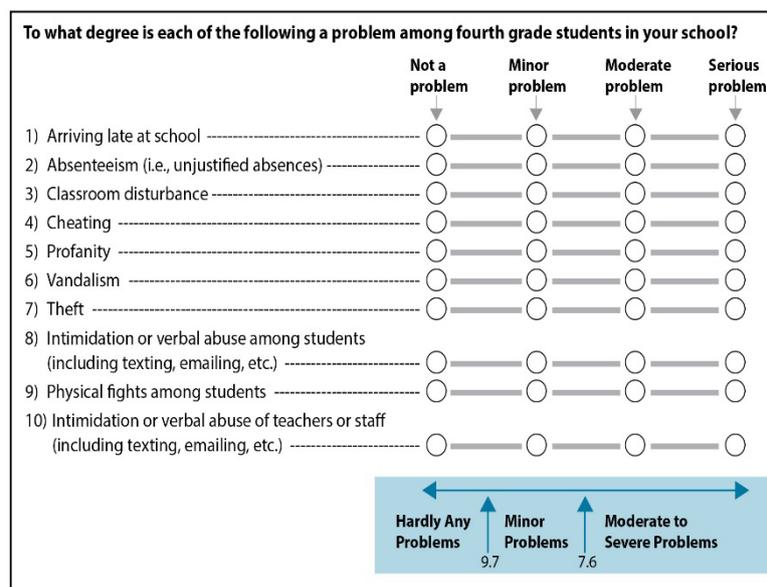
- headteachers reporting on the extent to which pupils are taught in schools in which there are discipline problems
- teachers reporting on the extent to which pupils are taught in schools that are safe and orderly
- pupils reporting on their experience of bullying behaviours
- pupils reporting on how safe they feel at school

Each is reported below with reference to year 5 and 9 pupils' average achievement in maths and science.

8.5.1 To what extent are pupils taught in schools with discipline problems?

Headteachers' views on the extent of discipline problems in their schools were assessed through a questionnaire comprising 10 statements for year 5, and 11 statements for year 9 ('Physical injury to teachers or staff' was included in the latter). There is some slight variation between the year 5 and year 9 statements for question 9, with the year 9 statement focusing on physical injury rather than fights. Figure 77 below shows the year 5 version of the questionnaire.

Figure 77: TIMSS questionnaire assessing headteachers' views on the extent to which there are discipline problems in their schools (maths year 5 version)



Source: TIMSS 2015.

Based on headteachers' response to these statements, pupils were assigned to one of three categories – those taught in schools in which there were either: hardly any problems; minor problems or moderate to severe problems⁹³. As in previous sections, the findings for maths in each year group are presented with any notable differences to science identified.

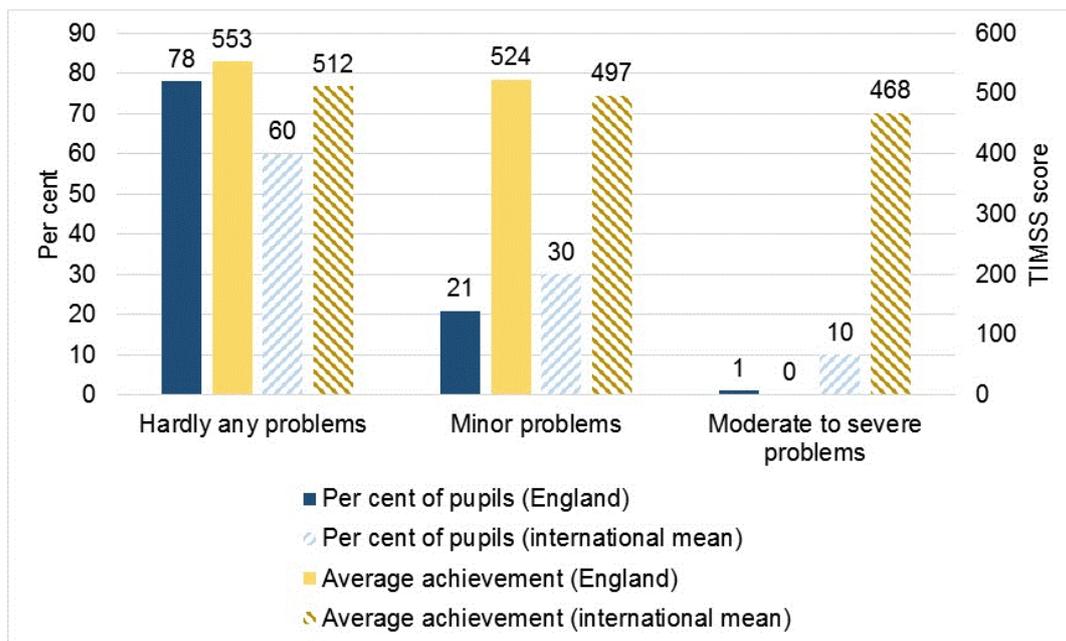
Year 5

Year 5 pupils in England were mostly taught in schools with hardly any problems (78%), while 21 per cent were taught in schools with minor problems (see Figure 78 below). There is an association between the level of discipline problems and pupils'

⁹³ See [Appendix E Table E13](#) for an explanation of how categories were determined from questionnaire responses.

average achievement, both in England and across participating countries as a whole, on average: the fewer the problems, the higher average achievement. The difference in average achievement between year 5 pupils taught in schools in England with hardly any problems compared to those taught in schools with minor problems was nearly double that found across participating countries as a whole, on average (29 scale points compared to 15).

Figure 78: Year 5 pupils taught in schools with different levels of school discipline problems according to headteachers and their average achievement in maths (England with international comparisons)



Source: TIMSS 2015.

Note 1: School discipline problems reported by headteachers.

Note 2: Average achievement for year 5 pupils in England was lower in science in both the hardly any problems and minor problems categories (542 and 517 respectively).

Year 5 pupils were among the least affected by discipline problems across all countries. The proportion taught in schools with hardly any problems was above the international mean (78% compared to 60%). Only Ireland, the Netherlands, South Korea and Lithuania had larger proportions of year 5 pupils taught in schools with hardly any problems, than England.

In maths, the six highest-performing countries (the East Asian group and Northern Ireland) were all above the international mean for the proportion of pupils taught in schools with hardly any discipline problems. In science, Slovenia was the only high-performing country below the international mean (61%), with 52 per cent of its pupils taught in schools with hardly any discipline problems. All of the seven English-speaking countries were above this mean. However, from the comparator countries,

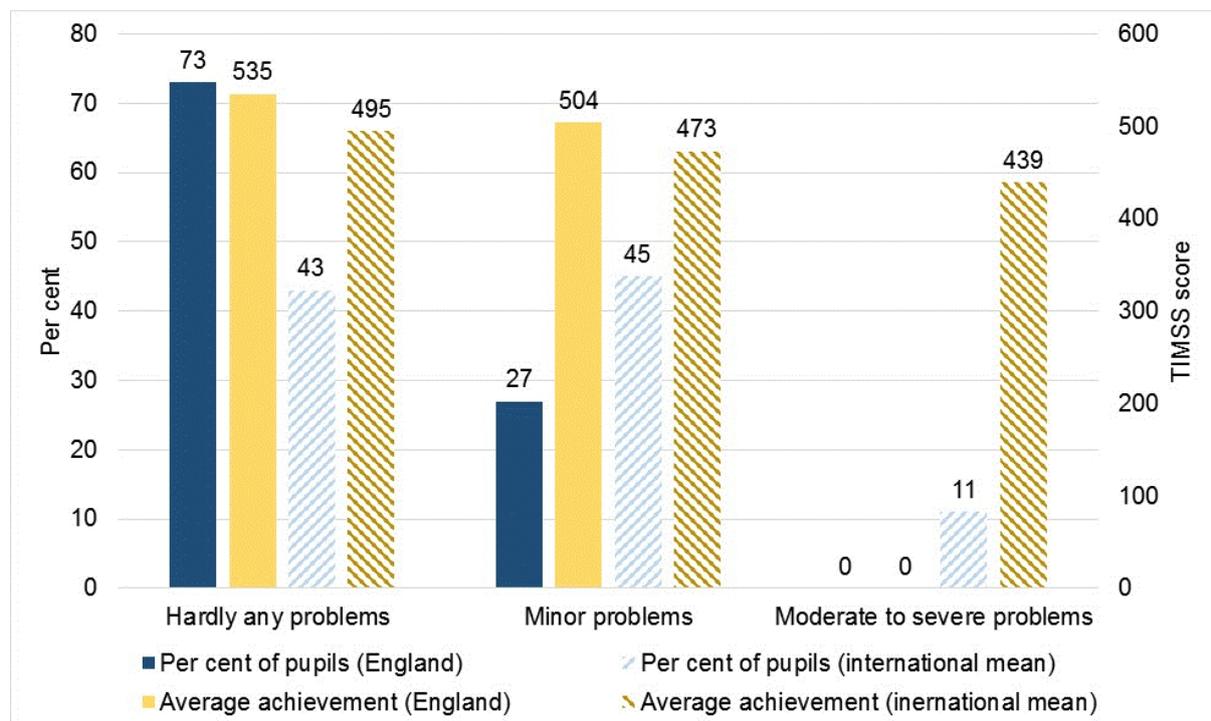
a number of European countries were below the international mean, including Denmark, Sweden and France.

Year 9

Figure 79 shows the proportion of year 9 pupils taught maths in schools with different levels of discipline problems. As with year 5, year 9 pupils in England were mostly taught in schools with hardly any problems (73%), with the remainder taught in schools with minor problems (27%). No pupils were taught in schools with moderate to severe problems.

As in year 5, there is an association between the level of discipline problems and pupils' average achievement, both in England and across participating countries as a whole, on average. The difference in average achievement between year 9 pupils in England taught in schools with hardly any problems compared to those taught in schools with minor problems is approximately a third larger than that found across participating countries as a whole, on average (31 scale points compared to 22).

Figure 79: Year 9 pupils taught in schools with different levels of school discipline problems according to headteachers and their average achievement in maths (England with international comparisons)



Source: TIMSS 2015.

Note 1: School discipline problems reported by head teachers.

Note 2: Average achievement for year 9 pupils in England in the Hardly any problems and Minor problems categories was higher in science than in maths (552 and 522 respectively).

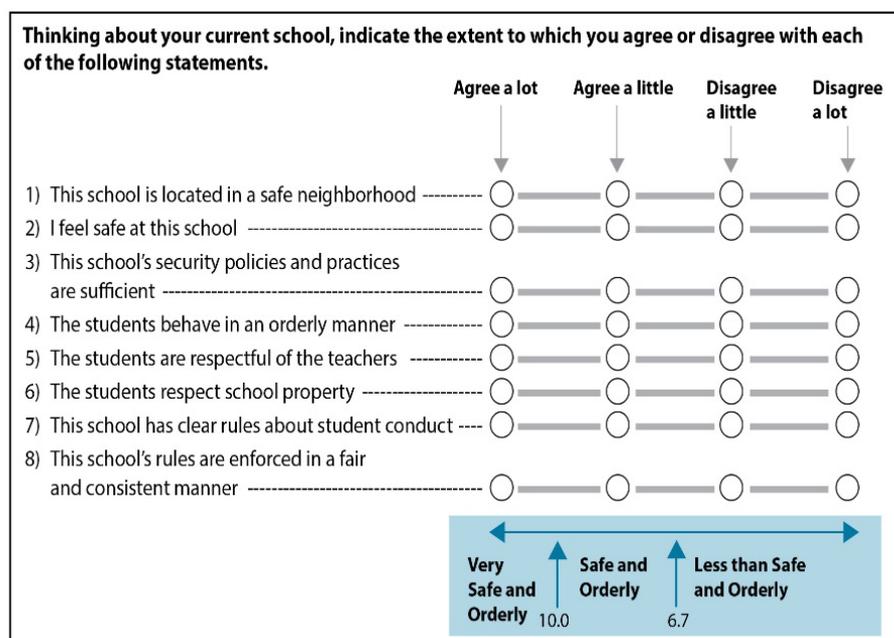
The proportion of year 9 pupils in England taught in schools with hardly any problems (73%) was notably higher than the international mean (43%). Only Singapore (the highest-performing country) had a larger proportion of pupils than England. The other highest-performing countries (the remainder of the East Asian group and Russia) all had proportions above the international mean. In science, the highest-performing countries (the East Asian countries and Slovenia) were similarly all above the international mean, except Slovenia, for the proportion of pupils taught in schools with hardly any problems according to their schools' principals.

Of the English-speaking countries, England, Ireland, Australia and Canada were all above the international mean for the proportion of pupils taught in schools with hardly any problems, while the United States and New Zealand were below this. Of the countries that performed similarly to England in maths, half were below this mean, while in science, only two were: Hungary and the United States.

8.5.2 To what extent are pupils taught in schools that are safe and orderly?

Teachers reported on the extent to which pupils were taught in safe and orderly schools and this was assessed through a questionnaire comprising eight statements (see Figure 80 below). These statements were the same for both subjects and year groups.

Figure 80: TIMSS questionnaire assessing teachers' views on the extent to which their schools are safe and orderly (year 5 maths version)



Source: TIMSS 2015.

Based on how much teachers agreed with these statements, pupils were assigned to one of three categories – those taught in schools that were either: very safe and orderly; safe and orderly or less than safe and orderly⁹⁴.

Year 5

Year 5 pupils in England were mostly (76%) taught maths in schools that were very safe and orderly (73% in the science study). The remainder were taught in schools that were safe and orderly, except for one per cent taught in schools identified as less than safe and orderly according to teachers of science (see Figure 81 below). These findings largely align with headteachers' views on the proportion of pupils taught in schools with different levels of school discipline problems.

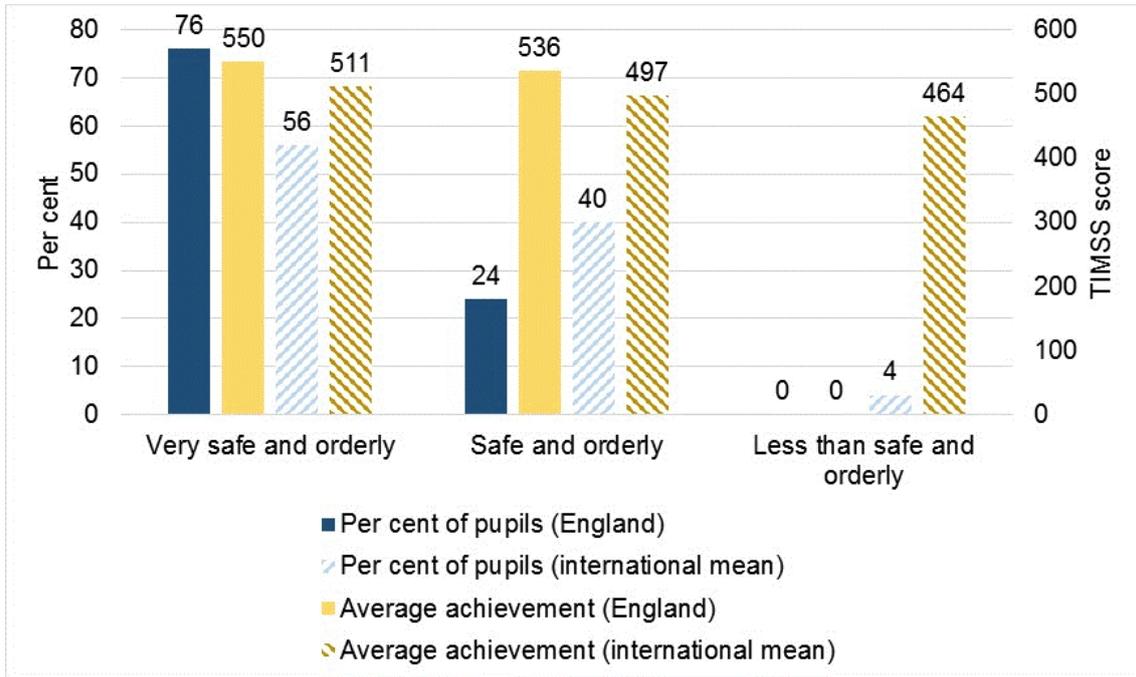
There is an association between the extent to which year 5 pupils in England were taught in schools that were safe and orderly and their average achievement: the more safe and orderly the school, the higher pupils' average achievement⁹⁵. This was also the case, on average, across all participating countries. The difference in average achievement between year 5 pupils in England taught maths in very safe and orderly schools compared to those taught in safe and orderly schools was the same as that found, on average, across all participating countries (14 scale points).

The proportion of year 5 pupils in England taught in very safe and orderly schools, according to their teachers, is above the international mean (76% compared to 56% in maths and 73% compared to 57% in science). Only Indonesia, Northern Ireland, Ireland, Qatar, and Spain had larger proportions of pupils taught maths in very safe and orderly schools. These same countries also had larger proportions of pupils taught in such schools in science with the addition of two comparator group countries: Australia and Kazakhstan (the latter of which performed significantly higher than England). This means that pupils in the East Asian group were taught in schools with smaller proportions of pupils taught in very safe and orderly schools than England according to their teachers' views. While Hong Kong and Singapore were above the international mean for the proportion of pupils taught in schools that were very safe and orderly, Taiwan, South Korea and Japan were all below this.

⁹⁴ See [Appendix E Table E14](#) for an explanation of how categories were determined from questionnaire responses.

⁹⁵ No average achievement data were reported for the one per cent of pupils in the 'less than safe and orderly' schools.

Figure 81: Year 5 pupils taught in schools with different levels of safety and orderliness according to teachers and their average achievement in maths (England with international comparisons)



Source: TIMSS 2015.

Note 1: Degree of safety and orderliness reported by teachers.

Most of the English-speaking countries were above this international mean (Northern Ireland, Ireland, Australia and New Zealand), while Canada and the United States were just below the mean (in science the United States’ proportion was the same as the mean). A number of the European comparator countries (Denmark, France, Sweden, Finland and Slovenia) had the smallest proportions of pupils taught maths in very safe and orderly schools, alongside Taiwan and Japan (with Taiwan outside of this set of countries in science).

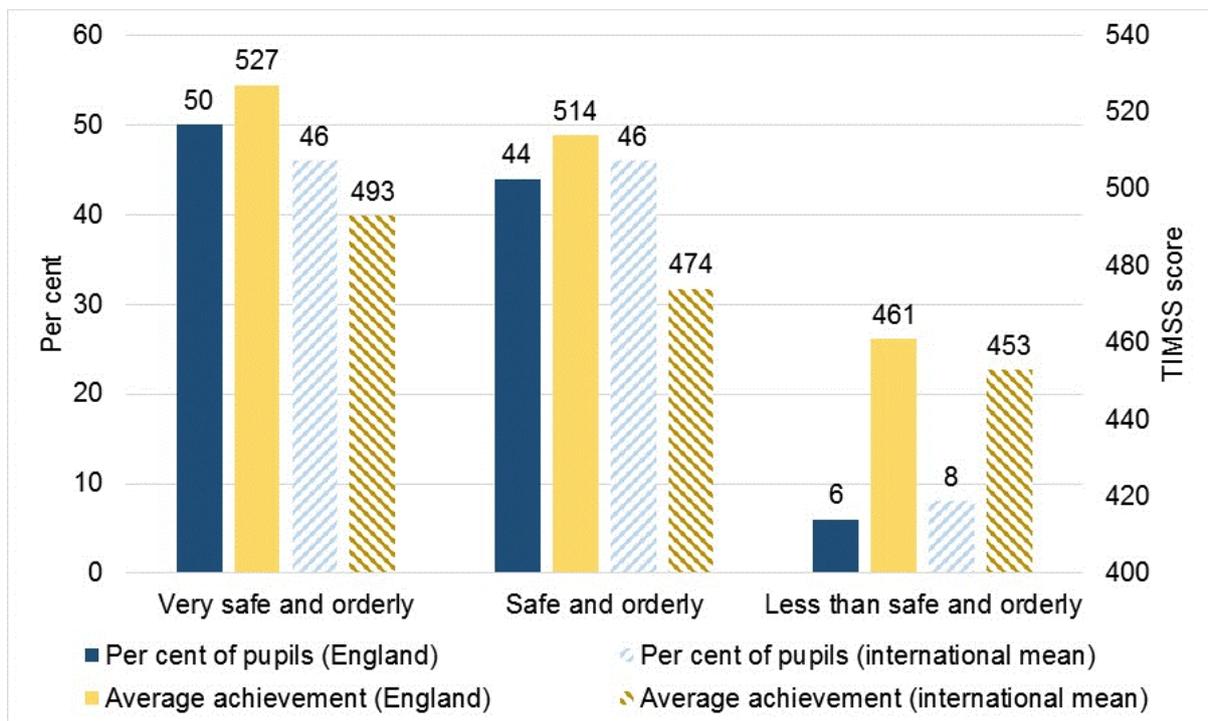
Year 9

In year 9, as shown in Figure 82 below, about half of year 9 pupils in England were taught in schools that were very safe and orderly, with around one in twenty (6%) taught in schools that their teachers consider to be less than safe and orderly. This latter proportion is notably larger than for year 5 (1% according to year 5 teachers of science only), while similar to the international mean (8%). It is noteworthy that year 9 teachers in England seemed to rate school behaviour less favourably than their headteachers, although the questionnaires and statements were different. This disparity was less evident across all participating countries, on average, where proportions were far closer.

As in year 5, there is an association between the extent to which pupils in England

were taught in schools that were safe and orderly and their average achievement: the more safe and orderly the school, the higher pupils' average achievement. This is also evident across all participating countries. The difference in average achievement between year 9 pupils taught in schools that were very safe and orderly compared to those taught in less than safe and orderly schools was larger than that found, on average, across all participating countries in maths (66 scale points compared to 40). However, in science, the difference was smaller (53 scale points compared to 42).

Figure 82: Year 9 pupils taught in schools with different levels of safety and orderliness according to teachers and their average achievement in maths (England with international comparisons)



Source: TIMSS 2015.

Note 1: Degree of safety and orderliness reported by teachers.

Note 2: The average achievement of pupils in England in science was higher across all three categories (551, 527 and 498).

The proportion of year 9 pupils in England taught in very safe and orderly schools, according to their teachers, is slightly above the international mean. The United States is the only country from the English-speaking group of countries with a smaller proportion of pupils taught maths in very safe and orderly schools (this group also comprises: Ireland, Canada, Australia and New Zealand; Northern Ireland did not participate in year 9 assessments in 2015).

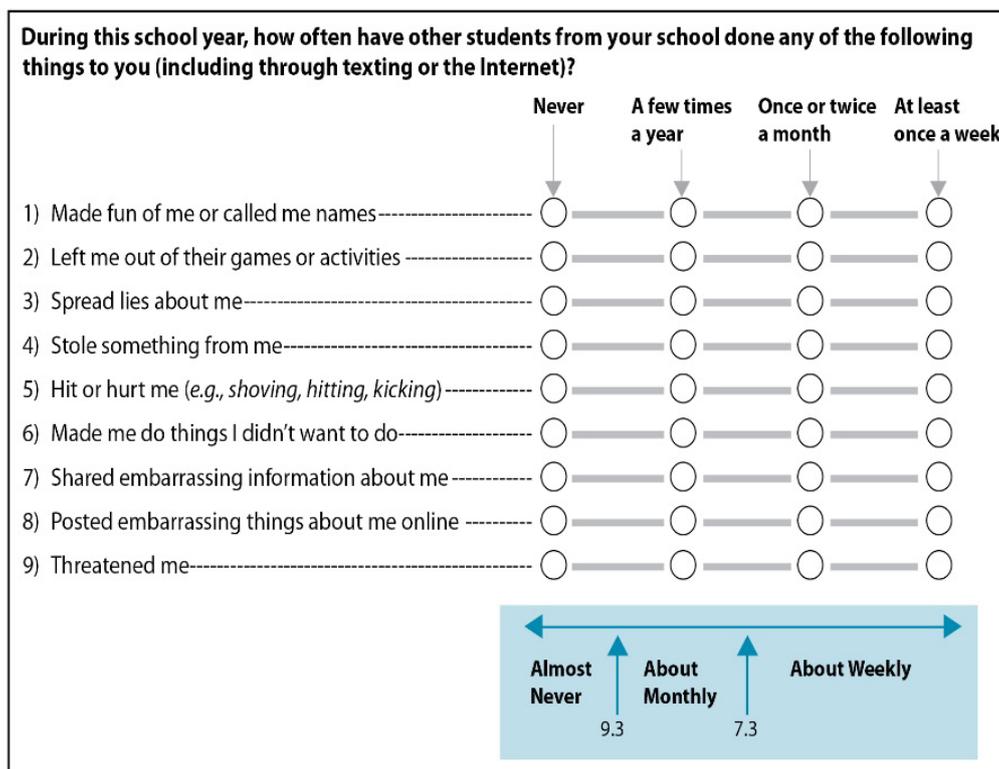
Of the six highest-performing countries, only Singapore and Hong Kong had larger proportions of year 9 pupils taught in safe and orderly schools than England. Except

for Russia, the other highest-performing countries (Taiwan, South Korea and Japan in both subjects, and Slovenia in science only) are below the international mean (46 in maths and 45 in science). Of those performing at a similar level to England in both subjects, both Ireland and Kazakhstan have relatively large proportions of pupils taught in very safe and orderly schools. Norway, which performs similarly to England in science, also has a relatively large proportion.

8.5.3 To what extent are pupils taught in schools in which they experience bullying behaviours?

Pupils reported on the extent to which they experienced bullying behaviours, which was assessed through a questionnaire (see Figure 83 below) comprising eight statements for year 5 pupils and nine statements for year 9 pupils (statement 8: ‘Posted embarrassing things about me online’ was added for year 9 questionnaires). There were no differences in questionnaires between subjects.

Figure 83: TIMSS questionnaire assessing pupils’ views on the extent to which they had experienced bullying behaviours in the past year (year 9 version)



Source: TIMSS 2015.

Based on how much pupils' agreed with these statements, they were assigned to one of three categories - those taught in schools in which they experienced these behaviours: almost never; about monthly or about weekly in the past year⁹⁶.

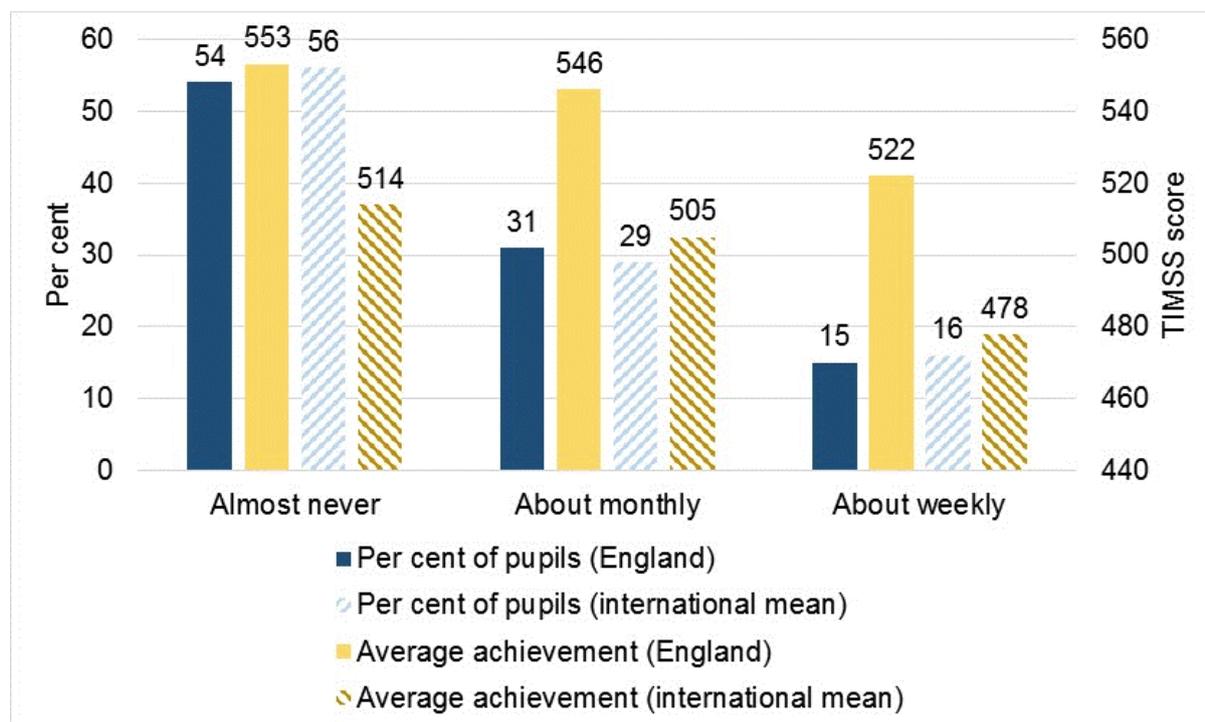
Year 5

Just over half (54%) of year 5 pupils in England almost never experienced the eight bullying behaviours, as shown in Figure 84 below. About a third (31%) experienced these about monthly and about one in six pupils (15%) experienced these about weekly. These percentages are very similar to the international means from across participating countries as a whole.

There is an association between the extent to which year 5 pupils in England experienced the eight behaviours and their average achievement: the lesser the extent to which pupils experience these behaviours, the higher their average achievement. The average achievement of pupils in England who experienced these behaviours the most was 31 scale points lower than those who experienced them the least in maths (26 scale points in science). The difference in average achievement between year 5 pupils in England who almost never experienced these behaviours and those that experienced them about weekly was lower than across participating countries as a whole, on average (31 scale points compared to 36 points in maths, and 26 points compared to 34 points in science).

⁹⁶ See [Appendix E Table E15](#) for an explanation of how categories were determined from questionnaire responses.

Figure 84: Percentage of year 5 pupils taught in schools with different levels of experience of bullying behaviours according to pupils and their average achievement in maths (England with international comparisons)



Source: TIMSS 2015.

Note 1: Level of bullying behaviours experienced reported by pupils.

Note 2: The average achievement for year 5 pupils in England in science was lower across all categories (542, 535 and 516 respectively).

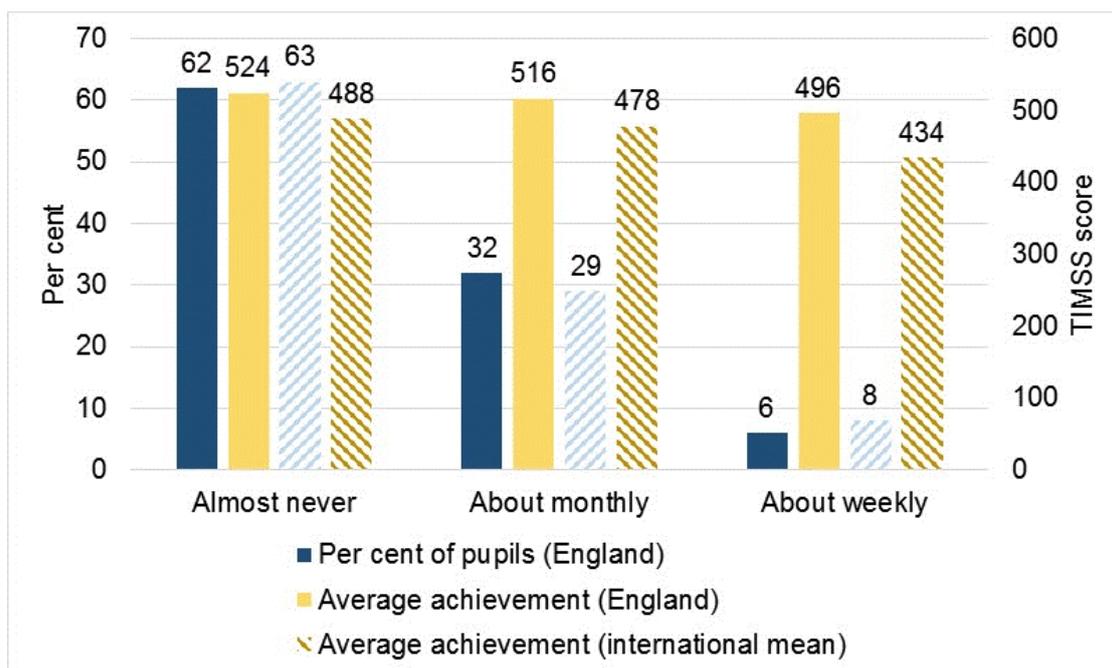
Of the 14 countries that performed either significantly higher, or similarly to England, only Russia, Singapore and Belgium (Flanders) had smaller proportions of year 5 pupils that had almost never experienced the bullying behaviours, compared to England. Canada, Australia and New Zealand (all of which performed significantly lower than England) also had smaller proportions than England, while Ireland had the largest proportion of pupils that had almost never experienced these. In science, these findings were replicated, except that Belgium (Flanders) was replaced by Bulgaria. The average achievement of the former was significantly lower than England's, while Bulgaria's was similar.

Year 9

Figure 85 below shows that, in year 9, nearly two-thirds (62%) of pupils in England almost never experienced the nine bullying behaviours they reported on, a higher proportion than in year 5. About one in twenty (6%) year 9 pupils experienced these behaviours about weekly, which is less than half the proportion for year 5 (6% compared to 15%). These proportions are very similar to the international means across all participating countries.

As with year 5 pupils, there is an association between the extent to which English year 9 pupils experience the eight behaviours and their average achievement: the lesser the extent to which pupils experience these, the higher their average achievement. Pupils who experienced these behaviours the most had an average achievement score 28 scale points below those who almost never experienced them. The association is also found across participating countries as a whole, on average.

Figure 85: Year 9 pupils taught in schools with different levels of experience of bullying behaviours according to pupils and their average achievement in maths (England with international comparisons)



Source: TIMSS 2015.

Note 1: Level of bullying behaviours experienced reported by pupils.

Note 2: The average achievement for pupils in England was higher in each of the categories for science (540, 538 and 516 respectively).

Of the 15 countries with average achievement in year 9 maths either significantly higher, or similar to England's, only Hong Kong and Singapore had smaller proportions of pupils that had almost never experienced the nine behaviours than their English peers⁹⁷. Australia and New Zealand were the only English-speaking countries that had smaller proportions of pupils almost never experiencing such behaviours. Six of the eight highest proportions were those of countries from the comparator groups: Taiwan, Kazakhstan, South Korea, Japan, Norway and Ireland. All of these countries performed significantly higher, or similar to England (except Norway in science).

⁹⁷ There were no data for Israel for year 9 pupils experiencing bullying behaviours.

8.5.4 To what extent do pupils feel safe at school?

One of the questions pupils were asked in the TIMSS Sense of School Belonging questionnaire was to what extent they felt safe at school. Pupils were able to answer with one of four responses: agree a lot; agree a little; disagree a little or disagree a lot.

Seventy-one per cent of year 5 pupils in England agreed a lot with feeling safe at school; five per cent disagreed a little and two per cent disagreed a lot. Of the English-speaking countries, pupils from both Northern Ireland and Ireland had slightly larger proportions of pupils that agreed a lot with feeling safe than their peers in England. Pupils from all of the five highest-performing East Asian countries had smaller proportions of pupils that agreed a lot with feeling safe at school than peers in England. Three of these (Japan, South Korea and Taiwan) had the smallest proportions across all countries that agreed a lot with feeling safe at school.

Forty-four per cent of year 9 pupils in England agreed a lot with feeling safe at school; ten per cent disagreed a little and two per cent disagreed a lot. A greater proportion of pupils from all the other English-speaking countries agreed a lot to feeling safe than their peers in England. Pupils from the five East Asian countries, as in year 5, had relatively small proportions of pupils that agreed a lot with feeling safe at school, alongside Russia and Slovenia from the comparator groups.

In summary, year 5 pupils in England felt safer in school than their year 9 peers (71% compared to 44% agreeing a lot). Compared to year 5 pupils, twice as many year 9 pupils disagreed a little that they feel safe at school (10% compared to 5%).

8.6 Summary of school related factors and how they influence pupil learning

Table 16 below offers a comparison of the achievement differences related to the first three school related factors analysed in this chapter – focus on academic success, problems with conditions and shortage of resources. It compares the difference between the average achievement of pupils in the highest category (for example, very high emphasis) with those in the lowest category (for example, medium emphasis) for each year group, except in the third column (shortage of resources) where no schools in England were in the lowest category and so comparison is made between the top and middle categories. Caution should be used in interpreting these findings, both because of the points raised previously about the difference between correlation and causation, but also because the third column measures the difference between the top two categories of response, rather than all three categories as in the first two columns. It is also important to highlight that the

first and third columns reflect headteacher responses, while the middle column reflects teacher responses.

Across these three whole-school factors, the school's emphasis on academic success (according to headteachers) is associated with a much wider range of pupils' average achievement than either of the other two factors, both in England and across participating countries as a whole. In year 9 there was an 89 scale point gap between pupils taught in schools with a very high emphasis on academic success and those in schools with a medium emphasis on success (the lowest category), on average. This indicates that an emphasis on academic success (and the statements related to this in the TIMSS questionnaire for this factor) may be more influential, in terms of its impact on pupil performance, than whether or not a school faces problems with conditions or a shortage of resources. However, it is worth remembering that the equivalent range for year 9 pupils' confidence in maths in England (the pupil level factor associated with the greatest range of performance in the last chapter) was greater (99 scale points) than the difference for a focus on academic success (89 scale points).

Table 16: Comparison of the average achievement differences between the highest and lowest category scores in three whole-school factors (England with all participating TIMSS countries in parentheses)

	School emphasis on academic success	School problems with conditions and resources	Shortage or inadequacy of resources⁹⁸
	Average achievement difference	Average achievement difference	Average achievement difference
Year 5 maths	54 (37)	6 (13)	20 (17)
Year 9 maths	89 (69)	25 (23)	24 (31)

Source: TIMSS 2015.

Table 17 draws together three of the aspects studied in this chapter that relate to behaviour and safety. It compares them to average achievement, enabling comparisons to be drawn although, in addition to the points raised above around interpreting these tables, it should be noted that the data comes from three different sources – headteacher (column 1), teachers (column 2) and pupils (column 3).

⁹⁸ As there are no data for the lowest category for pupils in England, the difference between the highest (not affected) and second-highest (affected) categories has been calculated, both for England and all other participating countries

In the third column, the difference between the average achievement for the lowest and highest categories is calculated to provide a scale point difference. For the first column, and in year 5 for the second column, there were no pupils in England taught in schools in the lowest categories, so in these cases the difference has been calculated between the highest and second-highest categories as explained in the footnotes. This makes comparisons between the columns less direct.

The potential effect of school discipline problems on average achievement appears to be more notable for pupils in England than for pupils across all countries as the performance gaps between pupils taught in schools with very few problems and minor problems are larger than the equivalent gaps at the international level. Similarly, the potential effect of being taught in a safe and orderly school at year 9 in England appears more notable: the difference between the first category (hardly any problems) and second category (minor problems) is 26 scale points more than across all countries (66 scale points compared to 40). The potential effects of bullying behaviours are similar, in terms of scale point differences, to those calculated across all countries in year 5, but not as great in year 9 (28 compared to 54 scale point difference).

Table 17: Comparison of the average achievement differences between the highest and lowest category scores in three behaviour and safety aspects (England with all participating TIMSS countries in parentheses)

	The extent to which pupils were taught in schools with different levels of discipline problems⁹⁹	The extent to which pupils were taught in safe and orderly schools	The extent to which pupils were taught in schools in which they experienced different levels of bullying behaviours
	Average achievement difference	Average achievement difference	Average achievement difference
Year 5 maths	29 (16)	14 (14) ¹⁰⁰	31 (36)
Year 9 maths	31 (22)	66 (40)	28 (54)

Source: TIMSS 2015.

⁹⁹ As there were no data for the lowest category for year 5 and 9 pupils in England, the difference has been calculated between the highest category (hardly any problems) and the second category (minor problems) both for England and all other participating countries.

¹⁰⁰ As there were no data for the lowest category for year 5 pupils in England, the difference has been calculated between the highest category (very safe and orderly) and the second category (safe and orderly) both for England and all other participating countries.

Chapter 9. Teachers and teaching

This chapter focuses on aspects related to teachers and their teaching. It presents data and analyses on:

- the number of hours devoted to teaching maths and science
- teachers' experience in years
- the extent of teachers' training in maths and science and the foci for this
- teachers' confidence in teaching maths and science
- the extent to which teachers face challenges in teaching and their job satisfaction
- how teaching is assessed

As in the previous section, the TIMSS teacher and headteacher samples are small. For this reason a number of findings may not be significant despite appearing large. Comparisons with other countries are provided where relevant.

9.1 Main Findings

- Pupils in year 5 in England spend more time learning maths than the international mean, but less time learning science. Pupils in year 9 in England spend less time learning maths than the international mean, and substantially less time learning science. Across all countries, there does not appear to be an association between more teaching time and higher average achievement.
- Teachers in England generally have less teaching experience than the international mean. Across TIMSS countries as a whole there is a relatively weak association between pupils being taught by more experienced teachers and performing slightly higher, but this is not consistently the case in England.
- More year 5 pupils in England have computers available in maths and science lessons than was the case, on average, for their peers in other countries. In year 9, about the same proportion of pupils in England have computers available as their peers in other countries in maths, while in science, the proportion was considerably higher. Across all countries, there is an association between availability of computers and higher average achievement across both years and subjects.
- Year 9 pupils in England spend less time on homework, on average, than other countries as a whole. In England, both in maths and science, there is an association between pupils spending between 45 minutes and 3 hours on homework and higher average achievement, compared to less than 45 minutes. This association is also found across all participating countries.
- The majority of year 5 and 9 pupils in England are taught maths by teachers who have undertaken recent training centred upon content, curriculum and pedagogy/instruction (less so for science teachers). This is higher than in most other countries, particularly in year 5.
- Most year 5 and 9 pupils in England were taught by teachers that reported very high or high levels of confidence in the different aspects of teaching maths and science.
- Teachers in England (particularly year 9 science teachers) report relatively challenging teaching conditions, an overarching theme that covers issues such as having too many teaching hours or difficulty keeping up with curriculum changes. Job satisfaction among year 5 and 9 teachers in England is low compared to teachers in most other countries. Only pupils in Japan were taught by teachers with lower levels of job satisfaction at year 9. In England there is an association between pupils' average achievement and the level of their teachers' satisfaction.

9.1 How many hours are spent teaching maths and science in schools in England?

Year 5

Instructional time spent teaching maths and science is calculated using headteacher and teacher TIMSS questionnaire responses. In England, year 5 pupils were taught maths, on average, for 189 hours out of a total 994 hours in the academic year (19%), above the international mean.

As shown in Figure 86 below, countries from the comparator groups that devoted more teaching time to maths included two that performed significantly higher than England (Singapore and Northern Ireland), and two that performed similarly to England (Belgium (Flanders) and the United States). Other countries from the comparator groups that devoted more teaching time to maths all performed significantly lower than England: Australia, Canada and France.

Russia and South Korea (both of which also performed significantly higher than England) were two of four countries across all those participating that devoted the least teaching time to maths. South Korea, for example, devoted 89 fewer hours than England. There is therefore no clear association between more time devoted to maths teaching in year 5 and higher average achievement.

**Figure 86: Hours per year devoted to year 5 maths teaching
(England and comparator countries)**

Source: TIMSS 2015.

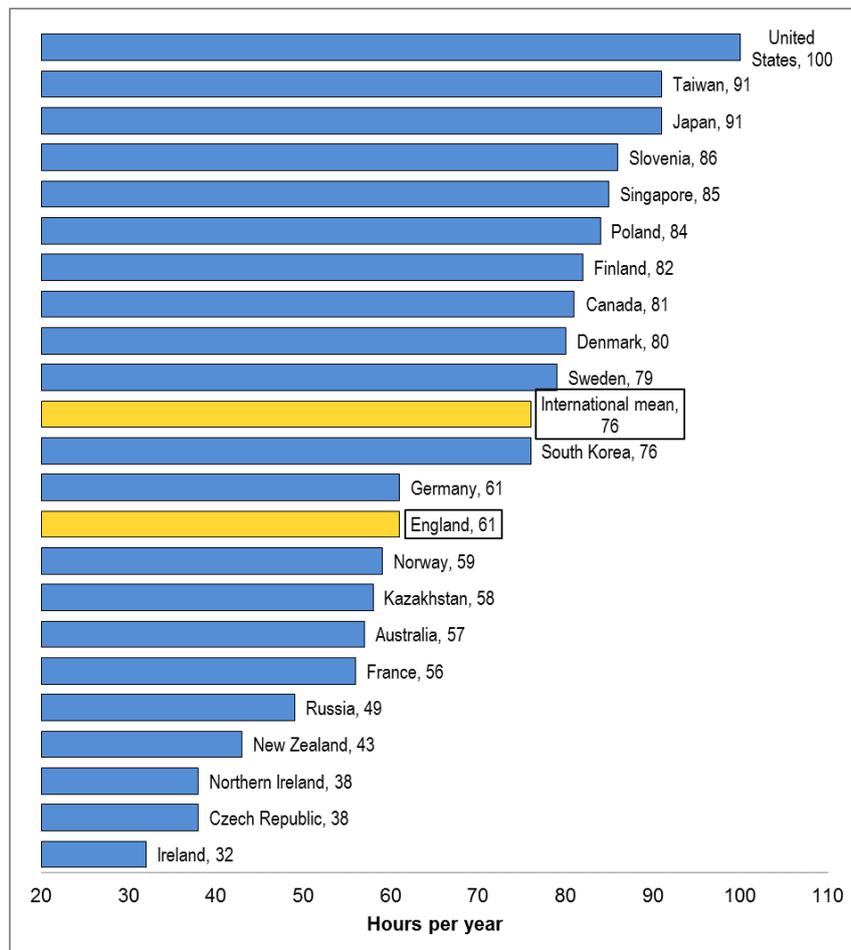
In science, year 5 pupils in England were taught for an average of 61 hours out of a total of 994 in the academic year (6%), below the international mean, as shown in Figure 87 below.

Comparator countries that devoted more teaching time to science included the majority of those that performed significantly higher than England (the East Asian group¹⁰¹, the United States, Slovenia, Poland, Finland), and one that performed similarly to England (Sweden). Of the countries that performed significantly higher than England, only Russia and Kazakhstan devoted less teaching time to science; although the latter only devoted three fewer hours annually. Two countries from the

¹⁰¹ Except Hong Kong for which no data were presented.

comparator groups that devoted more teaching time to science performed significantly lower than England: Canada and Denmark. While the highest-performing countries tend to devote more teaching time to science than England, Russia is a notable exception.

Figure 87: Hours per year devoted to year 5 science teaching (England and comparator countries)



Source: TIMSS 2015.

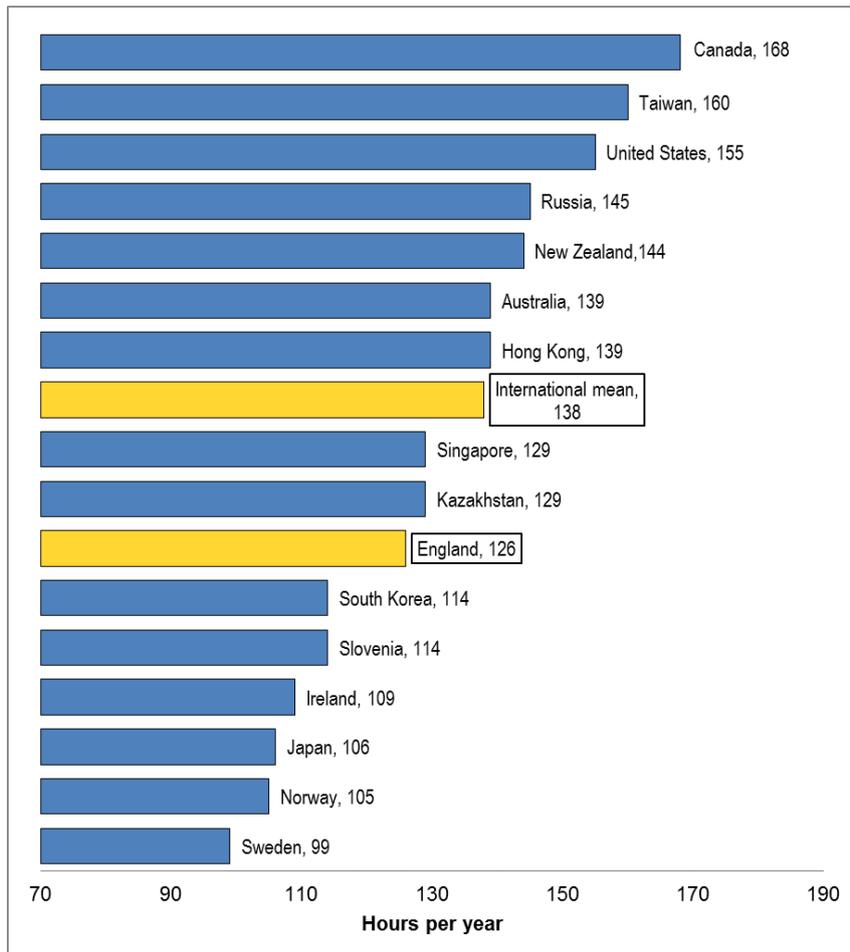
Year 9

In England, year 9 pupils were taught maths, on average, for 126 hours, out of a total teaching time of 1,009 hours per year (about 12%), lower than the international mean, as shown in Figure 88 below.

Countries that devoted more teaching time to maths in year 9 include those that performed significantly higher than England (Taiwan, Russia, Hong Kong and Singapore); those that performed similarly (Canada, the United States and Kazakhstan) and those that performed significantly lower (Australia and New Zealand). However, the highest-performing country overall (Singapore) only devoted

three more hours annually to year 9 maths teaching than England. South Korea and Japan (both of which performed significantly higher than England) devoted less teaching time to maths. As in year 5, there is therefore no clear association between more time devoted to maths teaching in year 9 and higher average achievement.

Figure 88: Hours per year devoted to year 9 maths teaching (England and comparator countries)



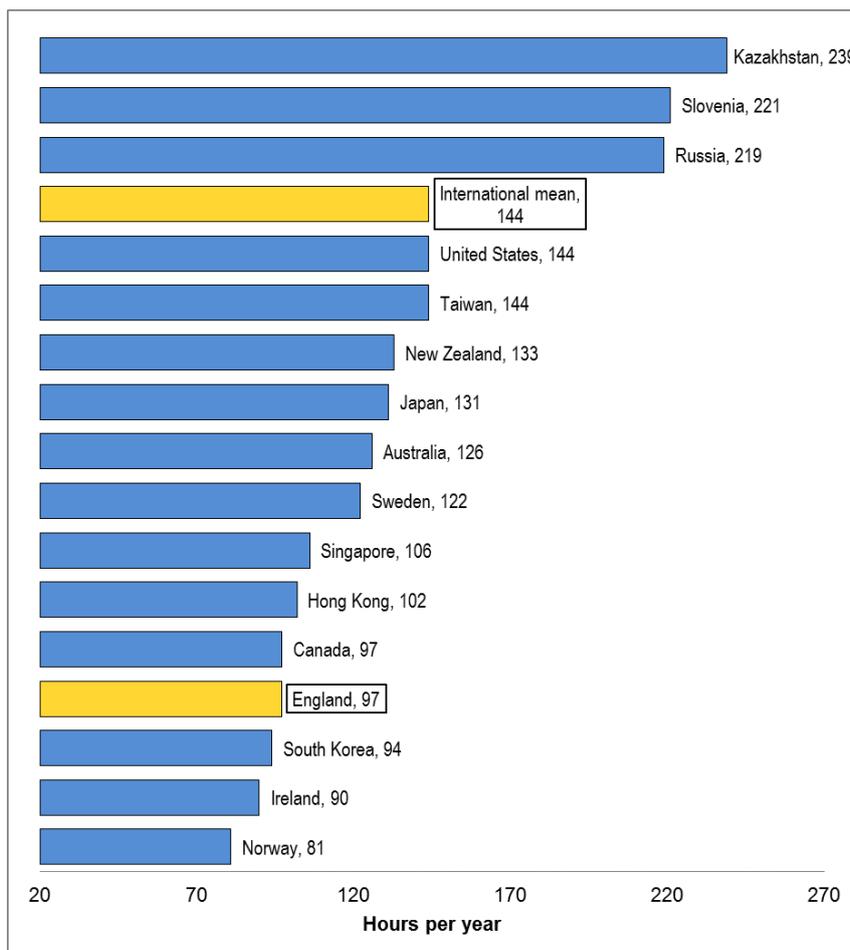
Source: TIMSS 2015.

In science, year 9 pupils in England were taught for 97 hours per year on average out of a total teaching time of 1,009 hours (11%), notably less than the international mean, as shown in Figure 89 below.

Countries that devoted more teaching time to maths include all those that performed significantly higher than England, apart from South Korea (i.e. Singapore, Japan, Taiwan and Slovenia). However, South Korea only devoted three hours less annually than England while Singapore only devoted nine hours more (see Figure 89 below). By contrast, Slovenia devoted more than double the amount of teaching time to year 9 science compared to England. Of the comparator group countries that performed at a similar level to England (Hong Kong, Russia, Kazakhstan, Ireland and the

United States), all devoted more teaching time to science than England, except Ireland. Similarly to Slovenia, both Russia and Kazakhstan devoted more than twice the teaching hours to science compared to England. Norway devoted less teaching time to science and performed significantly lower than England. Slovenia was the only country from the highest-performing group to devote more time to teaching science than the international mean. There is therefore no clear association between more time devoted to science teaching in year 9 and higher achievement.

Figure 89: Hours per year devoted to year 9 science teaching (England and comparator countries)



Source: TIMSS 2015.

9.2 Do maths and science lessons in schools in England differ from those in other TIMSS countries?

Teachers were asked about the extent to which science investigation was emphasised in lessons and about the availability of computers in lessons in maths and science. Year 9 pupils only were asked about the amount of time they spent on homework each week.

9.2.1 To what extent are year 5 pupils taught by teachers who emphasise science investigation in about half the lessons or more?

In England, 26 per cent of year 5 pupils were taught by teachers who emphasised science investigation in about half of their lessons or more, similar to the international mean (27%). The difference in the average achievement between year 5 pupils in England that were taught in these lessons, compared to those taught by teachers that emphasised investigation in less than half of lessons was three scale points (540 compared to 537); the same as the international mean.

Year 5 pupils in the highest-performing East Asian countries in science (South Korea, Taiwan, Singapore and Japan) were taught by teachers who had a greater emphasis on science investigation than teachers in England. Pupils in South Korea, for example, were taught in such lessons more than twice as frequently as their peers in England. However, the scale score difference in average achievement between those pupils in South Korea taught in lessons with a greater emphasis on investigation, compared to those with less of an emphasis, was even smaller than for pupils in England: one scale point.

Kazakhstan, a 'fast mover' from the comparator groups, also had a higher proportion of year 5 pupils taught in lessons with a greater emphasis on science investigation than in England (39% compared to 26%) with a relatively large difference in average achievement between the two Kazakhstan groups: 14 per cent points. Several other high-performing countries had less of an emphasis on science investigation in lessons than England (Finland, Poland, the United States, Russia and Slovenia).

While there is an association, both in England and across all countries, between the proportion of pupils taught by teachers who emphasised science investigation in about half of their lessons or more and average achievement, these differences tend to be small. In some countries, there is no such association, with some pupils, in Poland for example, performing better when the proportion of lessons with this emphasis was less than half.

9.2.2 To what extent are year 9 pupils taught by teachers who emphasise science investigation in about half the lessons or more?

In year 9, 18 per cent of pupils in England were taught by teachers who emphasised science investigation in about half of their lessons or more; below the international mean (27%) and notably less than in year 5. Year 9 pupils whose teachers emphasised investigation tended to score higher. The difference in the average achievement between year 9 pupils in England that were taught in these lessons, compared to those taught by teachers that emphasised investigation in less than half of lessons was 11 scale points (547 compared to 536), while across all countries this difference was five scale points (490 compared to 485).

Of the countries that performed significantly higher than England (Singapore, Japan, Taiwan, South Korea and Slovenia), all had smaller proportions of pupils taught by teachers who emphasised science investigation in about half of their lessons or more than England, except Japan (both had 18% of pupils). However, while there was a positive association between pupils' average achievement in England and being taught in lessons with this emphasis, this was not the case in Japan, where average achievement was five scale points higher for pupils taught in less than half of lessons with this emphasis. These variations were also found in other comparator countries. The eight per cent of year 9 pupils in Singapore that were taught by teachers who emphasised science investigation more, achieved notably higher (617 compared to 595; a difference of 22 scale points). By contrast, pupils in Sweden in such lessons achieved notably lower (497 compared to 524; a difference of 27 scale points).

As in year 5, while there is an association, both in England and across all countries, between the proportion of pupils taught by teachers who emphasised science investigation in about half of their lessons or more and higher average achievement, there is also evidence of exceptions, such as Sweden (and also, Japan, Kazakhstan and Canada, although average achievement differences in these countries were much smaller at around five scale points).

9.2.3 To what extent do year 5 pupils have computers available in maths and science lessons

Maths

Almost three-fifths (58%) of year 5 pupils in England had computers available in maths lessons. This is above the international mean (37%). There is an association for year 5 pupils in England between pupils having computers available in lessons and higher average achievement (551 compared to 542; a difference of nine scale points), this was also found across all countries, on average (510 compared to 504).

Of the seven countries that were in the highest-performing group (the East Asian countries, Russia and Northern Ireland) only the Russia and Ireland had higher proportions of pupils for whom computers were available in maths lessons. Of this group, only Taiwan had a negative association between computer availability and average achievement (595 compared to 598). The country from the comparator groups that had the highest proportion of availability was New Zealand (89%). The average achievement difference between its pupils for whom computers were available in lessons and those for whom they were not was 11 scale points (492 compared to 481) similar to England's difference of nine scale points.

As well as stating whether computers were available in maths and science lessons, teachers also identified, where they were used at least monthly, the purpose for their use in lessons. The categories for use in maths and science varied in most cases, although two were consistently used: to practise skills and procedures, and to look up ideas and information. Teachers could select all those that applied.

In England, where year 5 pupils were taught by teachers who enabled them to use computers at least monthly, the majority (52%) used them to practise skills and procedures compared to the other two purposes: to explore mathematics principles and concepts (49%), and to look up ideas and information (45%). The main purpose of using computers was also found to be to practise skills and procedures in other countries, on average (33%).

Across other countries from the comparator groups, the percentages of pupils whose teachers enabled them to use computers for these purposes at least monthly were, like in England, mostly below 50 per cent. Notable exceptions are Northern Ireland (between 58% and 68%) and New Zealand (between 76% and 86%).

Science

The majority (71%) of year 5 pupils in England had computers available in science lessons, a larger proportion than in maths. This is 25 per cent above the international mean (46%). While there is an association across all countries between pupils having computers available in lessons and higher average achievement (509 compared to 504; a difference of five scale points), this is not the case for year 5 pupils in England, where there is a negative association (536 compared to 543). Of the 24 comparator group countries, only Japan, Slovenia and the Netherlands had similar negative associations.

Of the six highest-achieving countries (the East Asian group and Russia), all except South Korea are above the international mean for the proportion of pupils that had computers available in science lessons, though only marginally in the case of Singapore, Taiwan and Hong Kong (one to three scale points above the mean). As in maths, the country from the comparator groups that had the highest proportion of

availability (91%) was New Zealand; it also had the highest average achievement difference between pupils for whom computers were available in lessons and those for whom they were not (508 and 477: 31 scale points compared to England's five scale points). This was far greater than the 11 scale points' difference for New Zealand in maths.

In England, where year 5 pupils were taught by teachers who enabled them to use computers at least monthly, the majority (69%) used them to look up ideas and information as opposed to the other three purposes: to practise skills and procedures (43%); to do scientific procedures or experiments (42%); to study natural phenomena through simulations (54%). This emphasis of use for looking up ideas and information was also found, on average, across all countries (41%).

In England, where year 5 pupils were taught by teachers who enabled them to use computers at least monthly, the majority (69%) used them to look up ideas and information as opposed to the other three purposes: to practise skills and procedures (43%); to do scientific procedures or experiments; (42%); to study natural phenomena through simulations (54%). This emphasis of use for looking up ideas and information was also found, on average, across all countries (41%).

9.2.4 To what extent do year 9 pupils have computers available in maths and science lessons

Maths

Just under one-third (29%) of year 9 pupils in England had computers available in maths, a little below the international mean (32%). While there is an association across all countries between pupils having computers available in lessons and higher average achievement (485 compared to 481; a difference of four scale points), this was not the case for year 9 pupils in England, where there was a negative association (511 compared to 520). Of the other 16 comparator group countries, ten others, including Ireland and Singapore had similar negative associations.

Of the highest-performing group (the five East Asian countries and Russia), all except Taiwan and Hong Kong had higher proportions of pupils for whom computers were available to use in year 9 maths lessons. Of these, like England, none had a positive association between computers being available for pupils' use in lessons and average achievement. The country from the comparator groups that had the highest proportion of availability (65%) was Sweden, which also had a negative association between computer availability in year 9 maths lessons and average achievement (499 compared to 502).

In England, where year 9 pupils were taught by teachers who enabled them to use computers at least monthly, the majority (23%) used them to practise skills and procedures compared to the other three purposes: to explore mathematics principles and concepts (17%); to look up ideas and information (17%); and to process and analyse data (13%). This was the same main purpose found in the other countries, on average (23%). Like England, the percentage of pupils that were enabled to use computers at least monthly was relatively low in most comparator countries (typically, between 10% and 30%). Exceptions were Australia (between 44% and 52%) and Kazakhstan (between 45% and 51%).

Science

Just under half (48%) of year 9 pupils in England had computers available in science lessons, larger than the proportion in maths. This is above the international mean (42%). There is an association both for pupils in England (543 compared to 534) and those in all countries, on average (493 compared to 483), between their having computers available in lessons and higher average achievement.

Of the five countries that performed significantly higher than England, all except Slovenia and Taiwan had higher proportions of pupils that had computers available in science lessons. Of the three that did, South Korea and Singapore had negative associations between availability of computers and average achievement, while the difference between those pupils that did, and those that did not, in Japan was only one scale point (571 compared to 570). The country from the comparator groups that had the highest proportion of availability (80%) was Sweden, which also had a relatively high level of negative association with average achievement (520 compared to 533).

In England, where year 9 pupils were taught by teachers who enabled them to use computers at least monthly, the majority (44%) used them to look up ideas and information as opposed to the other four purposes: to practise skills and procedures (23%); to do scientific procedures or experiments (18%); to study natural phenomena through simulations (24%); to process and analyse data (28%). This emphasis of use for looking up ideas and information was also found, on average, across all countries (37%).

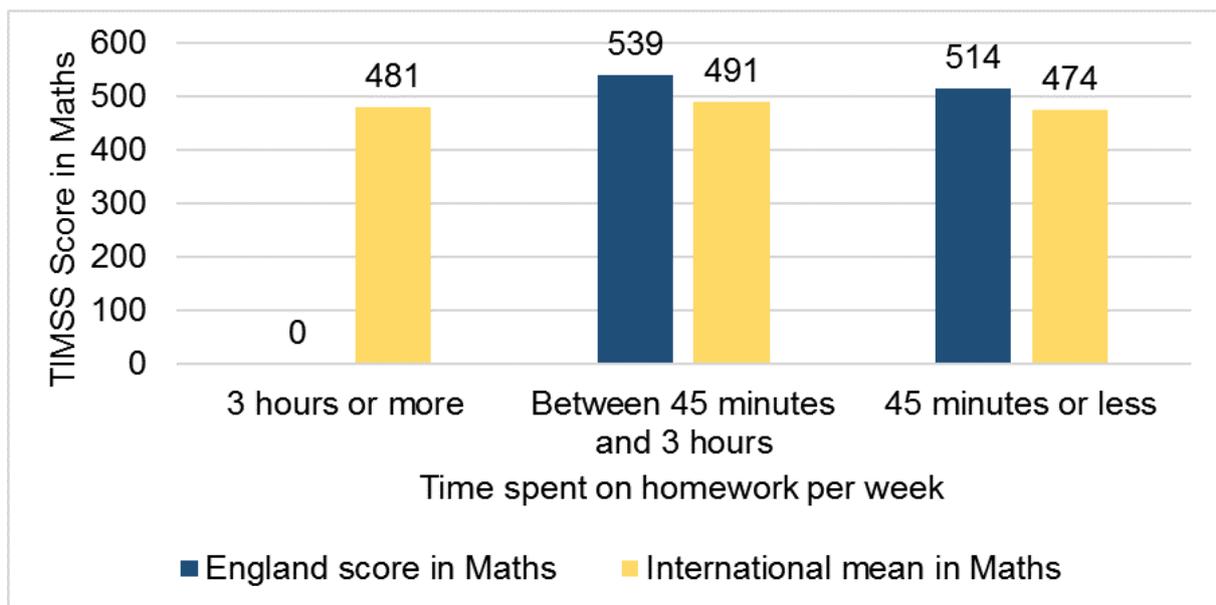
Across other countries from the comparator groups, the percentages of pupils whose teachers enabled them to use computers for these purposes at least monthly were, like in England, mostly below 50 per cent. A notable exception is Kazakhstan, one of the 'fast movers' – having moved from performing significantly lower than England in 2011 to performing at the same level in 2015. Where Kazakhstan's pupils were taught by teachers who enabled them to use computers at least monthly, between 70 per cent and 74 per cent of pupils used them for each of the five purposes.

9.2.5 How much time do year 9 pupils spend on homework in maths and science each week?

In both maths and science, on average, across all participating countries, pupils who spent three or more hours on homework had lower average achievement than peers that spent between 45 minutes and three hours per week. In addition, in science, these pupils had lower average achievement than peers who spent less than 45 minutes per week on homework. This is shown in Figures 90 and 91 below.

In England, both in maths and science, there is an association between pupils spending between 45 minutes and 3 hours on homework, compared to less than 45 minutes, and average achievement. In maths, this difference is 25 scale points and, in science, 39 scale points. This association is also found across all participating countries.

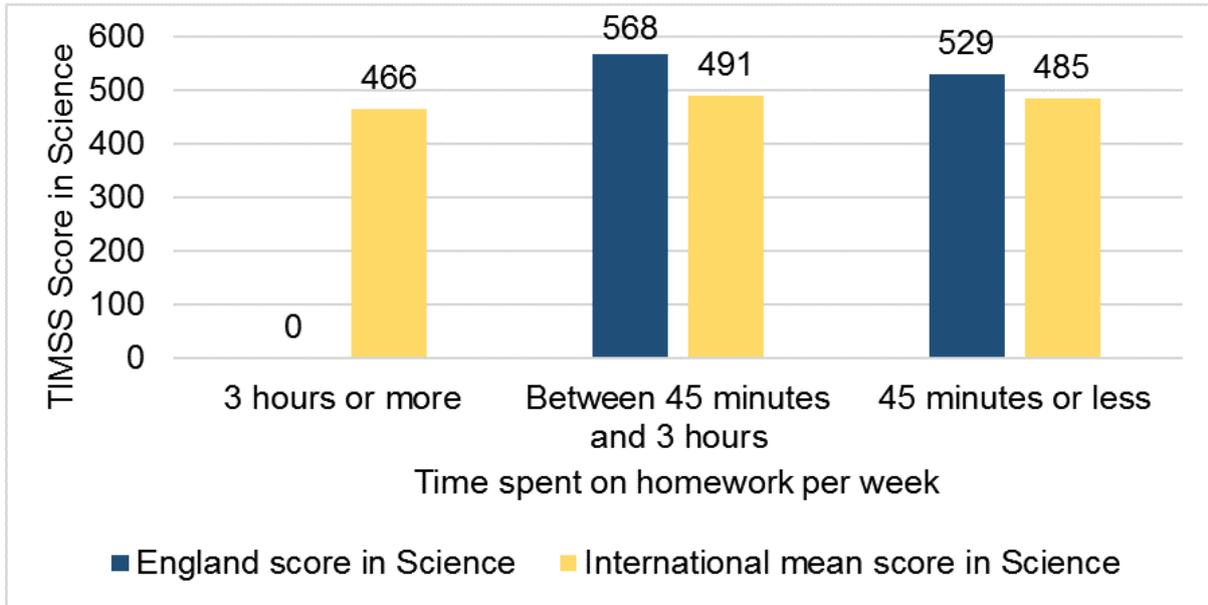
Figure 90: Average maths achievement of year 9 pupils according to the time spent on homework per week (England with international comparisons)



Source: TIMSS 2015.

Note 1: One per cent of year 9 pupils in England spent more than three hours per week on homework: too small a percentage to calculate average achievement data.

Figure 91: Average science achievement of year 9 pupils according to the time spent on homework per week (England with international comparisons)



Source: TIMSS 2015.

Note 1: One per cent of year 9 pupils in England spent more than three hours per week on homework: too small a percentage to calculate average achievement data.

The proportion of year 9 pupils in England who spent three or more hours per week on homework (1% in each case) was the lowest across all comparator countries in maths and equal third lowest in science with Japan and South Korea (both of which performed significantly higher than England). As shown in Figures 92 and 93, these proportions were notably below the international means. By contrast, 22 per cent of pupils in Singapore (the highest-performing country in maths and science) spent three hours or more on homework in maths and, in maths, nine per cent did. In Russia (which performed significantly higher than England) and Kazakhstan (a ‘fast mover’ which performed similarly to England), around twice as many pupils spent three hours or more per week on their maths homework than peers in Singapore.

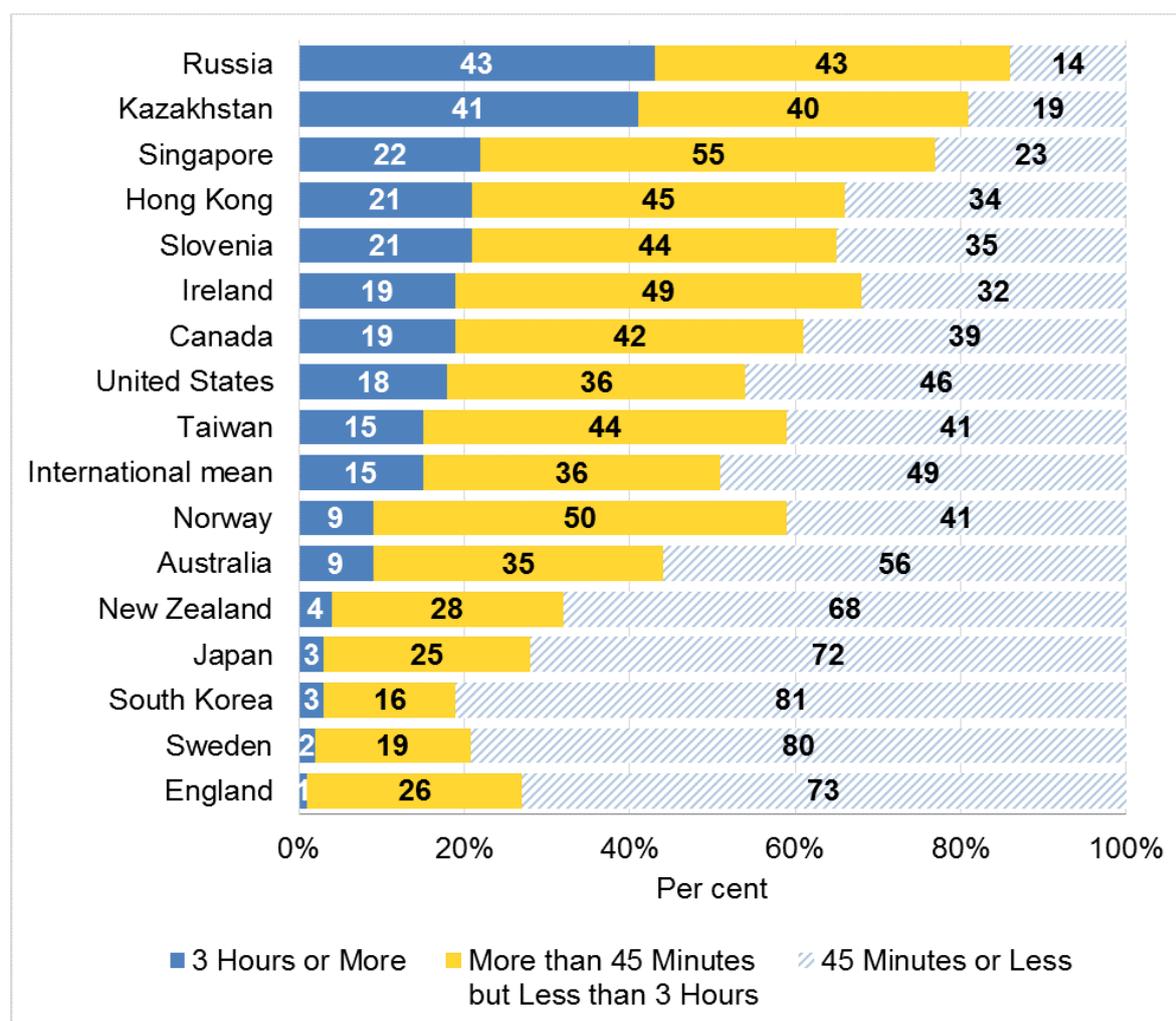
In maths and science, about a quarter (26%) of pupils in England spent between 45 minutes and 3 hours on homework. This was below the international mean in maths but close to this in science. In maths, four of the highest-performing countries had larger proportions than this (Singapore, Hong Kong, Taiwan and Russia), while two had smaller proportions (Japan and South Korea). All of the comparator group countries that performed similarly to England had larger proportions of pupils that spent between 45 minutes and 3 hours per week on maths homework. In science, the same East Asian countries had larger and smaller proportions of pupils that spent between 45 minutes and 3 hours per week on homework than England. Of those who performed similarly to England from the comparator groups, Ireland had a

larger proportion of pupils that spent between 45 minutes and 3 hours per week on science homework than England, while the opposite was true for the United States.

Most pupils in England stated they spent less than 45 minutes per week on homework in both subjects with proportions below the international mean in both cases. In maths, this was similar to New Zealand and Sweden (both of which performed significantly lower than England), and Japan and South Korea (both of which performed significantly higher than England). In science, there is more of an even spread in the proportions of pupils that spent less than 45 minutes per week on homework but with the same variation between the highest-performing group of East Asian countries.

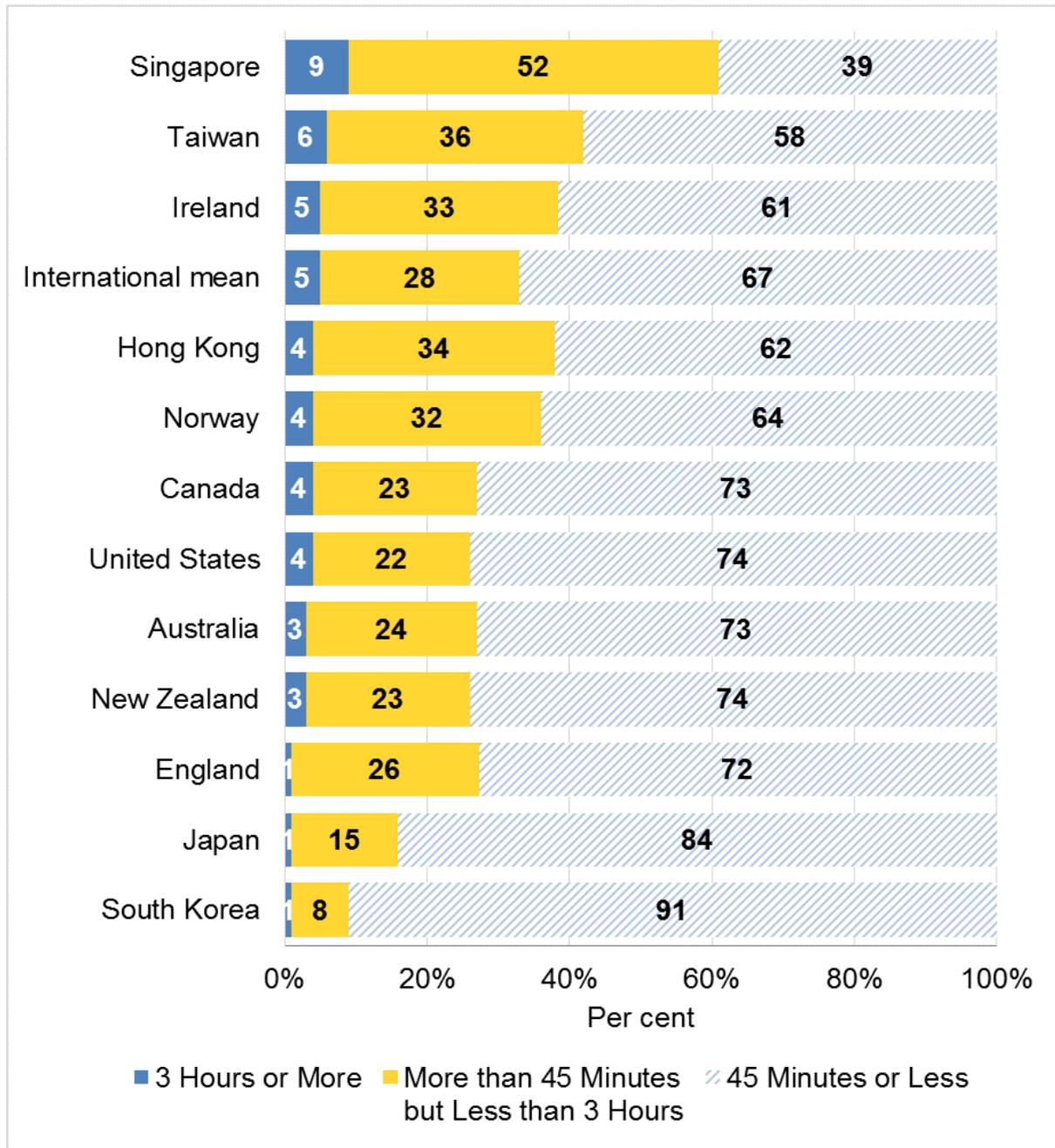
In considering these findings, it might also be helpful to consider the proportions of pupils that received additional tuition outside of school (see chapter 10) to gain a fuller picture of pupils' maths and science learning outside of school.

Figure 92: Time spent on maths homework per week by year 9 pupils (England and comparator group countries)



Source: TIMSS 2015.

Figure 93: Time spent on science homework per week by year 9 pupils (England and comparator group countries)



Source: TIMSS 2015.

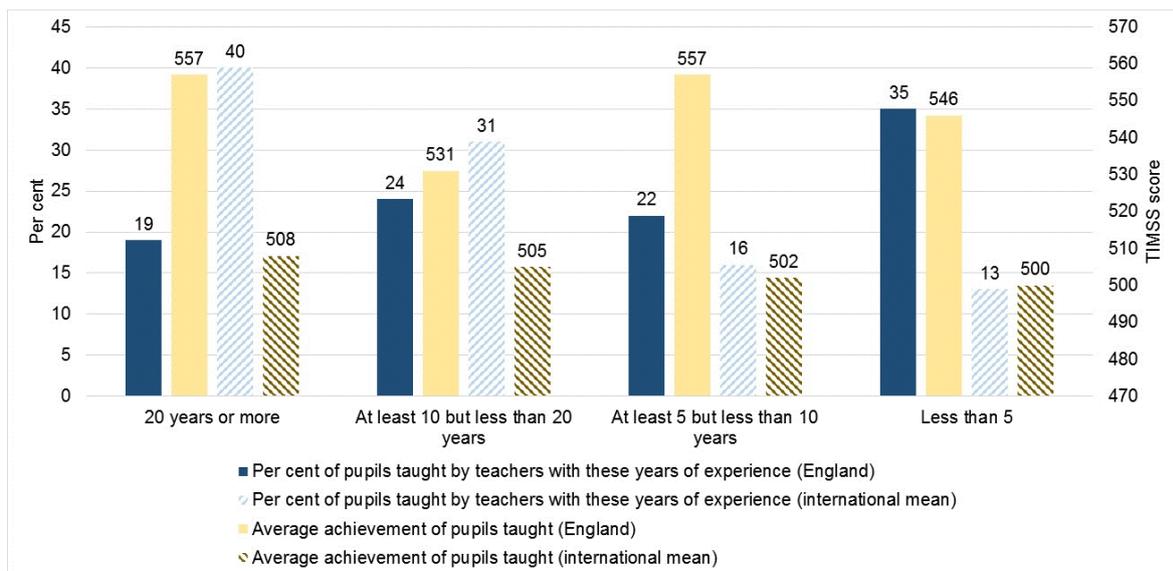
9.3 How experienced are teachers in England and how does this compare to other TIMSS countries?

Year 5 and year 9 teachers of maths and science in England reported their years of service on the teacher questionnaires. The corresponding percentage of pupils taught by these teachers and their average achievement were calculated and these are shown in Figures 94 and 95 for maths and Figures 96 and 97 for science below. Average achievement figures shown are against the international mean (500). When reading the charts in this section, it is important to note that the data captures the association between two variables and does not explore potential causality.

Maths

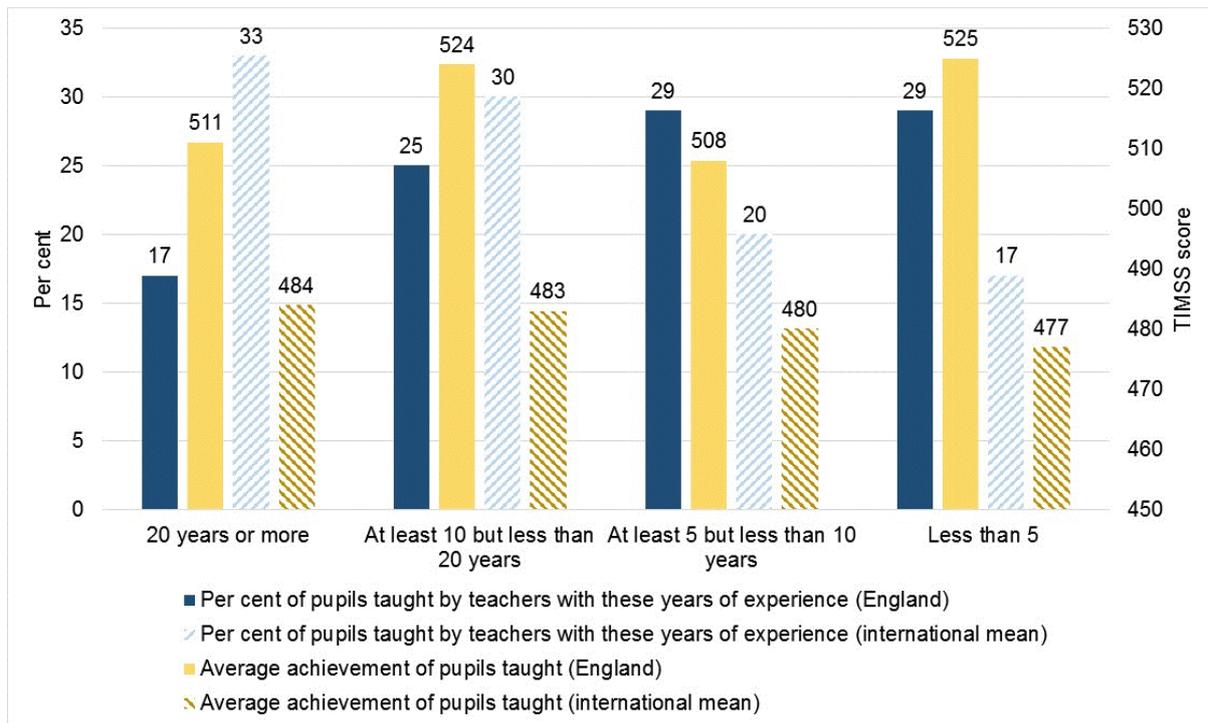
On average, those teaching maths in England had 11 years of experience in both years 5 and 9, which is below the international mean for both year groups (17 and 16 respectively). About one third of year 5 and 9 pupils (35% and 29% respectively) were taught by teachers with less than five years' experience; much greater proportions than the international means (13% and 17% respectively). The other two thirds were distributed between the other three possibilities. While across all participating countries there is some level of association between greater experience and average achievement in both year 5 and 9, this is not consistently evident in the data for England. For example, year 9 pupils in England taught by teachers with less than five years' experience have average achievement scores higher than those taught by teachers with 20 years or more experience.

Figure 94: Year 5 pupils taught maths by teachers with different years of experience and their average achievement (England with international comparisons)



Source: TIMSS 2015 report.

Figure 95: Year 9 pupils taught maths by teachers with different years of experience and their average achievement (England with international comparisons)

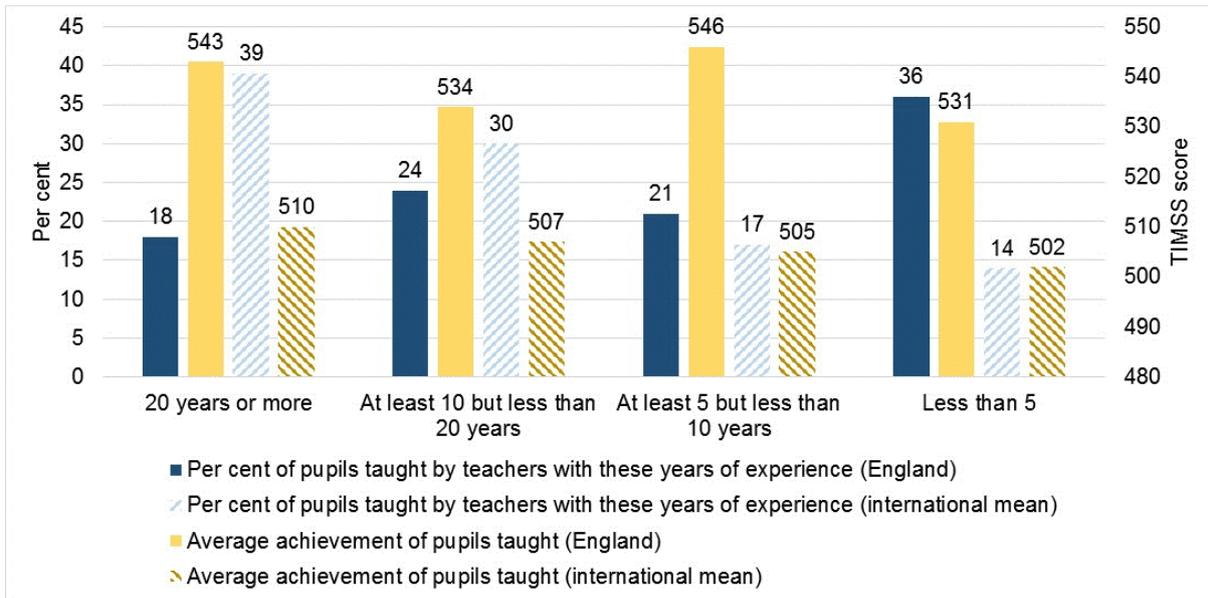


Source: TIMSS 2015.

Science

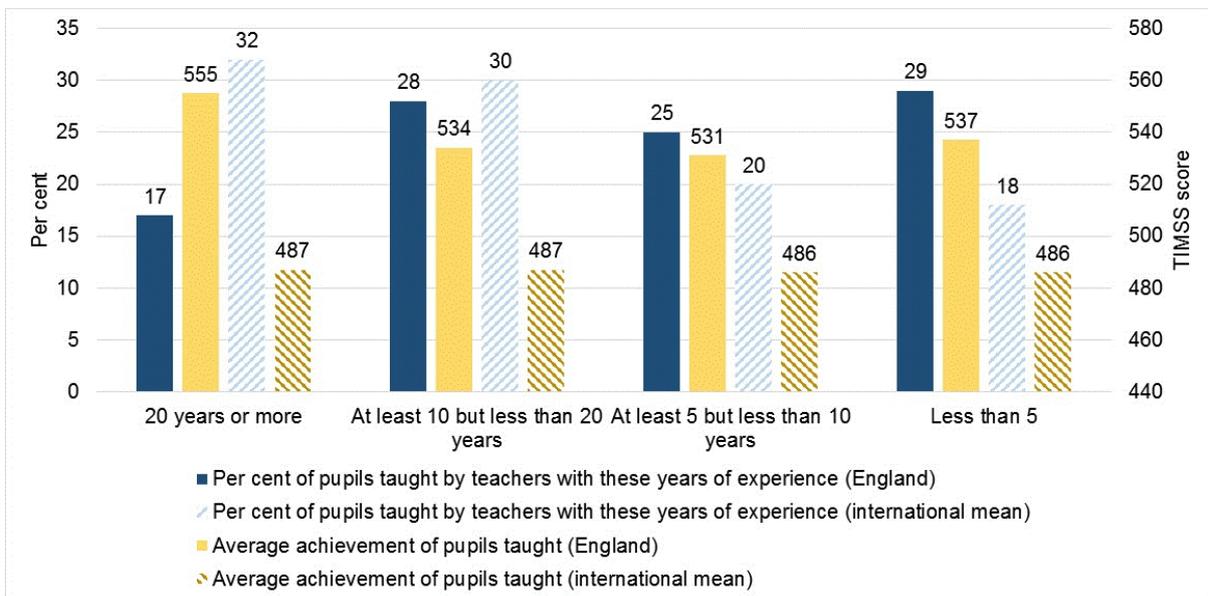
The average number of years of experience for science teachers was 10 for year 5 teachers and 11 for year 9 teachers, both below the international means (17 and 15 respectively). About a third of year 5 and 9 pupils (36% and 29% respectively) were taught by teachers with less than five years of experience (see Figure 96 below). The other two-thirds were distributed across the three other possibilities. While across all participating countries there is an association between greater experience and average achievement at year 5 science, this is not evident at year 9. In England, both at years 5 and 9 there is an association between the pupils taught by the most experienced teachers having higher average achievement in science than teachers with less than five years' experience. However, for year 9 pupils in England, average achievement for those taught by teachers with less than five years' experience is higher than for those taught by teachers in the middle two categories.

Figure 96: Year 5 pupils taught science by teachers with different years of experience and their average achievement (England with international comparisons)



Source: TIMSS 2015.

Figure 97: Year 9 pupils taught science by teachers with different years of experience and their average achievement (England with international comparisons)



Source: TIMSS 2015.

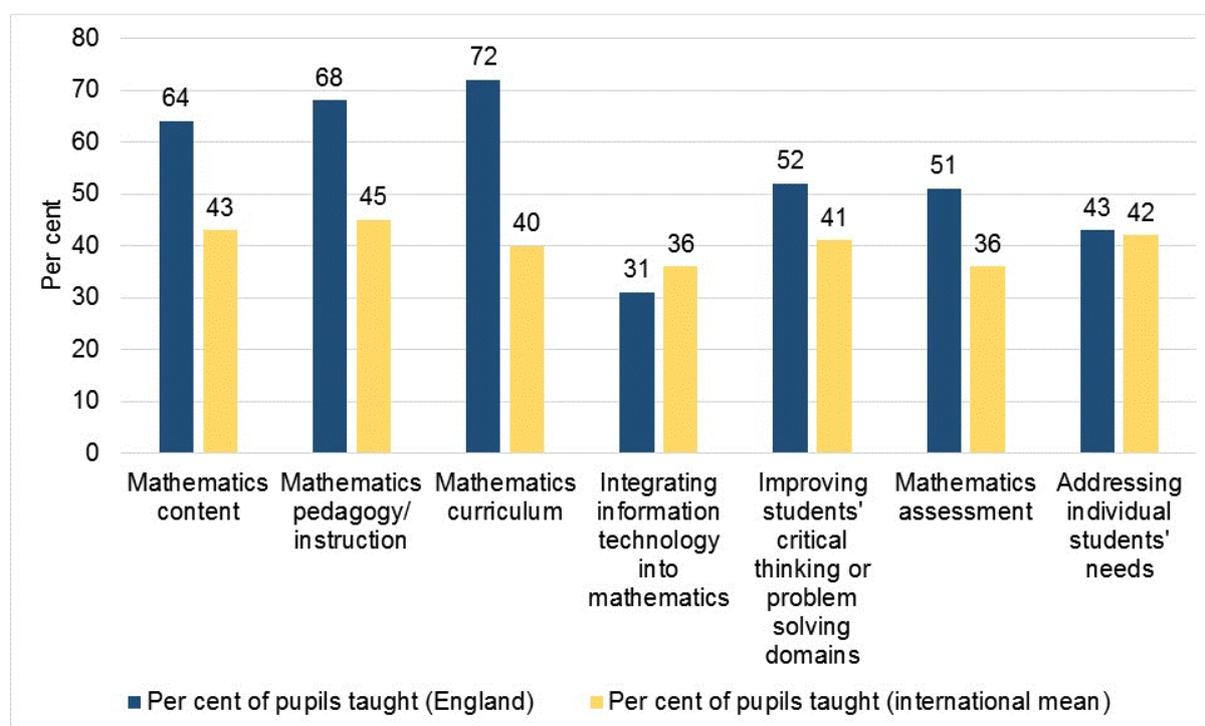
9.4 How much professional development have teachers in England had?

Year 5 and year 9 teachers of maths and science in England reported, through a questionnaire, on the professional development they had received in different aspects of their subject during the past two years. The percentages of pupils taught by these teachers according to these aspects of professional development were then calculated. These are shown in Figures 98 (maths) and 99 (science) below.

Maths

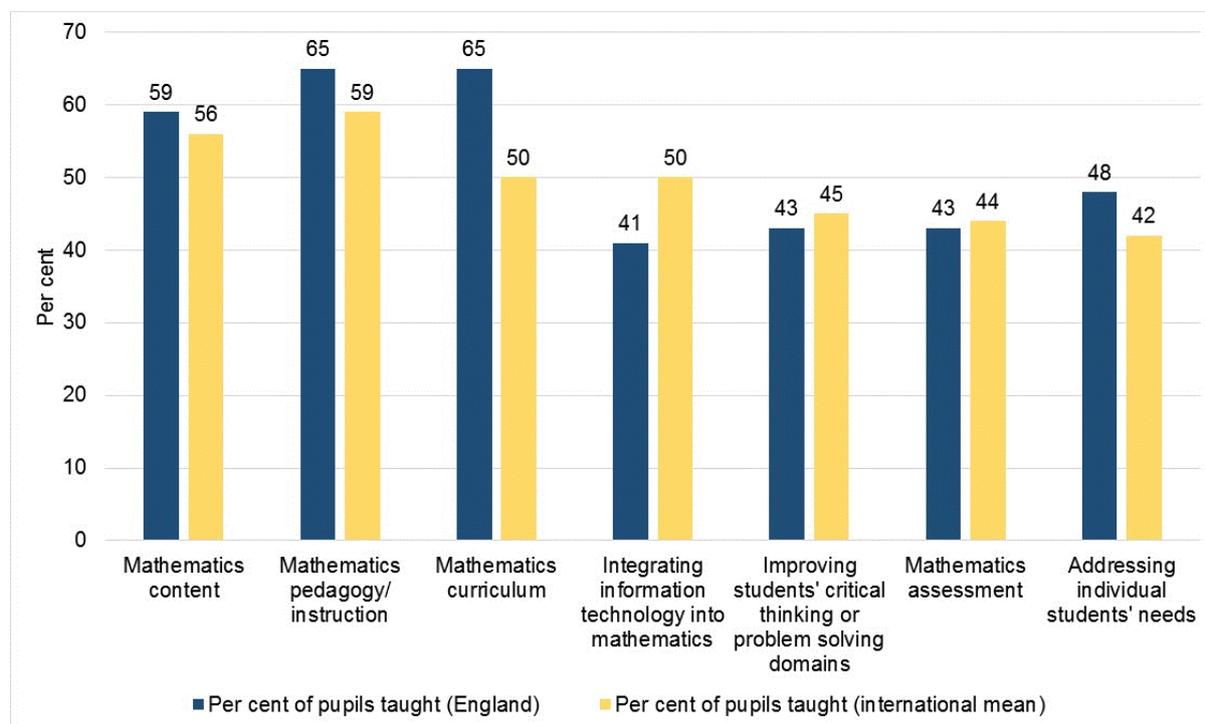
The majority of year 5 and 9 pupils in England were taught maths by teachers who had received professional development centred upon content, curriculum and pedagogy/instruction. These proportions were higher than the mean across all participating countries for these aspects, particularly in year 5. This higher level may reflect the introduction of the new National Curriculum in England in the years before TIMSS 2015 was undertaken. The lowest percentage of pupils in England, in both years 5 and 9, were those whose teachers had received professional development training in 'integrating information technology into mathematics'. These proportions were closer to those found across all countries.

Figure 98: Aspects of professional development undertaken by year 5 teachers of maths over the past two years and the percentage of pupils taught by these (England with international comparisons)



Source: TIMSS 2015.

Figure 99: Aspects of professional development undertaken by year 9 teachers of maths over the past two years and the percentage of pupils taught by these (England with international comparisons)



Source: TIMSS 2015.

Compared to other countries, in year 5 maths, Russia (which has moved from performing similarly to England in 2011 to significantly higher in 2015) has a higher proportion of pupils taught by teachers who have received professional development in integrating information technology into maths than England (67% compared to 31%). This is also the case for pupils in Kazakhstan (76%), which now performs at a similar level to England, having performed significantly lower in 2011. Kazakhstan also has the highest percentage across all countries for pupils taught by teachers that have received professional development in improving pupils' critical thinking skills (81%), followed by Hong Kong (73%). Of the highest-performing countries, Singapore and Hong Kong have relatively high percentages of pupils taught by teachers receiving professional development across all the aspects, most notably in pedagogy (81% and 83% respectively, compared to 68% in England).

In year 9, Kazakhstan, which has moved from performing significantly lower than England in 2011 to a similar level in 2015, again has a higher proportion of pupils taught by teachers who had received professional development in integrating information technology into maths (82% compared to 41% in England) and improving critical thinking skills (75% compared to 43%). Singapore, the highest-performing country, has the highest proportion of pupils taught by teachers that have received

professional development in pedagogy (90%), followed by Russia (79%) and Ireland (78%).

However, pupils in some countries are taught by teachers that have received relatively little professional development in the past two years, for example Norway. Norway performed at a similar level to England in 2015, having performed significantly lower in 2011, yet only between 12% and 36% of its pupils are taught by teachers who have received professional development across all of the aspects.

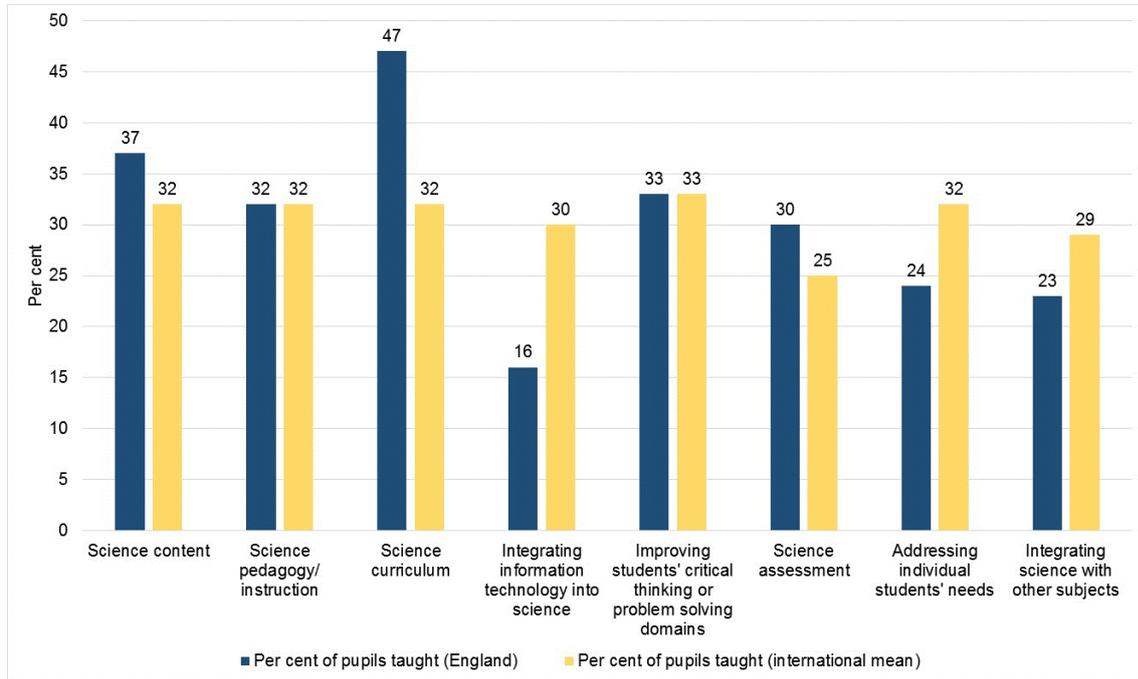
Science

In science, fewer than half of year 5 pupils in England were taught by teachers who had received professional development in each aspect; this mirrored the findings across all participating countries. More year 5 pupils in England were taught by those who had received professional development in content and curriculum (37% and 47% respectively), possibly reflecting the introduction of the new National Curriculum in England during this period (see Figure 100 below). As with year 9 pupils, the lowest proportion of pupils was those taught by teachers who had received professional development in 'integrating information technology' which was almost half (16% compared to 30%) of those taught by teachers across all countries.

Over half (50%) of year 9 pupils were taught science by teachers who had received professional development in all the aspects except two: 'integrating information technology into science' and 'Improving students' critical thinking or problem solving domains' (see Figure 101 below). The proportion of year 9 pupils in England taught by teachers who had received professional development in the maths curriculum was the highest (62%); as with year 5, this possibly reflected the introduction of the new National Curriculum in England during this period. As with year 5 pupils, the lowest percentage of pupils being taught by teachers who had received professional development in a particular aspect was for 'integrating information technology' which was below the international mean for this aspect (32% compared to 50%).

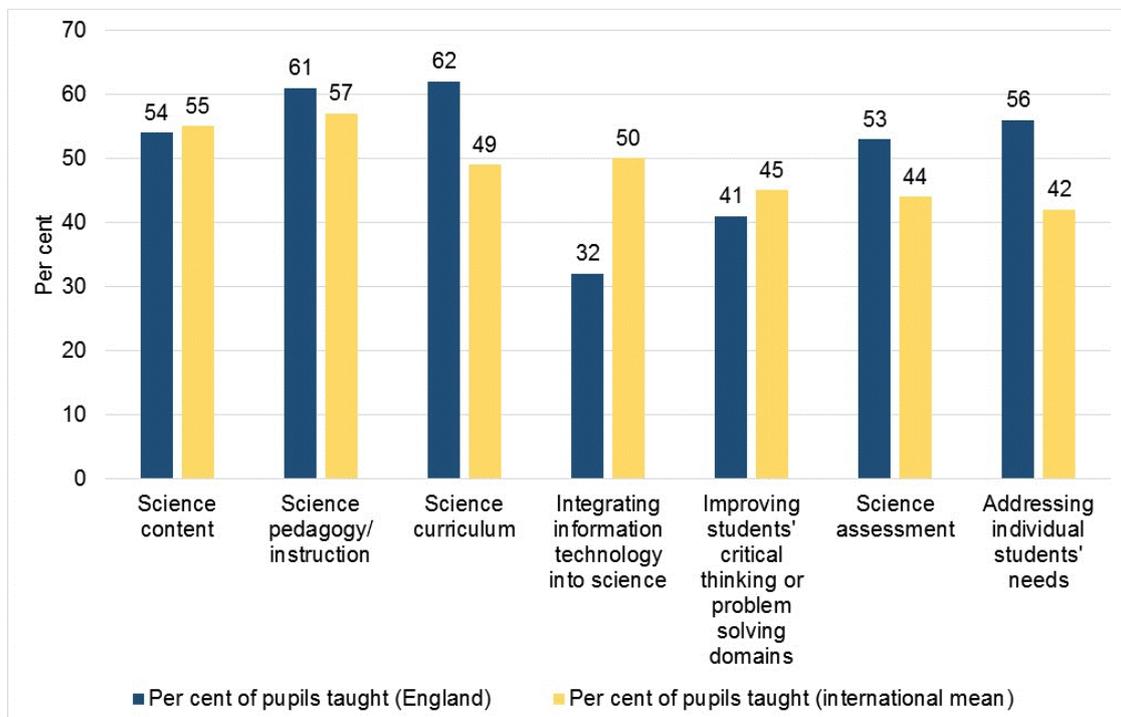
The proportion of year 5 pupils taught by teachers who had received professional development in aspects of science is consistently less than for maths. As for maths, the proportions of year 5 and 9 pupils taught by teachers who had received professional development were smallest for 'integrating information technology' into the subject.

Figure 100: Aspects of professional development undertaken by year 5 teachers of science over the past two years and the percentage of pupils taught by these (England with international comparisons)



Source: TIMSS 2015.

Figure 101: Aspects of professional development undertaken by year 9 teachers of science over the past two years and the percentage of pupils taught by these (England with international comparisons)



Source: TIMSS 2015.

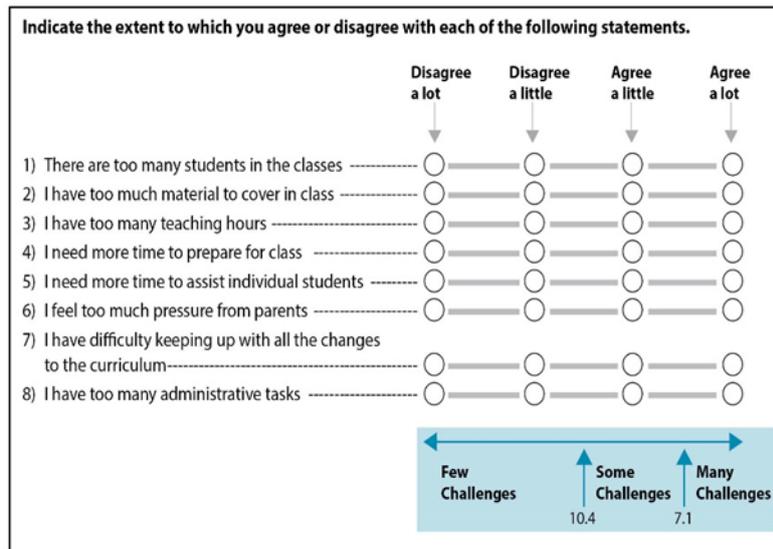
Singapore, the highest-performing country in year 5 science, had the highest proportion of year 5 pupils, across all countries, taught by teachers who received professional development in pedagogy (78%). Hong Kong's pupils (who performed significantly higher than England's in 2015 having performed at a similar level in 2011), are most notably taught by teachers that received professional development in improving pupils' critical thinking skills (63%). This was also the case for a high proportion (77% - the highest across all countries) of pupils from Kazakhstan, another country that in 2015 performs significantly higher than England. Poland, the third country that moved from performing significantly below to higher than England in 2015, had a relatively higher proportion of pupils than other countries taught by teachers receiving professional development in content (74% - the highest across all countries), curriculum (61%) and integrating technology into science (67%). The proportion of pupils taught by teachers that received professional development in integrating technology into science in Kazakhstan (74%) was second only to peers in Russia.

In year 9, pupils in Singapore (the highest-performing country), for science as in maths, were taught by the teachers that received the highest amount of professional development across all countries in pedagogy (91%). Pupils in Slovenia (the only country to move from performing significantly lower than England in 2011 to significantly higher in 2015) had relatively high proportions of pupils taught by teachers who had received professional development in content (74%), pedagogy (66%) and integrating technology into science (65%). Pupils in Russia and Kazakhstan (both countries which performed similarly to England in 2015; the latter having performed significantly lower in 2011) also received teaching from teachers that received high levels of development in these aspects (Russia: 74%, 75%, 77% and Kazakhstan: 73%, 76%, 88%).

9.5 What proportion of pupils are taught in schools where teachers report challenges?

The extent to which teachers in England faced challenges was assessed through teacher questionnaires. The same questionnaire was used for year 5 and 9 teachers in both subjects. Figure 102 shows the questionnaire and the challenges it focuses upon.

Figure 102: TIMSS 2015 questionnaire assessing the extent to which teachers face challenges (teacher report)



Source: TIMSS 2015.

Based on how much teachers agreed with these statements, pupils were assigned to one of three categories: those taught by teachers facing: few challenges, some challenges or many challenges¹⁰². This section focuses on challenges reported on maths with any notable differences to science identified.

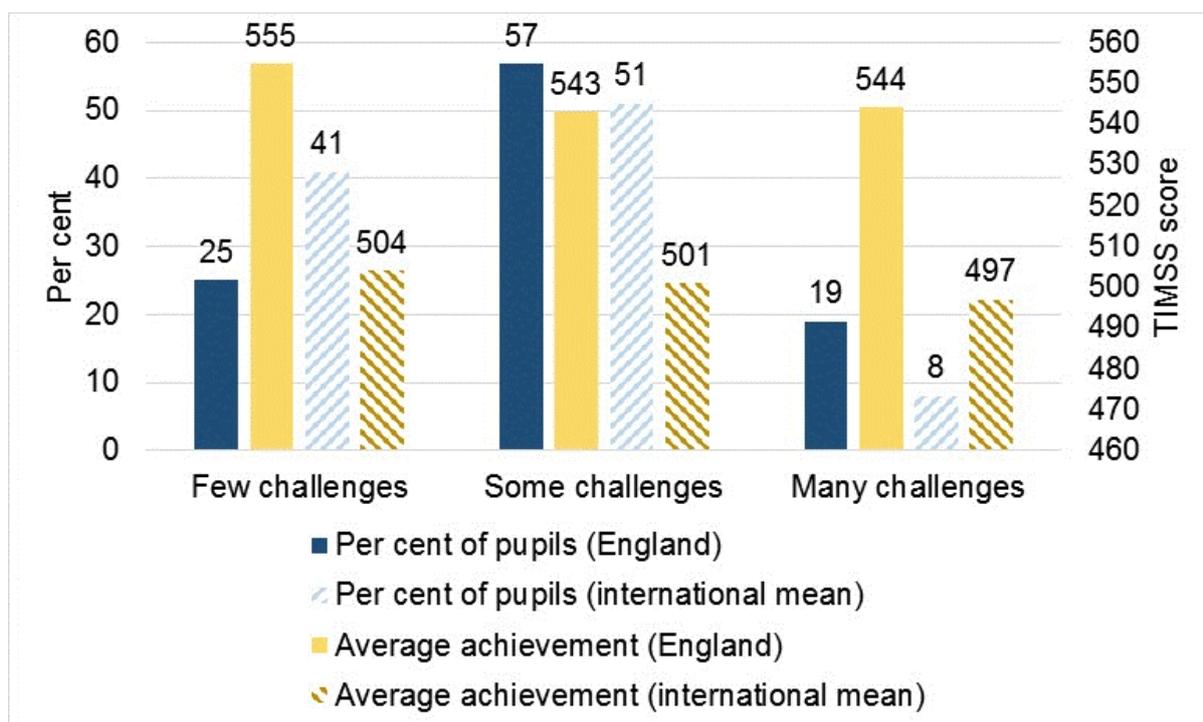
9.5.1 What proportion of year 5 pupils are taught in schools where teachers report challenges?

Most year 5 pupils in England were taught by teachers facing at least some challenges (76% in maths and 71% in science). Compared with all other countries, more than twice as many pupils in England were taught by teachers facing many challenges (19% compared to 8%). Correspondingly, a smaller proportion of pupils in England were taught by teachers facing few challenges (about 25%) than in other participating countries, on average.

There is no clear association between pupils in England's average achievement and the extent to which they were taught by teachers facing different levels of challenge in either subject although, as Figure 103 shows, pupils taught by teachers with few challenges did perform higher than the other two groups. Across all countries, there is such an association: the lower the levels of challenge faced by teachers, the higher the average achievement of the pupils they taught.

¹⁰² See [Appendix E Table E16](#) for an explanation of how categories were determined from questionnaire responses.

Figure 103: The percentage of year 5 pupils taught maths by teachers facing different levels of challenge (England with international comparisons)



Source: TIMSS 2015.

All of the countries¹⁰³ that performed significantly higher than England in both subjects had larger proportions of pupils taught by teachers with few challenges, except Northern Ireland in maths (both countries had 25% taught by teachers with few challenges). Similarly, most of the countries that performed at a similar level to England also had larger proportions of pupils taught by teachers with few challenges compared to England.

¹⁰³ There were no data on the percentage of year 5 pupils taught by teachers facing challenges for Singapore.

**Table 18: Year 5 pupils taught maths by teachers facing different levels of challenge
(England and comparator group countries)**

Country	Few Challenges		Some Challenges		Many Challenges		Mean Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
Poland	78 (3.1)	535 (2.5)	21 (2.9)	535 (4.3)	1 (1.0)	~ ~	11.4 (0.13)
Russia	77 (2.6)	567 (4.2)	23 (2.6)	553 (5.9)	0 (0.0)	~ ~	11.2 (0.10)
Finland	71 (3.0)	534 (2.4)	29 (3.0)	538 (3.3)	0 (0.0)	~ ~	11.0 (0.09)
Kazakhstan	65 (3.9)	547 (6.0)	34 (3.9)	542 (7.6)	1 (0.4)	~ ~	10.8 (0.09)
Czech Republic	50 (3.5)	527 (3.2)	48 (3.5)	529 (3.0)	2 (0.8)	~ ~	10.5 (0.12)
Taiwan	45 (3.9)	597 (2.6)	53 (4.0)	597 (2.5)	2 (1.1)	~ ~	10.2 (0.13)
Belgium (Flanders)	40 (3.4)	539 (3.7)	56 (3.5)	550 (2.7)	4 (1.6)	565 (11.8)	10.0 (0.10)
Japan	38 (3.0)	590 (2.7)	55 (3.2)	595 (2.9)	7 (1.7)	593 (5.9)	9.8 (0.10)
Germany	37 (2.9)	522 (3.5)	58 (3.1)	522 (3.0)	5 (1.7)	507 (13.2)	9.7 (0.11)
United States	36 (2.8)	535 (4.0)	54 (2.7)	539 (3.4)	10 (1.4)	549 (6.1)	9.7 (0.10)
Sweden	33 (4.3)	515 (4.9)	61 (4.6)	522 (3.5)	5 (1.9)	508 (14.6)	9.9 (0.14)
Ireland	33 (3.7)	545 (4.0)	53 (4.3)	547 (3.3)	14 (3.1)	551 (4.9)	9.4 (0.15)
New Zealand	31 (2.3)	486 (6.2)	55 (2.7)	492 (2.6)	14 (1.9)	498 (5.9)	9.5 (0.11)
Canada	30 (2.6)	505 (4.3)	58 (2.7)	512 (3.3)	12 (1.4)	520 (4.6)	9.4 (0.09)
Hong Kong	29 (4.0)	610 (6.1)	64 (4.4)	614 (4.2)	7 (2.5)	632 (13.4)	9.6 (0.17)
South Korea	27 (3.0)	612 (4.3)	58 (3.6)	604 (2.9)	15 (2.7)	615 (3.8)	9.3 (0.15)
Netherlands	r 27 (3.6)	524 (3.6)	69 (3.7)	532 (2.0)	4 (1.7)	541 (7.2)	9.5 (0.13)
Northern Ireland	r 25 (3.7)	581 (6.2)	57 (4.1)	568 (4.9)	18 (3.8)	576 (7.1)	9.1 (0.20)
England	25 (3.4)	555 (9.9)	57 (4.0)	543 (4.5)	19 (3.1)	544 (7.4)	9.2 (0.18)
Australia	24 (2.6)	522 (7.6)	67 (2.5)	515 (4.0)	8 (1.9)	529 (7.8)	9.4 (0.11)
Denmark	22 (3.0)	536 (6.6)	64 (3.7)	538 (4.0)	14 (2.7)	540 (6.4)	9.2 (0.14)
Norway	22 (3.6)	550 (5.0)	69 (3.6)	551 (3.3)	9 (2.5)	541 (6.7)	9.4 (0.16)
Slovenia	17 (2.5)	518 (3.5)	74 (2.9)	522 (2.2)	9 (2.2)	517 (7.6)	9.1 (0.11)
France	9 (2.1)	488 (8.2)	76 (2.9)	491 (2.9)	15 (3.0)	476 (6.1)	8.7 (0.12)
International Mean	41 (0.5)	504 (0.8)	51 (0.5)	501 (0.7)	8 (0.3)	497 (1.6)	

Source: TIMSS 2015.

Note: The TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centre point of 10 was located at the mean.

() 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.

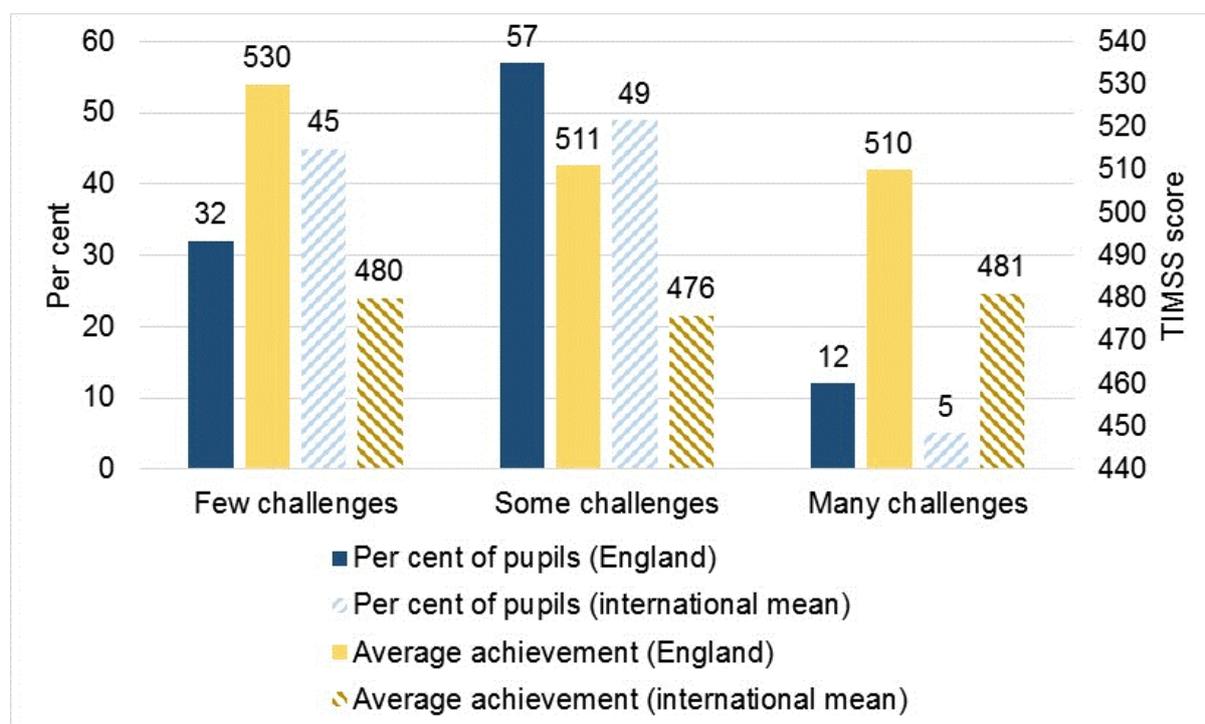
9.5.2 What proportion of year 9 pupils are taught in schools where teachers report challenges?

The percentage of year 9 pupils in England taught by teachers facing at least some challenges was 69% in maths and 83% in science (see Figure 104 below).

Compared with other countries, more than twice as many pupils in England were taught maths by teachers facing many challenges (12% compared to five per cent) and more than three-times as many of those taught science (22% compared to six per cent). Correspondingly, a smaller proportion of English pupils were taught by teachers facing few challenges (32% in maths and 18% in science).

The average achievement of year 9 pupils in England taught by teachers facing some challenges in maths was similar to those taught by teachers facing many challenges. This was replicated in science where the scores were the same. However, in both maths and science, the average achievement of year 9 pupils in England taught by teachers facing few challenges was higher than in the other two categories (some and many challenges). While there was an association across all countries in science, between the extent to which pupils were taught by teachers facing different levels of challenge and average achievement (mean scores of 487, 481, 473), this was not replicated in maths.

Figure 104: The percentage of year 9 pupils taught maths by teachers facing different levels of challenge (England with international comparisons)



Source: TIMSS 2015.

All of the countries that performed significantly higher than England in both subjects had larger proportions of year 9 pupils taught by teachers facing few challenges, except South Korea (see Table 19 below). Most of the comparator group countries performing at a similar level to England also had larger proportions of pupils taught by teachers with few challenges than England.

Table 19: The percentage of year 9 pupils taught by teachers of maths facing different levels of challenge (England and comparator group countries)

Country	Few Challenges		Some Challenges		Many Challenges		Mean Scale Score
	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	Per cent of Students	Average Achievement	
Russia	73 (3.4)	541 (4.6)	27 (3.4)	530 (8.4)	0 (0.0)	~ ~	11.0 (0.11)
Kazakhstan	67 (3.7)	533 (5.5)	33 (3.7)	518 (9.8)	0 (0.4)	~ ~	10.7 (0.10)
Taiwan	59 (3.8)	599 (3.9)	39 (3.9)	599 (5.1)	2 (0.9)	~ ~	10.5 (0.13)
Japan	56 (3.5)	587 (3.5)	40 (3.4)	584 (4.4)	4 (1.4)	602 (5.8)	10.2 (0.11)
United States	44 (3.0)	516 (4.8)	48 (2.8)	518 (5.0)	7 (1.4)	539 (10.9)	9.9 (0.15)
Canada	44 (3.3)	533 (3.1)	49 (3.3)	527 (3.8)	7 (1.6)	535 (5.9)	9.8 (0.13)
New Zealand	42 (3.0)	484 (5.3)	50 (3.2)	504 (5.8)	8 (2.1)	471 (12.3)	9.7 (0.12)
Sweden	38 (4.1)	495 (5.2)	59 (4.2)	504 (3.5)	3 (1.4)	507 (19.9)	9.7 (0.13)
Ireland	36 (2.8)	522 (5.1)	53 (2.9)	521 (4.3)	11 (2.1)	537 (6.7)	9.4 (0.12)
Slovenia	33 (2.8)	518 (4.4)	61 (2.8)	517 (2.4)	5 (1.2)	508 (7.8)	9.6 (0.09)
Hong Kong	33 (3.7)	602 (8.1)	63 (3.7)	589 (6.1)	3 (1.5)	612 (8.7)	9.7 (0.12)
England	32 (4.1)	530 (10.5)	57 (4.3)	511 (7.4)	12 (2.7)	510 (14.4)	9.2 (0.17)
Norway	31 (4.1)	511 (4.6)	60 (4.4)	513 (2.7)	9 (2.3)	516 (7.4)	9.4 (0.16)
Australia	29 (2.9)	514 (6.1)	58 (3.3)	505 (3.7)	13 (2.1)	508 (8.0)	9.2 (0.13)
South Korea	29 (3.4)	602 (5.2)	57 (3.5)	608 (3.5)	15 (2.6)	606 (6.8)	9.0 (0.14)
International Mean	45 (0.6)	480 (1.0)	49 (0.6)	476 (0.9)	5 (0.3)	481 (2.8)	

Source: TIMSS 2015.

Note: The TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centre point of 10 was located at the mean.

() Standard errors appear in parentheses.

Because of rounding some results may appear inconsistent.

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

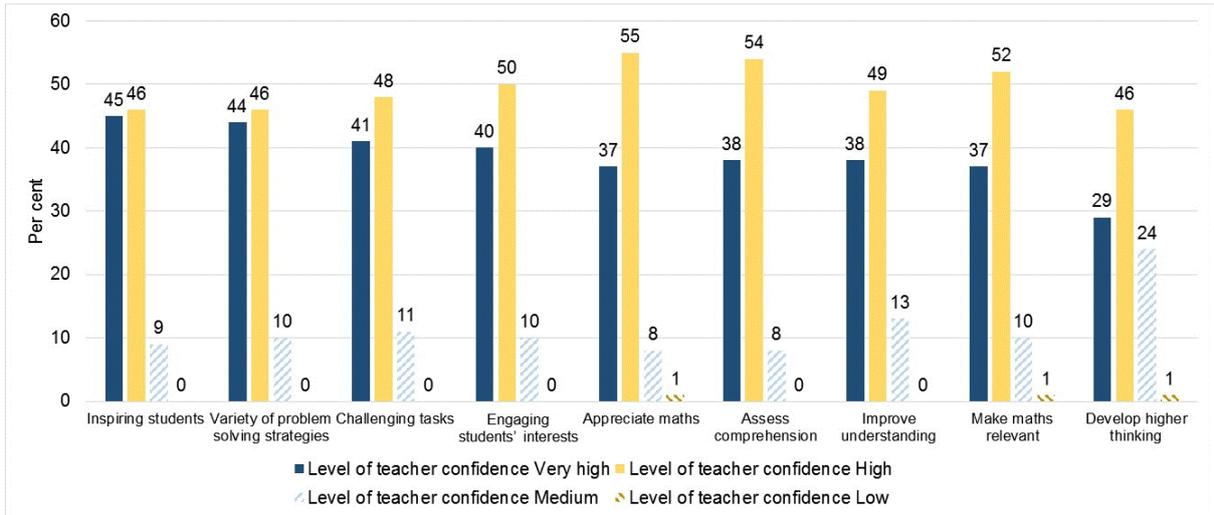
9.6 Do teachers in England feel confident in their ability to teach maths and science?

Teachers reported on their levels of confidence in teaching maths according to a range of criteria using a four-point scale ranging from Very High to Low. For year 5 in England, the same teachers may have completed the questionnaires for the teaching of maths and science, however schools were able to determine whether another teacher completed it, for example a subject leader. Year 9 teachers were specialist maths teachers whereas year 5 pupils were generally taught by generalist primary teachers.

Maths

Most year 5 maths teachers reported very high or high levels of confidence, with very few reporting medium or low confidence in the different aspects of teaching maths (see Figure 105). Inspiring pupils was perceived to be an aspect teachers in which teachers had a very high level of confidence, while developing higher-order thinking was the aspect in which the lowest proportion of teachers expressed very high levels of confidence.

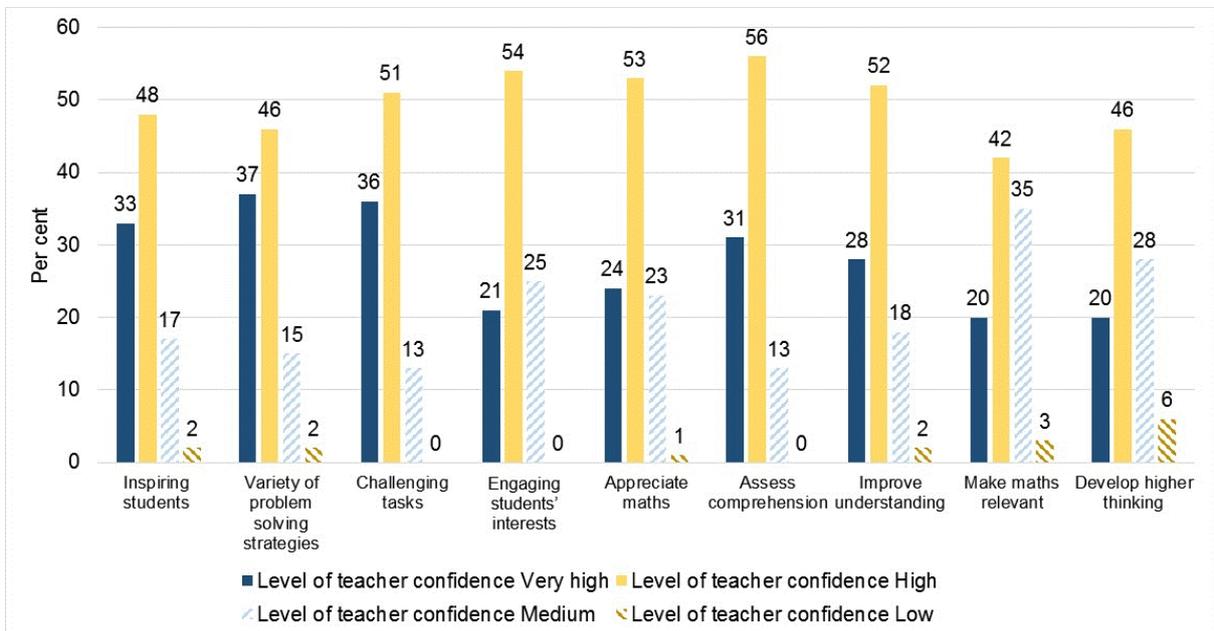
Figure 105: Year 5 teachers' level of confidence in teaching maths across different aspects (England)



Source: TIMSS 2015.

The corresponding reporting of confidence levels by year 9 teachers is shown below in Figure 106. As with year 5 teachers, the majority reported very high or high levels of confidence. However, more judged themselves as having medium levels of confidence overall. As with year 5 teachers, developing higher-order thinking was an aspect in which teachers were less confident, alongside making maths relevant.

Figure 106: Year 9 teachers' level of confidence in teaching maths across different aspects (England)



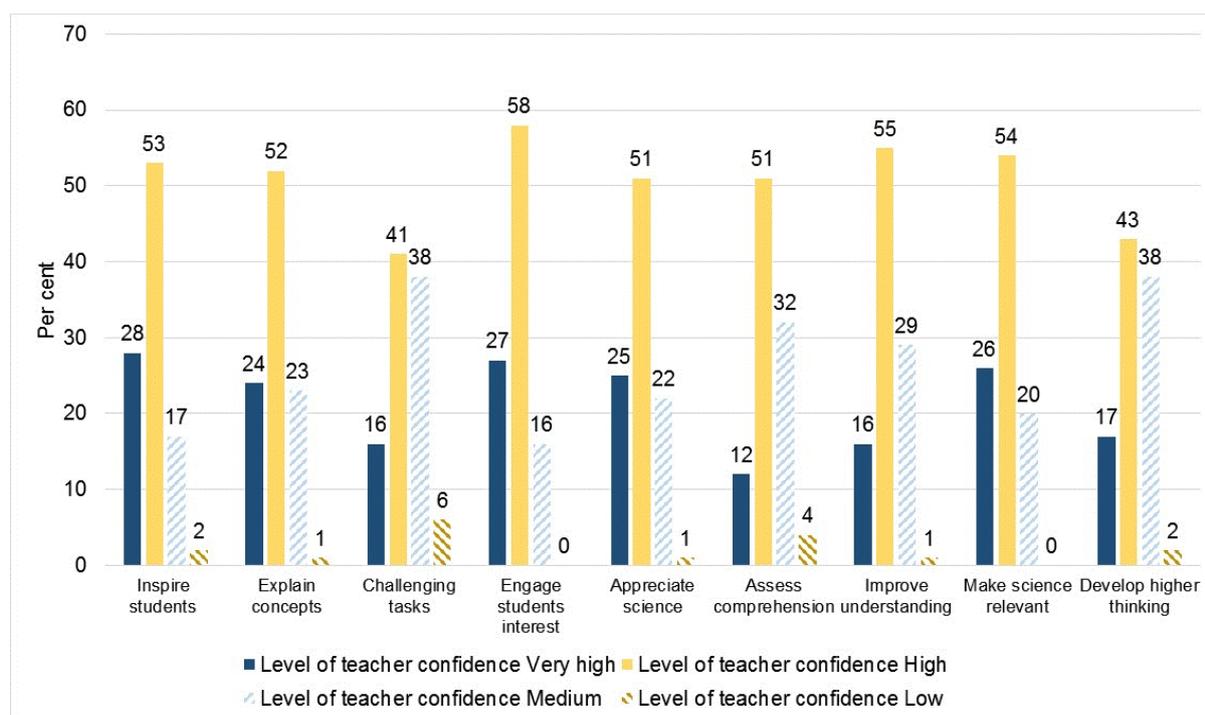
Source: TIMSS 2015.

Science

Overall, the majority of year 5 teachers reported very high or high levels of confidence in the different aspects of teaching science (see Figure 107 below). The

highest levels of confidence were reported to be inspiring and engaging pupils' interest. Teachers reported that they were comparatively less confident in setting challenging tasks, assessing pupils' comprehension and developing higher thinking, where a larger proportion used the rating, medium. However, very few teachers reported low levels of confidence.

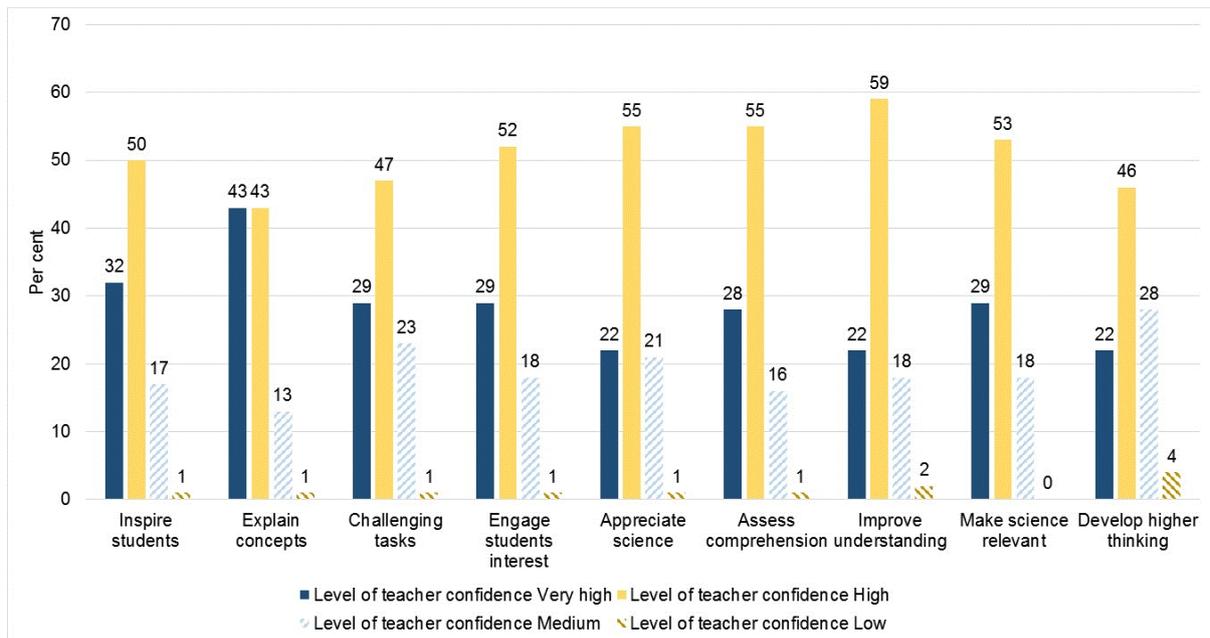
Figure 107: Year 5 teachers' level of confidence in teaching science across different aspects (England)



Source: TIMSS 2015.

The findings from year 9 teachers were similar to those from year 5. The majority of year 9 teachers reported very high or high levels of confidence in the different aspects of teaching science (see Figure 108 below). As with year 5 teachers, inspiring and engaging pupils' interest were rated highly, with the highest rating being an ability to explain concepts. Unlike the year 5 survey, assessing comprehension was also perceived as a relative strength. However, as with year 5 teachers, there were greater proportions of year 9 teachers who reported a medium level of confidence in setting challenging tasks and developing higher-order thinking. Very few reported low levels of confidence.

Figure 108: Year 9 teachers' level of confidence in teaching science across different aspects (England)

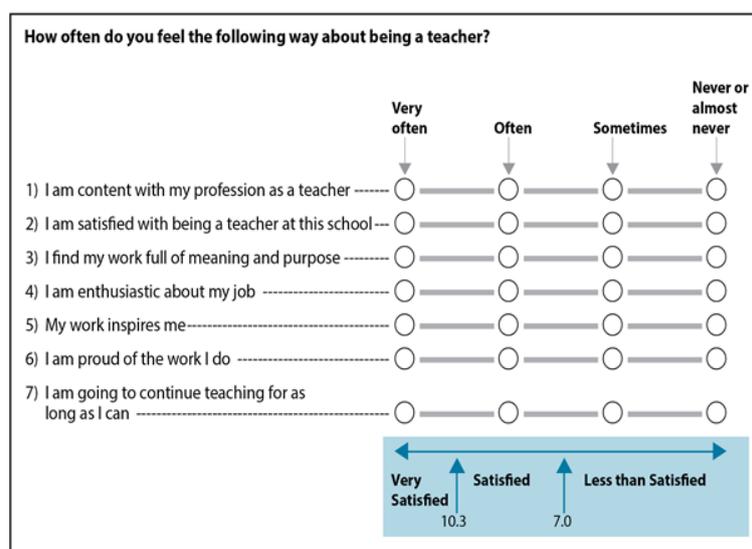


Source: TIMSS 2015.

9.8 How satisfied are teachers in England with their jobs?

The extent to which teachers were satisfied with their jobs was assessed through a questionnaire comprising seven statements which were rated using a four-point scale (see figure 109 below). The same questionnaire was used across both subjects and both year groups.

Figure 109: TIMSS questionnaire assessing teachers' views on job satisfaction



Source: TIMSS 2015.

Based on how much teachers agreed with these statements, pupils were assigned to one of three categories: those taught by teachers that were: Very satisfied, Satisfied or Less than satisfied with their jobs¹⁰⁴. In this section, maths data are presented for year 5 with notable differences between maths and science identified.

Year 5

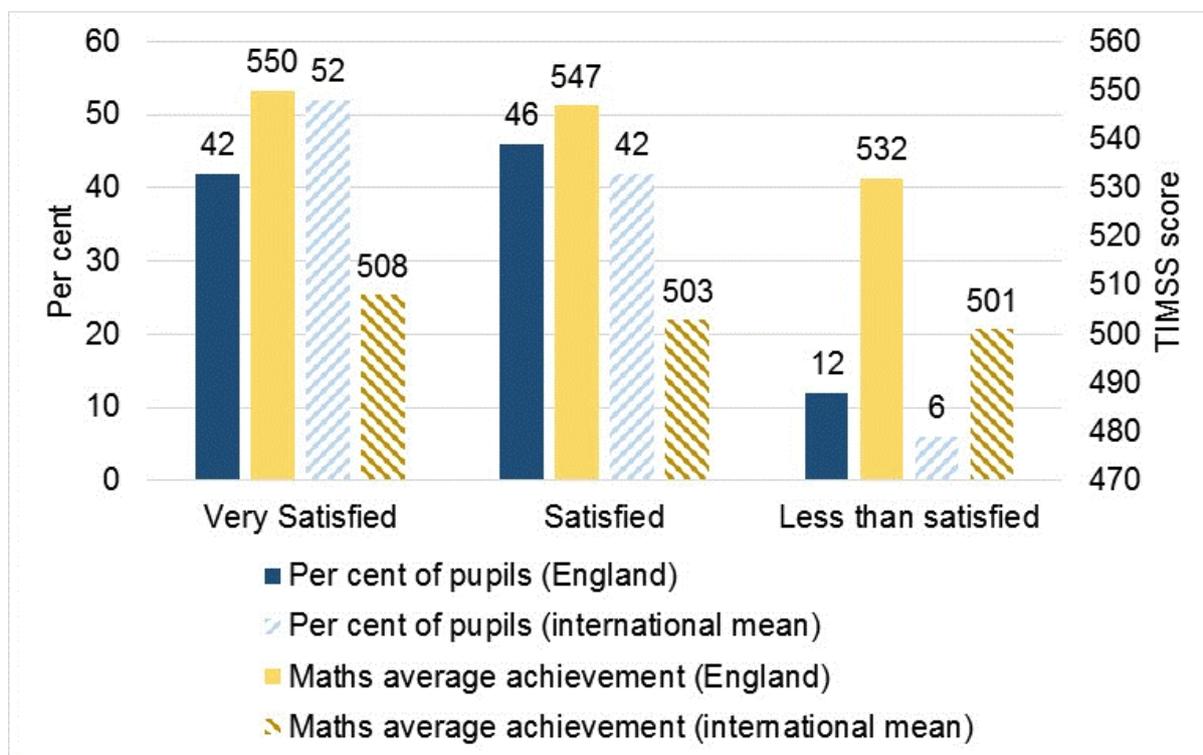
Figure 110 below shows year 5 pupils taught maths by teachers with different levels of job satisfaction and their average achievement. The percentages of pupils were very similar between maths and science although there were some differences in average achievement.

Job satisfaction among year 5 teachers appears to be low compared to other countries, although cultural differences and interpretations may be a factor in this. In both maths and science, about twice as many year 5 pupils were taught by teachers who were less than satisfied with their jobs compared to their peers from participating countries as a whole.

The difference in average achievement between pupils taught by teachers that were very satisfied with their job compared with those that were less than satisfied was larger in maths than science (18 scale points compared to 11), and larger than the difference between these categories across all participating countries (seven scale points). There is an association between levels of job satisfaction and pupils' average achievement both in England and across all countries: the more satisfied teachers were, the higher pupils achieved.

¹⁰⁴ See [Appendix E Table E17](#) for an explanation of how categories were determined from questionnaire responses.

Figure 110: The extent to which year 5 pupils were taught maths by teachers with different levels of job satisfaction and their average achievement (England with international comparisons)



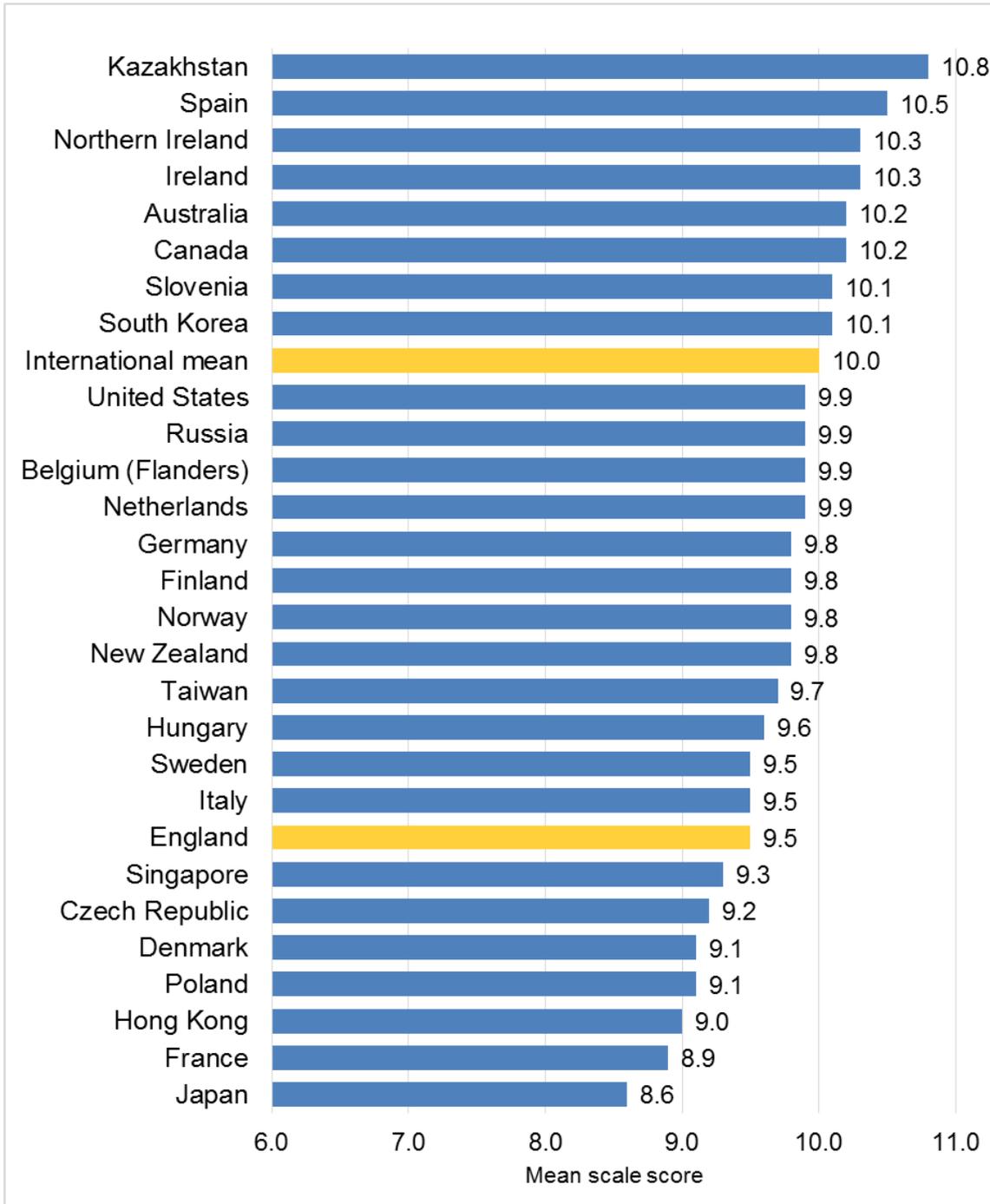
Source: TIMSS 2015.

Note 1: In science average achievement for pupils in England were: very satisfied - 539; satisfied - 537; less than satisfied - 528.

It is notable that of the five highest-performing countries in maths (the East Asian group), Singapore, Hong Kong and Japan all had smaller proportions of pupils taught by teachers that were very satisfied with their jobs than England (see Figure 111 below). Of this group of five, only South Korea was above the international mean for this measure of job satisfaction, with Taiwan below this mean. These findings were replicated in year 5 science.

Pupils in all of the other participating countries in which year 5 maths achievement was significantly above, or similar to England's, were taught by teachers more satisfied with their jobs than their English peers, except those in Denmark. In science, pupils in all countries except those in Poland and the Czech Republic were taught by teachers with lower levels of job satisfaction than peers in England. Figure 112 below reflects these findings.

Figure 111: Year 5 teachers of maths - level of job satisfaction (England and comparator group countries)



Source: TIMSS 2015.

Note 1: The TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centre point of 10 was located at the mean.

Note 2: A scale score below 10 represents rates of job satisfaction lower than the mean. Correspondingly, a scale score above 10 represents a level of job satisfaction higher than the mean.

Figure 112: Year 5 teachers of science - level of job satisfaction (England and comparator group countries)

Source: TIMSS 2015.

Note 1: The TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centre point of 10 was located at the mean.

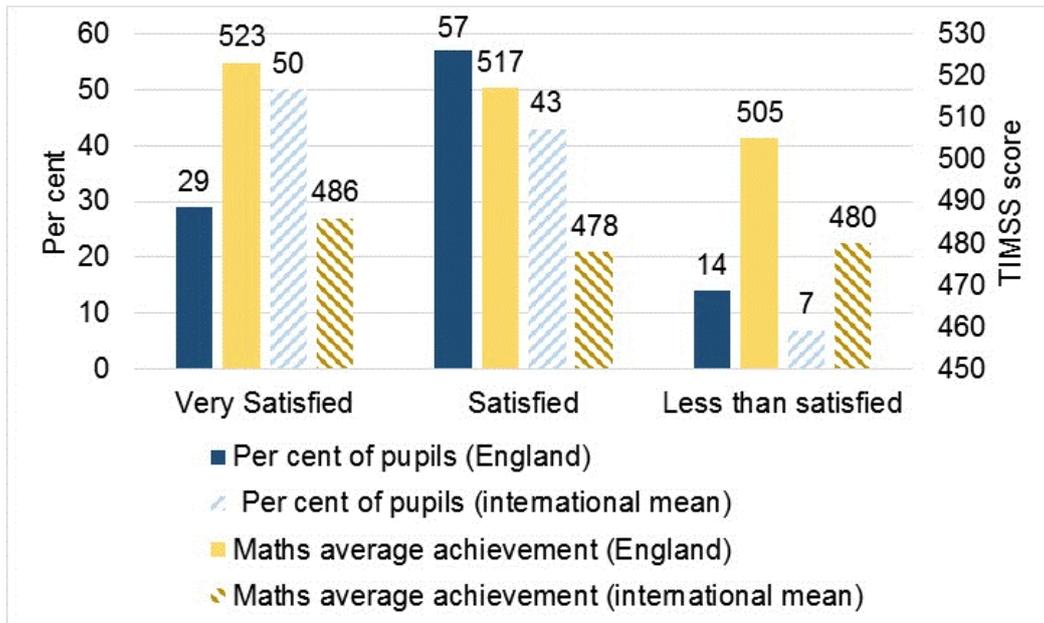
Note 2: A scale score below 10 represents rates of satisfaction lower than the mean. Correspondingly, a scale score above 10 represents a level of satisfaction higher than the mean.

Year 9

Job satisfaction among year 9 maths teachers appears to be very low compared to other countries. In both maths and science, year 9 pupils were about twice as likely to be taught by teachers who were 'less than satisfied' with their jobs (see Figures 113 and 114 below). Both in year 9 maths and science, there is an association between pupils' average achievement in England and their teachers' job satisfaction:

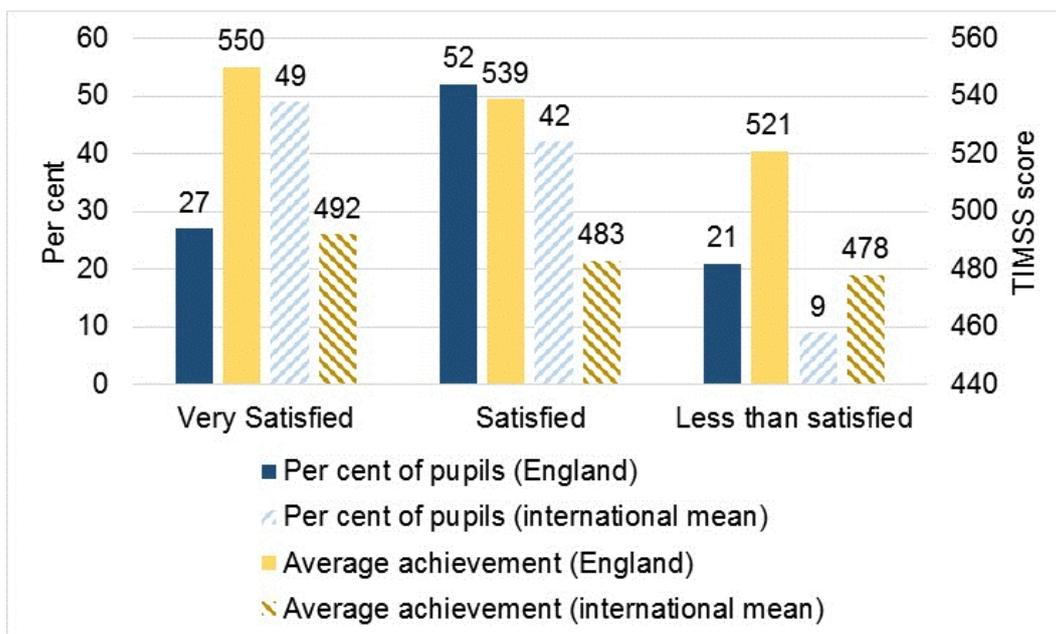
the higher the level of satisfaction, the higher pupils achieved. Across all countries, this association was evident in science but in maths pupils taught by less than satisfied teachers performed slightly better than those taught by satisfied teachers.

Figure 113: The extent to which year 9 pupils were taught maths by teachers with different levels of job satisfaction and their average achievement (England with international comparisons)



Source: TIMSS 2015

Figure 114: The extent to which year 9 pupils were taught science by teachers with different levels of job satisfaction and their average achievement (England with international comparisons)

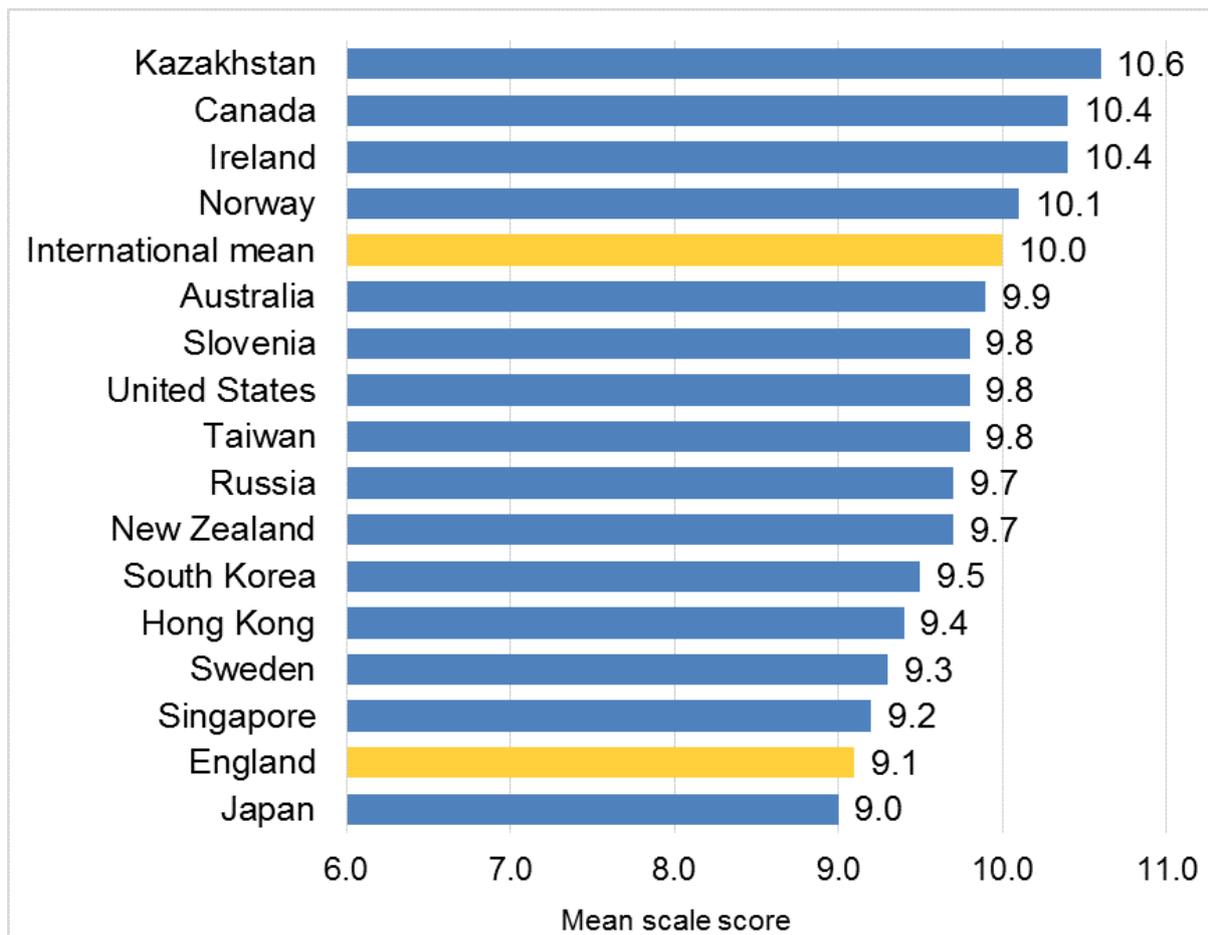


Source: TIMSS 2015.

In both maths and science, across all participating countries, only the proportion of year 9 pupils in Japan taught by very satisfied teachers was smaller than the proportion of pupils in England. Figure 115 below reflects this finding against comparator group countries.

Of the 15 countries that either performed significantly above, or similarly to, England in year 9 maths, only Kazakhstan, Canada, Ireland and Norway from the comparator groups had a larger proportion of pupils taught by teachers with a higher level of job satisfaction, compared to the international mean scale score.

Figure 115: Year 9 maths teachers' level of job satisfaction (England and comparator group countries)

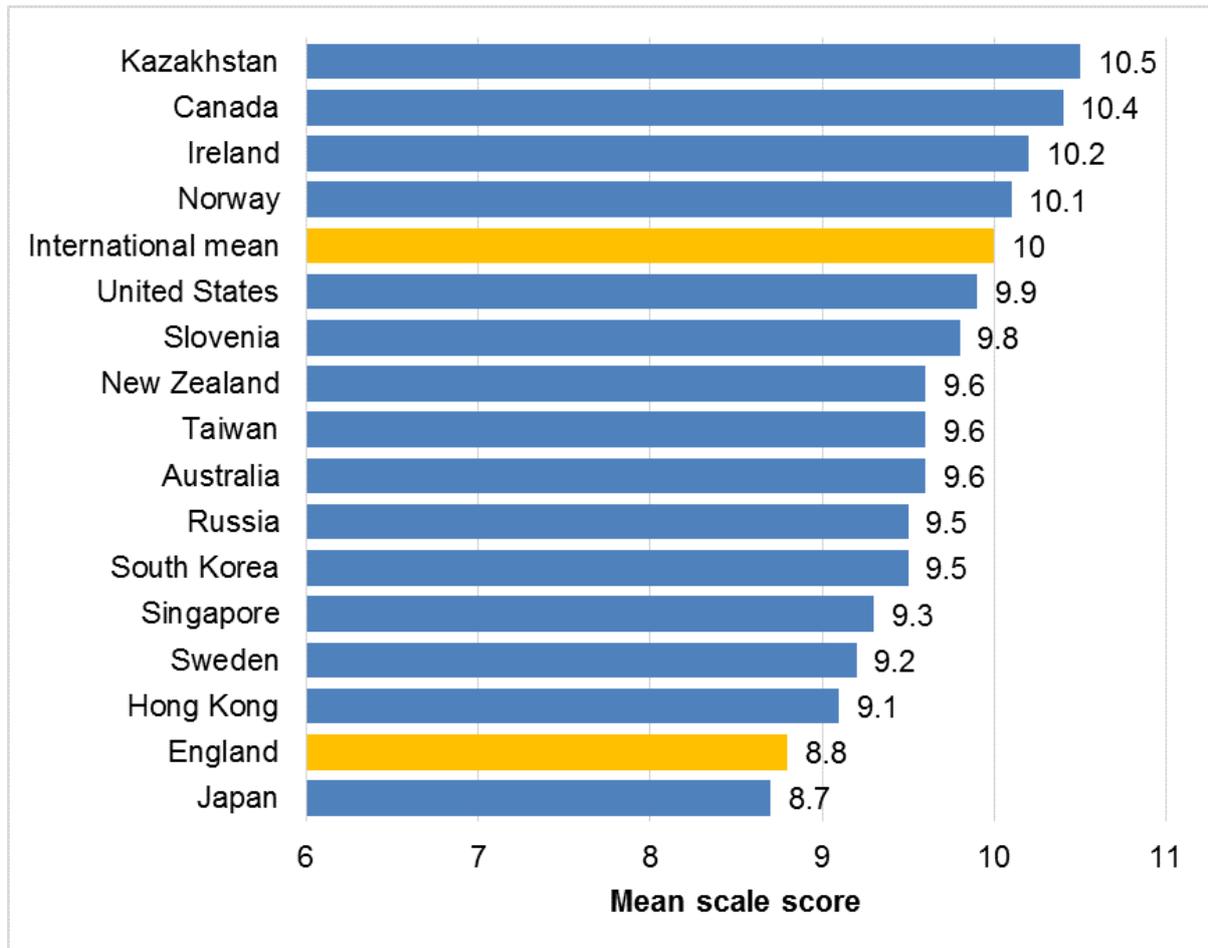


Source: TIMSS 2015.

Note 1: The TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centre point of 10 was located at the mean.

Note 2: A scale score below 10 represents rates of job satisfaction lower than the mean. Correspondingly, a scale score above 10 represents a level of job satisfaction higher than the mean.

**Figure 116: Year 9 science teachers' level of job satisfaction
(England and comparator group countries)**



Source: TIMSS 2015.

Note 1: The TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centre point of 10 was located at the mean.

Note 2: A scale score below 10 represents rates of satisfaction lower than the mean. Correspondingly, a scale score above 10 represents a level of satisfaction higher than the mean.

Chapter 10. Home Environment

This chapter focuses on factors within the home environment considered potentially influential on pupils' achievement. These comprise:

- Having access to computers and using the internet to support learning
- Having a study desk for homework
- Having additional tuition in maths and/or science.

These data were gathered from pupil questionnaires and comparisons with other countries are made where relevant.

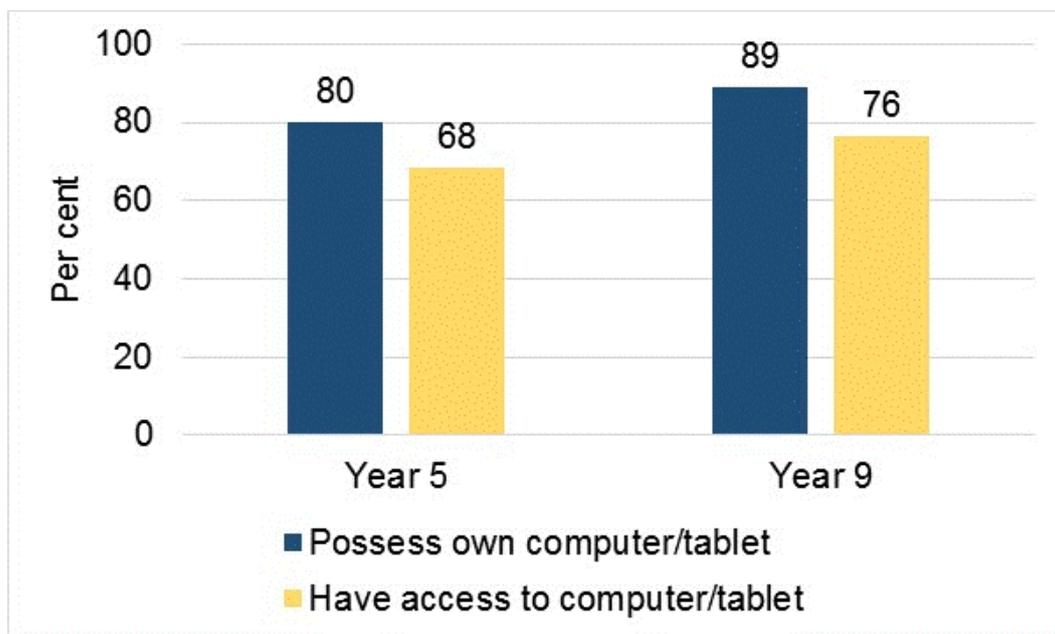
10.1 Main Findings

- The vast majority (95% and 99%) of both year 5 pupils and year 9 pupils in England reported having access to the internet at home.
- Most year 5 and year 9 pupils in England either possessed their own computer/tablet (80% and 89% respectively) or had access to a shared one in their home (68% and 76% respectively).
- Forty-seven per cent of year 5 pupils in England used a computer for their homework every day or almost every day, while 82 per cent used a computer for their homework at least once a week. Only 10 per cent used it only once or twice a month and eight per cent never or almost never.
- Most year 9 pupils in England (60%) used a computer/tablet every day or almost every day. The majority of pupils (89%) used their computer at least once a week. Only 11 per cent of pupils used a computer twice a month or less frequently.
- The majority of both year 5 and year 9 pupils in England had access to a study desk at home, with a larger proportion of year 9 pupils having this than year 5 pupils. The proportion of year 5 pupils with access to a study desk is below the international mean, while the proportion of year 9 pupils is the same.
- The uptake of additional tuition in maths and science by year 9 pupils in England is very low compared to other countries. About three-times as many pupils in the high-performing East Asian countries receive home tuition in maths.
- Year 9 pupils in England who received additional tuition in maths and science to excel performed better than those who received tuition to keep up. However, both groups performed less well than pupils who did not receive any tuition, although caution should be taken in interpreting the relationship as causal, since pupils might receive additional tuition based on their relatively low prior academic performance.

10.2 To what extent do pupils in England have access to computers and/or social networking resources at home and how often do they use them?

Almost all year 5 (95%) and year 9 pupils (99%) reported having access to the internet at home. Most pupils either possessed their own computer/tablet or had access to a shared one in their home (see Figure 117). Year 9 pupils tended to possess a computer/tablet more than year 5 pupils. Similarly, more year 9 pupils had access to a shared computer/tablet than year 5 pupils.

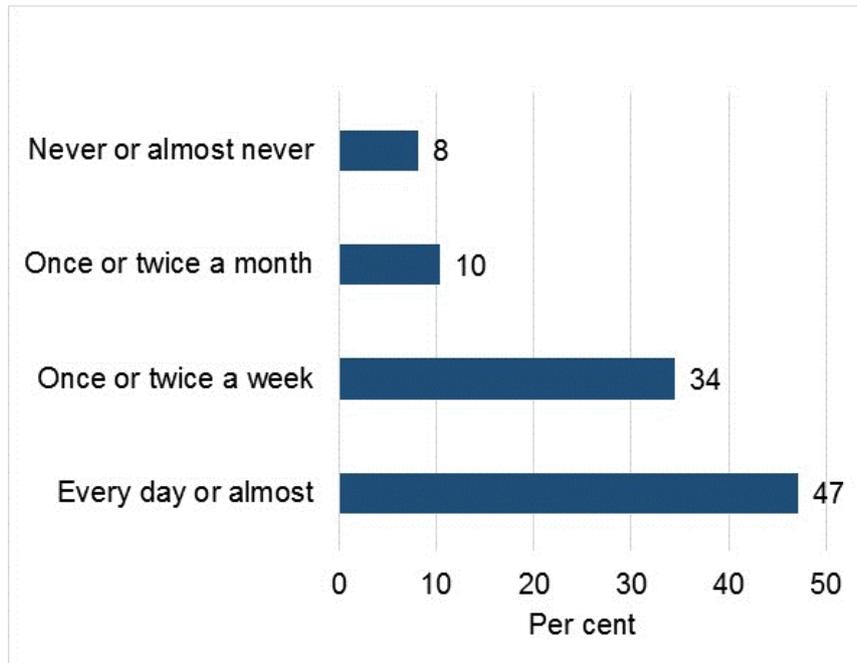
Figure 117: Percentage of pupils in years 5 and 9 who had access to their own or shared computer/tablet (England)



Source: TIMSS 2015.

The frequency with which year 5 pupils use their computer/tablet for homework is shown in Figure 118 below. Nearly half (47%) of year 5 pupils in England used a computer for their homework every day or almost every day. The vast majority (81%) used a computer for their homework at least once a week. Only 10 per cent used it once or twice a month and eight per cent never or almost never.

Figure 118: Percentage of year 5 pupils that used their computer/tablet for homework according to frequency of use (England)



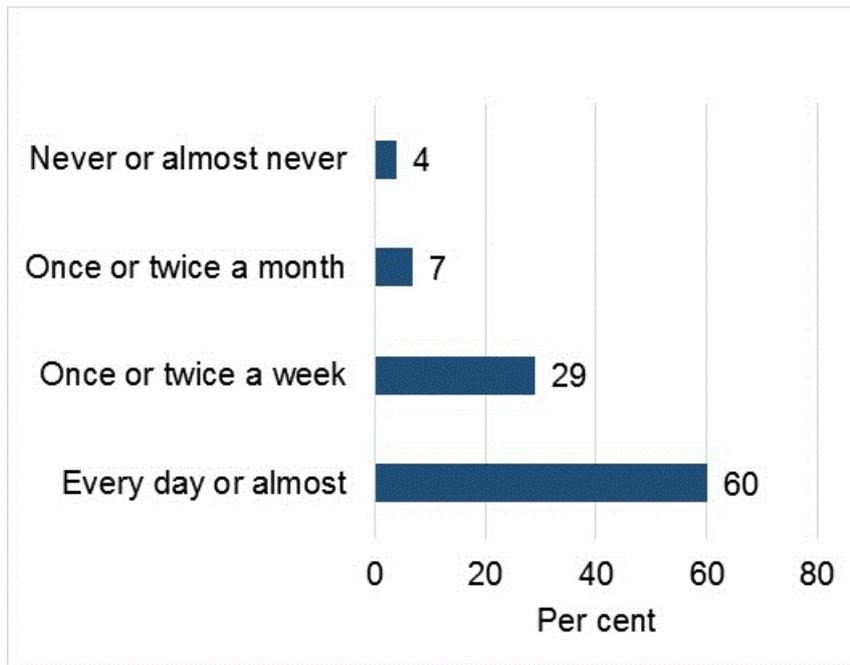
Source: TIMSS 2015.

Note 1: Figures may not total 100 due to rounding.

The frequency with which year 9 pupils used their computer/tablet is shown in Figure 119 below. It should be noted that the question year 9 pupils responded to was different to that asked of year 5 pupils. It was not specifically focused on pupils' use of their computer/laptop for homework but usage more broadly. It is unlikely therefore to be directly comparable to the year 5 findings or representative of year 9 pupils' use of their computer/laptop for homework alone.

The majority of year 9 pupils used a computer/tablet every day or almost every day, while most pupils (89%) used their computer at least once a week. Only 11 per cent of students used a computer twice a month or less frequently.

Figure 119: The frequency with which year 9 pupils used their computer/tablet (England)



Source: TIMSS 2015.

10.3 What proportion of pupils in year 9 use the internet for schoolwork?

A further series of questions explored the purpose for which year 9 pupils in England used the internet for homework when they did use it for this purpose.

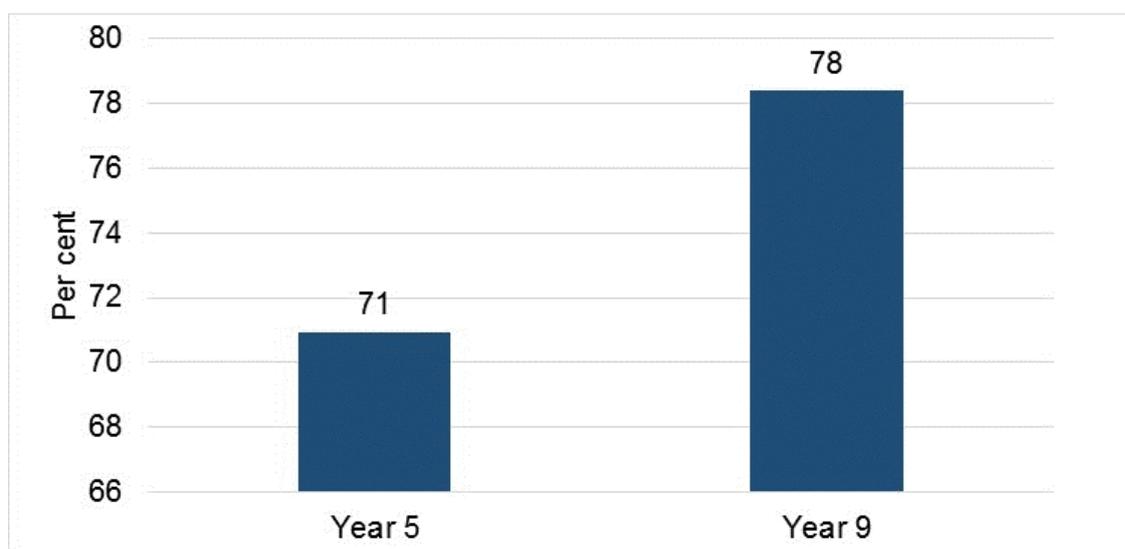
The data from this show that, in England, more than half (54%) of participating pupils reported that they used the internet to access textbooks/course materials, similar to the international mean (56%). Seventy-one per cent reported that they used the internet to access assignments, compared to the mean of 53 per cent. The percentage collaborating with peers on assignments/projects (53%) was below the international mean (69%), while one-third (33%) used the internet to communicate with their teachers (slightly below the mean of 36%).

Finally, around two-thirds of year 9 pupils used the internet to find information, articles, or tutorials to aid their understanding in maths (66%) and science (64%) respectively (slightly more than the respective international means: 57% and 61%).

10.4 Do pupils in England have access to a study desk at home?

The majority of both year 5 and year 9 pupils in England had access to a study desk at home, with a larger proportion of year 9 pupils having this than year 5 pupils (see Figure 120 below). The proportion of year 5 pupils with access to a study desk at home is below the international mean (77%), while the proportion of year 9 pupils is the same (78%).

Figure 120: The percentage of year 5 and 9 pupils who had access to a study desk at home (England)



Source: TIMSS 2015.

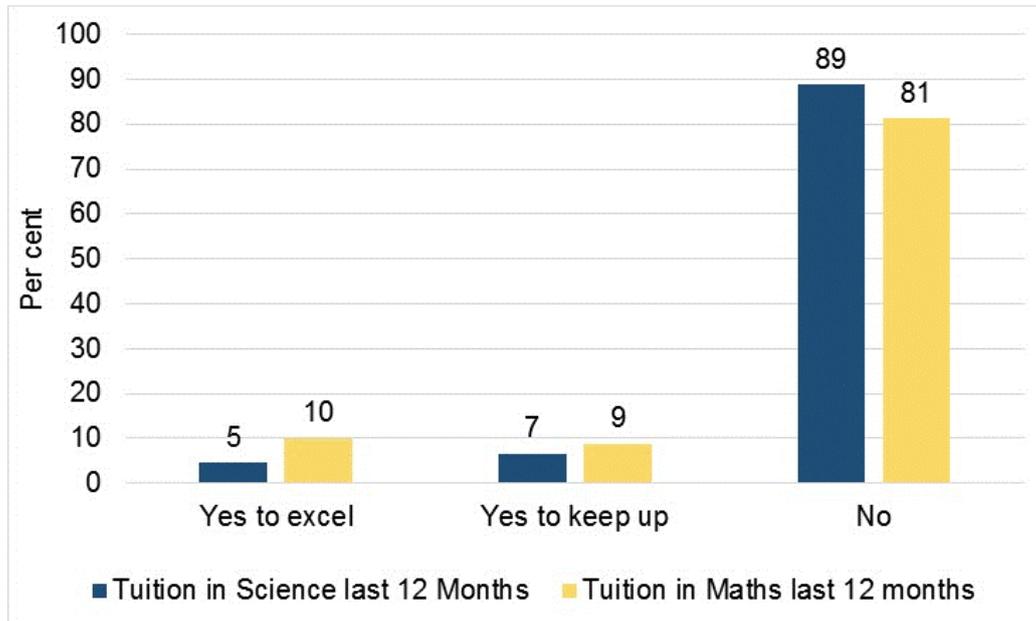
10.5 Does performance differ by pupils' engagement in additional tuition outside of their school?

10.5.1 What proportion of pupils in England receive additional maths or science tuition outside of school?

This question was only asked of year 9 pupils, with 22 per cent of these reporting that they had received additional tuition in at least one subject - maths or science - in the previous 12 months.

Figure 121 below provides further information about the nature of the additional tuition in maths and science. The majority of year 9 pupils in England did not receive any additional tuition but, of those that did, more received this in maths than in science. Those who received tuition in maths tended to engage with it more to excel than to keep up. The opposite is true in science where the goal was more to keep up than to excel.

Figure 121: Year 9 pupils' reasons for undertaking additional tuition in maths and/or science (England)



Source: TIMSS 2015.

10.5.2 How does the uptake of additional maths and science tuition in England compare to other TIMSS countries?

About one in five year 9 pupils in England received additional tuition in maths (19%). By contrast, of the five highest-performing countries: 55 per cent of year 9 pupils from Singapore; 70 per cent from South Korea; 54 per cent from Taiwan; 49 per cent from Hong Kong and 53 per cent from Japan take up additional tuition in maths. Of the English-speaking countries, Australia (23%) and the United States (25%) were those in which uptake was greatest; a little above the proportion of pupils in England.

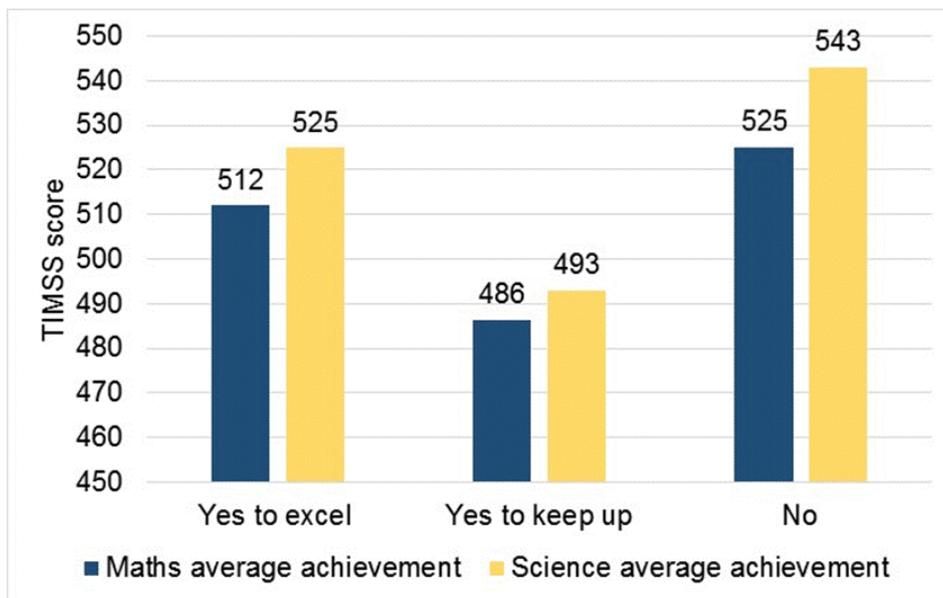
In science, about one in eight year 9 pupils in England received additional tuition (12%). By contrast, of the five highest-performing countries: 35 per cent of year 9 pupils from Singapore; 37 per cent from Japan; 37 per cent from Taiwan; 33 per cent from the South Korea and 30 per cent from Slovenia take up additional tuition in science. In the two English-speaking countries in which science tuition uptake was highest, the proportion of year 9 pupils receiving tuition in Australia (21%) was almost twice that in England, while it was similar in the United States (14%).

10.5.3 Is there an association between engagement in additional tuition outside school and performance in maths and science?

Figure 122 below shows the average achievement of year 9 pupils in England that have received tuition measured against the international mean (500). Year 9 pupils in England who received additional tuition in maths and/or science to excel

performed better than those who received tuition to keep up. However, both performed less well than pupils who did not receive any tuition. Caution should be taken in interpreting the relationship as causal as pupils might have received additional tuition based on their relatively low prior academic performance compared with their peers.

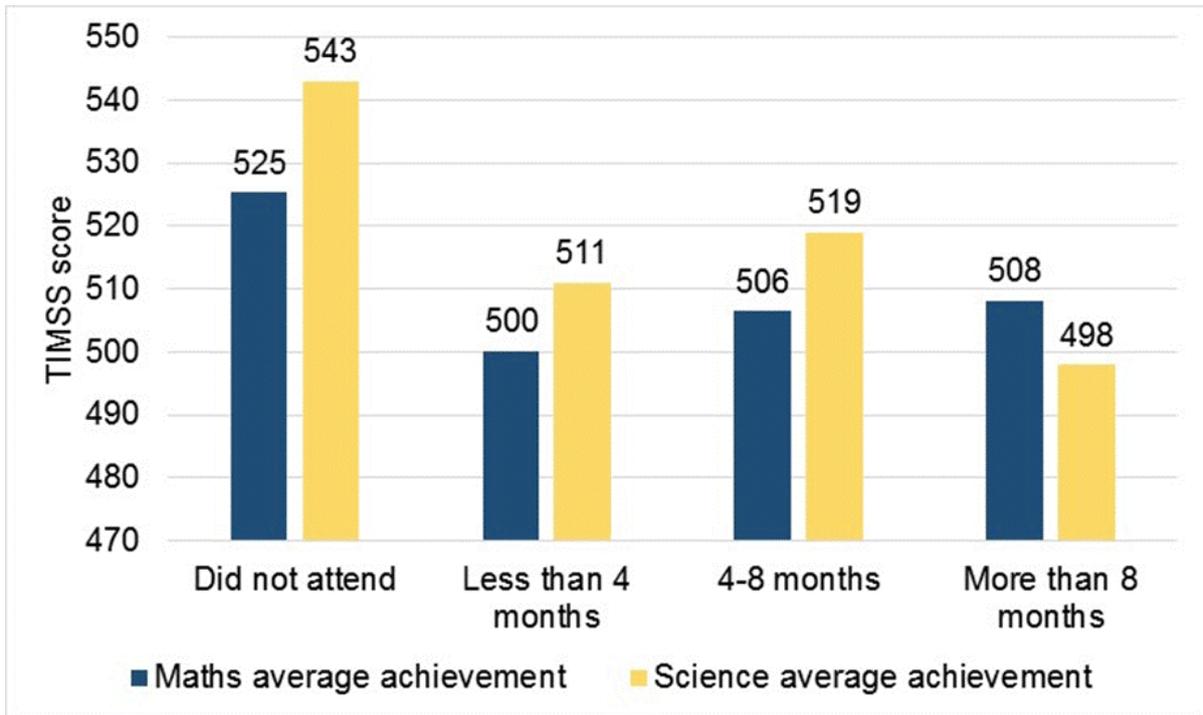
Figure 122: Average achievement of year 9 pupils that have received additional tuition in maths and/or science (England)



Source: TIMSS 2015.

Figure 123 below shows the average achievement of year 9 pupils that received additional tuition in maths and science based on the duration of this within a 12 month period. These data show that for those receiving additional tuition in maths, extended periods of time engaging in this are associated with higher average achievement, although the level of achievement is not significantly higher. However, for year 9 pupils who took additional tuition in science, the relationship between duration and performance follows an inverse pattern: there appears to be improvement by increasing the duration from less than four months to 4-8 months, and a decline from more than eight months. This may indicate that the benefits drop after eight months, or simply that the weaker pupils are more likely to receive tuition for longer. Equally, the differences in performance between duration categories are not significant.

Figure 123: Average achievement of year 9 pupils receiving additional tuition in maths based on its duration (England)



Source: TIMSS 2015.

Chapter 11. Conclusions

This report covers a huge amount of detail and there is even more in the TIMSS International Report 2015 and encyclopaedia. The range of possible issues for discussion that emerge, and the questions that warrant further research, is similarly vast. This conclusion does not attempt a comprehensive review of all these issues and questions, but rather draws out a small number of themes that have struck the research team as important.

We now have 20 years of data from TIMSS. England performed relatively badly in maths in 1995, coming below the international mean in both years 5 and 9, prompting the introduction of the National Numeracy Strategy for primary schools a few years later. Since then, performance in maths has improved significantly in both year groups, but particularly in year 5, where it is now significantly above the international mean. The gradual increase in the proportions of pupils achieving each of the international benchmarks for maths is particularly welcome, with the improvements in the Low benchmarks since 2011 especially important insofar as they represent a reduction in England's long tail of under-achievement. Performance in science was much better in both phases in 1995, and has remained significantly above the international mean in both year groups ever since. The worrying drop in year 5 science results in 2011 – which some attributed to the removal of universal science SATs for primary schools – appears to have been reversed between 2011 and 2015, with a significant improvement over the 20 year period. Whilst this picture of incremental improvement in maths, improvement in year 5 science and relatively steady performance in year 9 science might seem underwhelming, especially given the huge investment and the rapid pace of change in schools over that period, it nevertheless leaves England firmly in the second highest-performing group of countries internationally over a period during which many countries that were ahead of us in 1995 have seen declines.

As we highlight in the executive summary, three particular performance issues that stand out for England from the 2015 results are: that pupils here make relatively little progress in maths between years 5 and 9; that far higher proportions achieve the Advanced and High benchmarks in both subjects in the highest performing countries; and that we have wider gaps between our more and less advantaged pupils than most other high performing countries. Three curriculum areas where we perform poorly, and that therefore warrant attention, are Chemistry and Algebra in Key Stage 3, and Geometric Shapes and Measures in Key Stage 2.

Delving underneath the headline results, there are many other fascinating insights that require further exploration: the 2015 year 9 cohort has made progress in science since 2011, but has fallen back in maths; we are stronger in Knowing than Applying and Reasoning in year 5 maths, but in all other areas this pattern is reversed; we are

strong in Data and Chance in year 9 maths, but much weaker in Algebra; boys are significantly ahead of girls again in year 5 maths; EAL appears to be a barrier in science, but not in maths; pupil confidence in a subject appears to matter more than engaging teaching or whether or not pupils value it, and so on.

In many respects, England's schools can be favourably compared to their international comparators. For example, they have fewer challenges with lack of resources, with poor conditions, and with pupil behaviour than schools in most other countries, although there are other areas, such as teacher recruitment, staff challenges and job satisfaction for teachers, where they perform less well. England's schools score highly for their focus on academic performance, and this appears to be a particularly important factor in student attainment.

Once again, the East Asian group of countries has performed phenomenally well in the assessments. What is notable though is how these countries score in some of the other areas of TIMSS, for example with fewer pupils valuing or liking learning maths and science than in many other parts of the world, and with high levels of challenge for teachers and low levels of teacher job satisfaction. It is also important to note the high levels of home tutoring in these countries, often involving more than 50% of pupils. As ever with international comparisons, the importance of cultural and contextual differences cannot be ignored here. Nevertheless, as England adopts ever more of its curriculum content and maths pedagogy from East Asia it will be important to understand how these wider factors interact to secure high performance.

Finally, there is an important group of countries – the ones we call 'fast movers' in our analysis – that merit further research in order to understand how they have made their improvements. Some of these countries, such as Poland, have also seen rapid improvements in PISA in recent years, and so have been studied by the OECD, but others, such as Kazakhstan have not.

Appendix A: Background

1. TIMSS 2015: Introduction

TIMSS 2015 is the sixth cycle of the IEA's¹⁰⁵ series of comparative surveys of mathematics and science achievements. TIMSS has been administered every four years since 1995. The 2015 survey gives an updated picture of participating countries' educational performances relative to the previous study in 2011. Earlier cycles of TIMSS took place in 2007, 2003, 1999, and 1995.

2. TIMSS 2015 participants

TIMSS 2015 involved 55 participating countries and 9 benchmarking entities taking part at one or both of the target grades: fourth and eighth. In England, these grades correspond to years five and nine with pupils aged 9-10 and 13-14 respectively.

In TIMSS 2015 there were 57 participants at the fourth grade (49 countries and 8 benchmarking entities) and 47 participants at the eighth grade (38 countries and 9 benchmarking participants).

Table 20 gives a list of participating countries and benchmarking participants at each grade of the TIMSS 2015 survey. The TIMSS participants are diverse. They range from highly developed countries to developing ones and include education systems representative of all major traditions (comprehensive, selective, liberal, etc.). The countries vary in terms of the underlying characteristics of their education systems (e.g. age at which children start school, repetition, selection, length of each phase in number of years, etc.). More information about the educational systems in each country can be found in the TIMSS encyclopaedia (Mullis et al, 2012)¹⁰⁶.

¹⁰⁵ International Association for the Evaluation of Educational Achievement (IEA). <http://www.iea.nl>

¹⁰⁶ Mullis, I. V. S., Martin, M. O., Goh, S., & Cotter, K. (Eds.) (2016). TIMSS 2015 Encyclopaedia: Education Policy and Curriculum in Mathematics and Science. Available at: <http://timssandpirls.bc.edu/timss2015/Encyclopedia/>

Table A1: Countries participating in TIMSS 2015

Participants	4th grade ¹⁰⁷	8th grade ¹⁰⁸	Participants	4th grade	8th grade
Bahrain	•	•	Morocco	•	•
Belgium (Flemish)	•		Netherlands	•	
Bulgaria	•		New Zealand	•	•
Canada	•	•	Northern Ireland	•	
Chile	•	•	Norway	•	•
Croatia	•		Oman	•	•
Cyprus	•		Poland	•	
Czech Republic	•		Portugal	•	
Denmark	•		Qatar	•	•
Egypt		•	Russia	•	•
England	•	•	Saudi Arabia	•	•
Finland	•		Serbia	•	
France	•		Singapore	•	•
Georgia	•	•	Slovak Republic	•	
Germany	•		Slovenia	•	•
Hong Kong	•	•	South Korea	•	•
Hungary	•	•	Spain	•	
Indonesia	•		Sweden	•	•
Iran	•	•	Taiwan	•	•
Ireland	•	•	Thailand		•
Israel		•	Turkey	•	•
Italy	•	•	United Arab Emirates	•	•

¹⁰⁷ 4th grade equates to year 5 in England.

¹⁰⁸ 8th grade equates to year 9 in England.

Japan	●	●	United States	●	●
Jordan	●	●	Benchmarking participants		
Kazakhstan	●	●	Florida-USA	●	●
Kuwait	●	●	Abu Dhabi-UAE	●	●
Lebanon		●	Buenos Aires-ARG	●	●
Lithuania	●	●	Dubai-UAE	●	●
Malaysia		●	Ontario-CAN	●	●
Malta		●	Quebec-CAN	●	●
<hr/>			Botswana		●
			Norway	●	●
			South Africa	●	●

● = Indicates participation in particular assessment with results reported or forthcoming.

○ = Indicates participation in particular assessment but results either not reported or reported separately, typically due to sampling, response rates, or other procedural problems with the data.

Appendix B: Methodology

TIMSS Methodology

All the countries and benchmarking entities that participated in TIMSS followed strict guidelines and sampling targets to ensure that the groups of pupils that eventually participated in the study were nationally representative of the target age group.

Sampling in TIMSS was based on internationally specified criteria and used a two-stage sampling strategy, with a sample of schools drawn in the first stage, and one or more classes of students selected from the sampled schools in the second. Some schools and students were excluded from the sampling process according to the following predefined exclusion criteria:

- Geographical location (e.g. exclusion of schools in remote inaccessible areas).
- Linguistic (participants may exclude certain language groups if the survey was administrated in the majority languages only).
- Special educational needs (SEN). In some cases, schools could exclude pupils with SEN if they cannot access the assessment.

TIMSS guidance stipulated that exclusions should be limited to a maximum of 5% of the total population across all stages of the survey.

In TIMSS, each country had a main sample of schools and two matched replacement samples, which were included in the survey if the main sample schools declined to participate. Each school in the main sample was assigned a first and a second replacement school, which had the same key sampling characteristics. This ensured that if the main sample school declined to participate, it could be replaced with a similar school. This way, samples remained representative of the characteristics of the national education systems they were drawn from even if some main sample schools did not participate. If a main sample school and its two replacement schools declined to participate, then the participant country could not include any other school to avoid skewing the sample.

After the schools were sampled, the classes of pupils of the target age were then randomly selected with 95 per cent expected to participate. Within each class, 85 per cent of pupils were expected to participate. Samples were inspected by the IEA's sampling referee and if they meet the criteria they were accepted for TIMSS 2015.

In order to meet the criteria, countries had to achieve participation of:

- At least 85 per cent of their main sample schools, Or

- At least 85 per cent of sampled schools with at least 50 per cent from the main sample and the remaining from the matched replacement samples, Or
- A combined pupil/school rate of at least 75 per cent.

Participants who achieved either (a) or (c) were deemed to have met their sampling requirements fully. Participants who achieved (b) were deemed to have achieved a sample that was suitably representative at national level, but data from the country would be annotated in the TIMSS International Report 2015, with a note to indicate that replacement schools were used.

England's TIMSS 2015 sample.

The four countries comprising the United Kingdom are regarded separately in TIMSS. England and Northern Ireland participated in TIMSS 2015 with England participating in the assessments for both years, and Northern Ireland only participating in the year 5 assessments. England has participated in all surveys since 1995, making comparisons over time possible.

The English sample was stratified (into six strata) based on school funding (private or state funded), and prior attainment (quintiles across state funded schools only).

Independent schools were classified into the 'Private' stratum, and then Key Stage 1 (for Year 5) and Key Stage 2 (for Year 9) prior attainment information from the Spring Census was used to stratify the state funded schools.

Exclusions were applied at school level and within schools in the same way for both the Year 5 and Year 9 samples. At school level, international schools, special schools and very small schools were excluded, resulting in approximately 2 per cent of the total eligible cohort being excluded (with the majority coming from special schools). Within schools, pupils with significant special needs were also excluded, resulting in a further <2 per cent of the eligible cohort being excluded in each year group.

The IEA stipulated that pupils from 300 English schools be selected to take part in TIMSS 2015 (150 schools educating year 5 pupils and 150 educating year 9 pupils).

The target school sample was provided by the IEA in August 2014 and schools were invited to participate in TIMSS 2015. Once the final sample of participating schools had been agreed, approved class sampling was conducted using IEA-supplied software. Schools with more than 90 Year 5 pupils or 200 Year 9 pupils on the sampling frame were allotted two classes to sample. Additionally, classes of 14 pupils or fewer were designated as pseudo-classes, and if sampled then an additional class was also selected.

For Year 5 this resulted in 120 schools having a single sampled class, 25 having two classes (10 through size of school and 15 through pseudo-classes) and 2 having three sampled classes (Both due to pseudo-classes). For Year 9 these figures were 75 schools with a single sampled class, 65 schools with two sampled classes, (61 through size of school and 4 through pseudo-classes) and 3 schools with three sampled classes (All a combination of both size of school and pseudo-classes).

In total 147 Year 5 (primary) schools were recruited – 142 from the main sample and 5 first replacement schools. This total meant that a 95 per cent sampled school participation rate was achieved, which exceeded the 85 per cent target set by the IEA (therefore ensuring that England is included within the TIMSS International Report 2015 without any caveats). With replacement schools included, a 98 per cent participation rate was achieved.

A total of 143 Year 9 (secondary) schools were recruited – 135 from the main sample, 7 first replacement schools and 1 second replacement school. Two schools were found to have closed after the sampling frame had been completed. IEA procedure for closed schools is to not go to a replacement school, but rather to reduce the denominator for the target percentage. This total meant that a 91 per cent sampled school participation rate was achieved, which exceeded the 85 per cent target set by the IEA (therefore ensuring that England is included within the TIMSS International Report 2015 without any caveat). With replacement schools included, a 97 per cent participation rate was achieved.

Tables B1 and B2 below present the final number of schools recruited for TIMSS in England.

Table B1: Year 5 TIMSS School Sample in England

Number of schools recruited				Number of schools declined			
Main sample	First replacement	Second replacement	Total	Main sample	First replacement	Second replacement	Total
142	5	0	147	3	0	0	3

Table B2: Year 9 TIMSS School Sample in England

Number recruited				Number declined			
Main sample	First replacement	Second replacement	Total	Main sample	First replacement	Second replacement	Total
135	7	1	143	4	0	0	4

In England, 4,006 year 5 pupils participated in the 2015 TIMSS assessments (a 98% pupil participation rate) and 4,814 year 9 pupils participated in the 2015 TIMSS assessments (a 97% pupil participation rate). In both year groups the participation rates exceeded the 85 per cent pupil participation targets set by the IEA.

For more information on the schools and pupils that participated in TIMSS see [Table 1 in Section 1.2](#).

It is important to note that although the study is designed to test a nationally representative sample of pupils, the selected class group(s) might not necessarily be representative of all pupils in a sampled school (for example in a secondary school where setting is applied in maths and either the top or bottom set has been selected to complete the assessment). One implication of this approach is that robust analysis cannot be undertaken by school type – for example because an academy that might have selected its top set for maths cannot be compared with a maintained school that might have selected its bottom set. A second caveat to note is that the pupils who took TIMSS tests were selected from a stratified school sample rather than a stratified pupil sample. This means that there are relatively few TIMSS pupils from some minority groups, for example, so it is not always possible to analyse TIMSS results for small sub-groups of pupils.

The maths and science teachers for each class selected to take part in TIMSS 2015, along with the headteachers from each of the participating schools, were also asked to fill in a questionnaire.

In England, 338 teachers completed the year 5 questionnaire (a response rate of 85%) and 881 teachers completed the year 9 questionnaire (a response rate of 75%).

The year 5 teacher participation rate met the 85 per cent target set by the IEA while the year 9 teacher participation rate was slightly below this target. England's year 9 teacher data is therefore annotated in the TIMSS International Report 2015 to make readers aware that the participation rate in the year 9 teacher survey in England was below the 85% target but above 70%.

There was an 89% response rate to the year 5 headteacher questionnaire (exceeding the IEA participation target) and a 79% response rate to the year 9 headteacher questionnaire (just below the IEA participation target). England's year 9 headteacher data is therefore also annotated in the TIMSS International Report 2015 to make readers aware that the participation rate in the year 9 headteacher survey in England was below the 85% target but above 70%.

Survey Administration

Ahead of the sample selection process, a field trial took place in March 2014, in which school recruitment, new assessment questions, and each background questionnaire (Pupil, Teacher and School) were trialled to identify if the questions were likely to provide valuable information for the main study.

Test materials were provided by the IEA and adaptation of the test items for use in England was carried out by World Class Arena Ltd (WCAL). This process took place between December 2014 and January 2015 and it ensured that tests provided fair and reliable assessments of pupils in England. WCAL also undertook a curriculum matching exercise to identify which of the TIMSS test items pupils in English schools would have been expected to have studied by the time of the TIMSS tests.

Every participating school nominated a TIMSS School Coordinator who worked with a dedicated TIMSS test administrator to ensure that tests were delivered to the IEA's exact requirements. Any discrepancies in test delivery methods between countries could introduce bias into the study.

Pupils were asked to complete maths and science test booklets and background questionnaires (both in hard copy format). Headteachers and teachers were asked to complete online questionnaires.

An important change to TIMSS 2015 was the introduction of a questionnaire on home factors, which was completed by the parents or carers of Grade 4 (year 5 pupils) only. However, English schools did not participate in this.

Data collection for the main study in England took place from March 2nd to May 12th 2015. Once all the tests and questionnaires had been completed the papers were collated by RM and then marked by specialist teams at WCAL and RM. The data for England was submitted to the IEA for processing and checking before it was merged with the other participating countries' data. The IEA also commissioned a TIMSS Encyclopaedia article from each participating nation, an overview of the structure of local education systems in participating countries.

Data Processing

The IEA analysed the international database of country results and the evidence from pupil, head teacher and teacher questionnaires. This analysis is available in the IEA's TIMSS International Report 2015. The IEA released the international database underpinning their report on the 1st September 2016 and this data has been used to produce this report for England.

The data for England has been linked to the to the National Pupil database (NPD).

Both the international and national reports were published on the 29th November 2016.

Coverage

Throughout the report the year 5 maths and science achievement data are based on test results for the 4,006 year 5 pupils and 4,814 year 9 pupils that took part in TIMSS 2015.

The findings based on the pupil questionnaire are based on a slightly lower base number of pupils. This is because we did not collect pupil questionnaire data from three schools and we therefore do not have background questionnaire data for the pupils in these schools.

The process of matching the TIMSS 2015 data and the records from the NPD resulted in a data set of 3,591 Year 5 pupils and 4,348 Year 9 pupils (not all TIMSS 2015 pupils could be matched to a record on the NPD). Analysis of the matched TIMSS 2015-NPD data set is therefore based on these samples of pupils.

Sources of further information

For more information on sample design and implementation, instrument development, translation, quality assurance, and creation of the international database visit: <http://timssandpirls.bc.edu/methods/>

For documentation on methods and procedures in TIMSS 2015 refer to: <http://timssandpirls.bc.edu/publications/timss/2015-methods.html>

For the TIMSS 2015 Encyclopaedia see: Mullis, I. V. S., Martin, M. O., Goh, S., & Cotter, K. (Eds.) (2016). TIMSS 2015 Encyclopedia: Education Policy and Curriculum in Mathematics and Science. Available at: <http://timssandpirls.bc.edu/timss2015/Encyclopedia/>

For the TIMSS International Report 2015 see: <http://timssandpirls.bc.edu/timss2015/international-results/>

Appendix C: TIMSS Benchmarks¹⁰⁹

Table C1: International Benchmarks for TIMSS maths achievement at years 5 and 9 (Advanced)

Advanced international benchmark (TIMSS Score of 625)	
Year 5	Year 9
<p><i>Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning.</i></p> <p>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.</p>	<p><i>Students can apply and reason in a variety of problem situations, solve linear equations, and make generalisations.</i></p> <p>They can solve a variety of fraction, proportion, and percent problems and justify their conclusions. Students can use their knowledge of geometric figures to solve a wide range of problems about area. They demonstrate understanding of the meaning of averages and can solve problems involving expected values.</p>

Table C2: International Benchmarks for TIMSS maths achievement at years 5 and 9 (High)

High international benchmark (TIMSS Score of 550)	
Year 5	Year 9

¹⁰⁹ All tables in [Appendix C](#) sourced from TIMSS 2015

<p><i>Students can apply their knowledge and understanding to solve problems.</i></p> <p>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.</p>	<p><i>Students can apply their understanding and knowledge in a variety of relatively complex situations.</i></p> <p>They can use information to solve problems involving different types of numbers and operations. They can relate fractions, decimals, and percentages to each other. Students at this level show basic procedural knowledge related to algebraic expressions. They can solve a variety of problems with angles including those involving triangles, parallel lines, rectangles, and similar figures. Students can interpret data in a variety of graphs and solve simple problems involving outcomes and probabilities.</p>
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Table C3: International Benchmarks for TIMSS maths achievement at years 5 and 9 (Intermediate)

Intermediate international benchmark (TIMSS Score of 475)	
Year 5	Year 9
<p><i>Students can apply basic mathematical knowledge in straightforward situations.</i></p> <p>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.</p>	<p><i>Students can apply basic mathematical knowledge in a variety of situations.</i></p> <p>They can solve problems involving negative numbers, decimals, percentages and proportions. Students have some knowledge of linear expressions and two- and three-dimensional shapes. They can read and interpret data in graphs and tables. They have some basic knowledge of chance.</p>

Table C4: International Benchmarks for TIMSS maths achievement at years 5 and 9 (Low)

Low international benchmark (TIMSS Score of 400)	
Year 5	Year 9
<p><i>Students have some basic mathematical knowledge.</i> 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.</p>	<p><i>Students have some knowledge of whole numbers and basic graphs.</i></p>

Table C5: International Benchmarks for TIMSS science achievement at years 5 and 9
(Advanced)

Advanced international benchmark (TIMSS Score of 625)	
Year 5	Year 9
<p><i>Students communicate understanding of life, physical, and Earth sciences and demonstrate some knowledge of the process of scientific enquiry.</i></p> <p>Students demonstrate knowledge of characteristics and life processes of a variety of organisms, communicate understanding of relationships in ecosystems and interactions between organisms and their environment, and communicate and apply knowledge of factors related to human health. They communicate understanding of properties and states of matter and physical and chemical changes, apply some knowledge of forms of energy and energy transfer, and show some knowledge of forces and an understanding of their effect on motion. Students communicate understanding of Earth's structure, physical characteristics, processes, and history and show knowledge of Earth's revolution and rotation. Students demonstrate basic knowledge and skills related to scientific inquiry, recognizing how a simple experiment should be set up, interpreting the results of an investigation, reasoning and drawing conclusions from descriptions and diagrams, and evaluating and supporting an argument.</p>	<p><i>Students communicate understanding of complex concepts related to biology, chemistry, physics and Earth science in practical, abstract, and experimental contexts.</i></p> <p>Students apply knowledge of cells and their functions as well as characteristics and life processes of organisms. They demonstrate understanding of diversity, adaptation, and natural selection among organisms, and of ecosystems and the interaction of organisms with their environment. Students apply knowledge of life cycles, and heredity in plants and animals. Students demonstrate knowledge of the composition and physical properties of matter and apply knowledge of chemical and physical change in practical and experimental contexts. Students communicate understanding of physical states and changes in matter in practical and experimental contexts, apply knowledge of energy transfer, and demonstrate knowledge of electricity and magnetism. Students communicate understanding of forces and pressure and demonstrate knowledge of light and sound in practical and abstract situations. Students communicate understanding of Earth's structure, physical features, and resources as well as of Earth in the solar system. Students show understanding of basic aspects of scientific investigation. They identify which variables to control in an experimental situation, compare information from several sources, combine information to predict and draw conclusions, and interpret information in diagrams, maps, graphs, and tables to solve problems. They provide written explanations to communicate scientific knowledge.</p>

Table C6: International Benchmarks for TIMSS science achievement at years 5 and 9 (High)

High international benchmark (TIMSS Score of 550)	
Year 5	Year 9
<p><i>Students communicate and apply knowledge of the life, physical, and Earth sciences in everyday and abstract contexts.</i></p> <p>Students communicate knowledge of characteristics of plants, animals, and their life cycles, and apply knowledge of ecosystems and of humans' and organisms' interactions with their environment. Students communicate and apply knowledge of states and properties of matter, and of energy transfer in practical contexts, as well as showing some understanding of forces and motion. Students apply knowledge of Earth's structure, physical characteristics, processes, and history and show basic understanding of the Earth-Moon-Sun system. Students compare, contrast, and make simple inferences using models, diagrams, and descriptions of investigations, and provide brief descriptive responses using science concepts, both in everyday and abstract contexts.</p>	<p><i>Students apply and communicate understanding of concepts from biology, chemistry, physics, and Earth science in everyday and abstract situations.</i></p> <p>Students apply knowledge of cells and their functions and of the characteristics and life processes of organisms. They communicate understanding of ecosystems and the interaction of organisms with their environment and apply some knowledge of human health related to nutrition and infectious disease. Students show some knowledge and understanding of the composition and properties of matter and chemical change. They apply basic knowledge of energy transformation and transfer and of light and sound in practical situations, and demonstrate understanding of simple electrical circuits and properties of magnets. Students apply their knowledge of forces and motion to everyday and abstract situations. They apply knowledge of Earth's physical features, processes, cycles, and history, and show some understanding of Earth's resources, their use, and conservation as well as some knowledge of the interaction between the Earth and the Moon. Students demonstrate some scientific inquiry skills, including selecting and justifying an appropriate experimental method. They combine and interpret information from various types of diagrams, graphs, and tables; select relevant information to analyze and draw conclusions; and provide short explanations conveying scientific knowledge.</p>

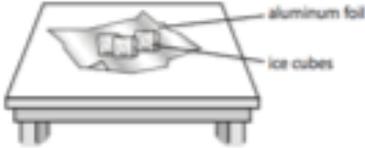
Table C7: International Benchmarks for TIMSS science achievement at years 5 and 9 (Intermediate)

Intermediate international benchmark (TIMSS Score of 475)	
Year 5	Year 9
<p><i>Students show basic knowledge of life, physical, and Earth sciences.</i> Students demonstrate some knowledge of life processes of plants and humans, communicate and apply knowledge of the interaction of living things with their environments as well as impacts humans can have on their environment, and communicate knowledge of basic facts related to human health. They apply knowledge about some properties of matter and about some facts related to electricity and to energy transfer, and apply elementary knowledge of forces and motion. They show some understanding of Earth's physical characteristics and demonstrate some basic knowledge of Earth in the solar system. Students interpret information in diagrams, apply factual knowledge to everyday situations, and provide simple explanations for biological and physical phenomena.</p>	<p><i>Students demonstrate and apply their knowledge of biology, chemistry, physics, and Earth science in various contexts.</i> Students demonstrate some knowledge of characteristics and life processes of animals and human health. They apply knowledge of ecosystems, the interaction of living things, and the adaptation of animals to their environments. Students apply some knowledge of the properties of matter. They also show knowledge of some aspects of force, motion, and energy. Students apply knowledge of Earth's processes, resources, and physical features. They interpret information from tables, graphs, and pictorial diagrams to draw conclusions, apply knowledge to practical situations, and communicate their understanding through brief descriptive responses.</p>

Table C8: International Benchmarks for TIMSS science achievement at years 5 and 9 (Low)

Low international benchmark (TIMSS Score of 400)	
Year 5	Year 9
<p><i>Students show basic knowledge of life and physical sciences.</i> Students demonstrate some basic knowledge of behavioural and physical characteristics of plants and animals as well as of the interaction of living things with their environments, and apply knowledge of some facts related to human health. Students show basic knowledge of states of matter and physical properties of matter. They interpret simple diagrams, complete simple tables, and provide short, fact-based written responses.</p>	<p><i>Students show some basic knowledge of biology, chemistry, physics, and Earth science.</i> Students apply basic knowledge of ecosystems and adaptation of animals to their environment, show knowledge of basic facts related to thermal and electrical conductivity and electromagnetism, and show knowledge of some basic Earth science facts. Students interpret simple pictorial diagrams and apply basic knowledge to practical situations.</p>

Appendix D: Example mathematics and science TIMSS test items

Subject	Year	Benchmark Level	Content Domain	Cognitive Domain	Item Description	Source
Science	Year 5	Intermediate International Benchmark (475)	Physical Science – Forms of Energy and Energy Transfer	Applying	Identifies the source of heat that causes ice cubes to melt	TIMSS 2015 Assessment. Copyright © 2016 IEA (International Association for the Evaluation of Educational Achievement). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.
<p>QUESTION</p> <p>Salem puts ice cubes on some aluminium foil on top of a table. After some time, the ice cubes melt.</p>  <p>What is a reason for this change?</p> <p>Ⓐ The table takes heat from the ice cubes. Ⓑ The air takes heat from the table. Ⓒ The aluminium foil gets heat from the ice cubes. Ⓓ The ice cubes get heat from the air.</p>				<p>MARK SCHEME</p> <p>The correct answer is D</p>		

Subject	Year	Benchmark Level	Content Domain	Cognitive Domain	Item Description	Source
Science	Year 5	Above the Advanced International Benchmark (625)	Earth Science – Earth in the Solar System	Knowing	Explains why stars are not visible during the day	TIMSS 2015 Assessment. Copyright © 2016 IEA (International Association for the Evaluation of Educational Achievement). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.
<p>QUESTION</p> <p>Why are the stars not visible during the day?</p>		<p>ANSWER SCHEME</p> <p>Correct Response</p> <p>Explain that the stars are not visible during the day because the light we see from the Sun is too bright compared with the light from the stars. Examples:</p> <ul style="list-style-type: none"> • During the day, we face the Sun and the Sun’s light is so bright we cannot see the stars. • The Sun is too bright. • It is not dark enough to see the stars. <p>Incorrect Response</p> <p>Incorrect (including crossed out, erased, stray marks, illegible, or off task), including responses that only mention the Sun, sunlight, daytime, and the fact that the Sun is bright or responses that only state a misconception. Examples:</p> <ul style="list-style-type: none"> • The stars turn off during the day. 				

- Because of the sunlight.
- It is daytime.
- The sky is bright during the day.
- The stars reflect sunlight.
- The stars are blocked by the Sun during the day.
- The stars move around the Earth.
- The Sun.

Nonresponse : Blank

Subject	Year	Benchmark Level	Content Domain	Cognitive Domain	Item Description	Source
Maths	Year 5	High International Benchmark (550)	Geometric Shapes and Measure	Applying	Completes a bar graph from information given in a tally chart (2 of 2 points)	TIMSS 2015 Assessment. Copyright © 2016 IEA (International Association for the Evaluation of Educational Achievement). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.

QUESTION

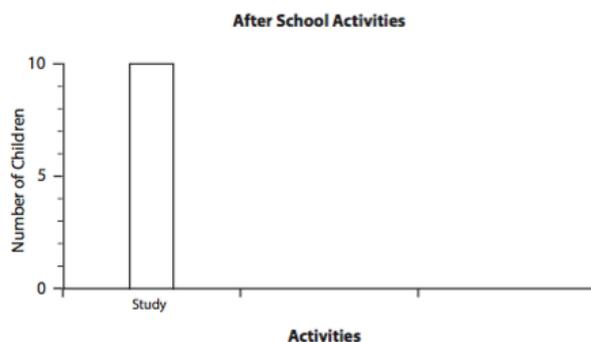
Mr. Smith asked the children in his class about what they did after school. These are the results for 3 things they did.

After School Activities

Activities	Tally Marks
Play sports	
Watch TV	
Study	

Mr. Smith started making a bar chart showing how many children did each activity.

Complete the graph by drawing and labelling the other two bars.



MARK SCHEME

Correct Response: Both bars correctly drawn. The bar for “sports” must be between 7.5 and 8.5 (exclusive). The bar for “watch TV” must be between 3.5 and 4.5 (exclusive).

Partially Correct Response:

- Both bars drawn but one or more not labelled correctly or incorrectly labelled.
- One bar only correctly drawn.

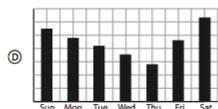
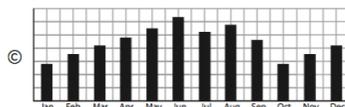
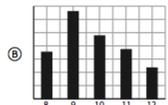
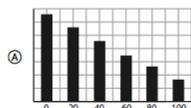
Incorrect Response: Incorrect – including crossed out, erased, stray marks, illegible or off-task.

Nonresponse : Blank

Subject	Year	Benchmark Level	Content Domain	Cognitive Domain	Item Description	Source
Maths	Year 5	High International Benchmark (550)	Data Display	Reasoning	Interprets a bar graph to solve a problem	TIMSS 2015 Assessment. Copyright © 2016 IEA (International Association for the Evaluation of Educational Achievement). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.

QUESTION

Roy carried out a survey of how many children watched television each night for one week. Which graph could show Roy's results?



MARK SCHEME

The correct answer is D

Subject	Year	Benchmark Level	Content Domain	Cognitive Domain	Item Description	Source
Maths	Year 9	At Advanced International Benchmark (625)	Number	Reasoning	Reasons about fractional parts of a whole in a word problem and explains answer	TIMSS 2015 Assessment. Copyright © 2016 IEA (International Association for the Evaluation of Educational Achievement). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.

QUESTION

Tom and his brother Peter received the same amount of money.

Tom spent $\frac{1}{3}$ of his money on books. He spent $\frac{3}{5}$ of the remaining money to buy a new pair of shoes.

Peter spent $\frac{3}{5}$ of his money to buy a new pair of shoes.

Who spent more for shoes?

(Tick one box.)

- Tom spent more money for shoes.
- Peter spent more money for shoes.
- They both spent the same amount for shoes.

Explain your answer.

MARK SCHEME

Correct Response

Peter, and correct explanation using fractions/decimals/percentages/drawings/or arbitrary amounts

Examples:

$$\frac{2}{3} \times \frac{3}{5} = \frac{2}{5}$$

$$\frac{2}{5} < \frac{3}{5}$$

$\frac{3}{5}$ of a whole is greater than $\frac{3}{5}$ of part of a whole

0.4 is less than 0.6

40% is less than 60%

If both had 30 zeds, Tom spent 12 zeds on shoes but Peter spent 18 zeds.

Incorrect Response

Student chose, "They both spent the same amount for shoes."

Other incorrect or inadequate explanation (including crossed out, erased, stray marks, illegible, or off task)

Nonresponse

Blank

Subject	Year	Benchmark Level	Content Domain	Cognitive Domain	Item Description	Source
Maths	Year 9	Advanced International Benchmark (625)	Data and Chance	Reasoning	Uses understanding of average to solve a problem	TIMSS 2015 Assessment. Copyright © 2016 IEA (International Association for the Evaluation of Educational Achievement). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.
<p>QUESTION</p> <p>Ahmed had the following scores out of 10 on his first 4 mathematics tests: 9,7,8,8. Ahmed has 1 more test with a maximum of 10 points and says he wants to get an overall average of 9. Is it possible for him to do this?</p> <p>Explain your answer.</p>				<p>MARK SCHEME</p> <p>Correct Response: No, with adequate justification, e.g. he would have to score 13 / he can only average 8.4 / he needs 45 points but can only get 42 or equivalent.</p> <p>Incorrect Response: Incorrect – including crossed out, erased, stray marks, illegible or off-task.</p> <p>Nonresponse : Blank</p>		

Subject	Year	Benchmark Level	Content Domain	Cognitive Domain	Item Description	Source
Science	Year 9	Intermediate International Benchmark (475)	Biology	Applying	Interprets information in a table to describe how the populations of two organisms changed over time	TIMSS 2015 Assessment. Copyright © 2016 IEA (International Association for the Evaluation of Educational Achievement). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.

QUESTION

The table below shows the population size of rabbits and a type of lynx, in a given area between 1996 and 2004.

Year	Population Size	
	Rabbit	Lynx
1996	60,000	1,200
1998	40,000	800
2000	30,000	600
2002	10,000	200
2004	6,000	135

MARK SCHEME PART A

Correct Response: Refers to the rabbit population decreasing (getting smaller, dropping) and the lynx population decreasing (getting smaller, dropping). Examples:

- Rabbit – the population is decreasing due to being eaten by the lynx or not finding any food. Lynx – the population is decreasing, as there are less rabbits to eat.
- Between 1996 and 2004 the rabbit population is decreasing in number. Between 1996 and 2004 the lynx is also decreasing in population.

Incorrect Response: Incorrect – including crossed out, erased, stray marks, illegible or off-task.

Nonresponse : Blank

Subject	Year	Benchmark Level	Content Domain	Cognitive Domain	Item Description	Source
<p>A. Describe what is happening to the population size of each organism between 1996 and 2004:</p> <p>Rabbit:</p> <p>Lynx:</p> <p>B Give one possible explanation for the number of lynxes in 1996 compared to 2004.</p>					<p>MARK SCHEME PART B</p> <p>Notes. Acceptable possible explanations include:</p> <ul style="list-style-type: none"> • Reduction of food sources/ not enough rabbits (to eat). • Killed by poachers, hunters, predators (for their fur, money). • Destruction of habitat. • Disease (spread among the lynxes and killed them). <p>Correct Response:</p> <p>Gives one possible explanation as indicated in the note above.</p> <p>Examples:</p> <ul style="list-style-type: none"> • The lynx population declined, because there were not enough rabbits for the lynx to eat. • They may have been killed by hunters who get paid money to kill them or the hunter sells the fur. • Their habitats are being destroyed by humans. • Hunters. • Diseases. • Less rabbits. <p>Incorrect Response: Incorrect – including crossed out, erased, stray marks, illegible or off-task.</p> <p>Nonresponse : Blank</p>	

Subject	Year	Benchmark Level	Content Domain	Cognitive Domain	Item Description	Source
Science	Year 9	High International Benchmark (550)	Chemistry	Knowing	Recognizes an everyday activity that is a chemical process that releases energy	TIMSS 2015 Assessment. Copyright © 2016 IEA (International Association for the Evaluation of Educational Achievement). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.
<p>QUESTION</p> <p>What is an example of a chemical process that releases energy?</p> <p>A Water boiling</p> <p>B Raw egg cooking</p> <p>C Oil lamp glowing</p> <p>D White sugar dissolving</p>			<p>MARK SCHEME</p> <p>The correct answer is C</p>			

Appendix E: Methodology for grouping questionnaire responses

Criteria for the creation of categories from questionnaire responses

Table E1: Category criteria for pupils' views on engaging teaching in maths

Category	Category criteria	
Very engaging	Year 5: Scale score of at least 9.0	'Agreeing a lot' with five of the 10 statements and 'agreeing a little' with the other five
	Year 9: Scale score of at least 10.4	
Less than engaging	Year 5: Scale score no higher than 7.0	'Disagreeing a little' with five of the 10 statements and 'agreeing a little' with the other five
	Year 9: Scale score no higher than 8.2	
Engaging	All pupils not in either of the categories above	

Source: TIMSS 2015.

Table E2: Category criteria for pupils' views on engaging teaching in science

Category	Category criteria	
Very engaging	Year 5: Scale score of at least 9.0	'Agreeing a lot' with five of the 10 statements and 'agreeing a little' with the other five
	Year 9: Scale score of at least 10.2	
Less than engaging	Year 5: Scale score no higher than 7.0	'Disagreeing a little' with five of the 10 statements and 'agreeing a little' with the other five
	Year 9: Scale score no higher than 8.1	
Engaging	All pupils not in either of the categories above	

Source: TIMSS 2015.

Table E3: Category criteria for year 5 and year 9 pupils' confidence in maths

Category	Category criteria	
Very confident in maths	Year 5: Scale score of at least 10.6	'Agreeing a lot' with five of the nine statements and 'agreeing a little' with the other four
	Year 9: Scale score of at least 12.1	
Not confident in maths	Year 5: Scale score no higher than 8.5	'Disagreeing a little' with five of the nine statements and 'agreeing a little' with the other four
	Year 9: Scale score no higher than 9.5	
Confident in maths	All pupils not in either of the categories above	

Source: TIMSS 2015.

Table E4: Category criteria for year 5 and year 9 pupils' confidence in science

Category	Category criteria	
Very confident in science	Year 5: Scale score of at least 10.2	'Agreeing a lot' with four of the seven statements and 'agreeing a little' with the other three
	Year 9: Scale score of at least 11.5	'Agreeing a lot' with four of the eight statements and 'agreeing a little' with the other four
Not confident in science	Year 5: Scale score no higher than 8.2	'Disagreeing a little' with four of the seven statements and 'agreeing a little' with the other three
	Year 9: Scale score no higher than 9.2	'Disagreeing a little' with four of the eight statements and 'agreeing a little' with the other four
Confident in science	All pupils not in either of the categories above	

Source: TIMSS 2015.

Table E5: Category criteria for the extent to which year 9 pupils valued maths and science

Category	Category criteria	
Strongly value maths	Scale score of at least 10.3	‘Agreeing a lot’ with five of the nine statements and ‘agreeing a little’ with the other four
Strongly value science	Scale score of at least 10.7	
Do not value maths	Scale score no higher than 7.7	‘Disagreeing a little’ with five of the nine statements and ‘agreeing a little’ with the other four
Do not value science	Scale score no higher than 8.4	
Value maths Value science	All pupils not in either of the categories above	

Source: TIMSS 2015.

Table E6: Category criteria for the extent to which year 5 and 9 pupils liked learning maths

Category	Category criteria	
Very much like learning mathematics	Year 5: Scale score of at least 10.1	'Agreeing a lot' with five of the nine statements and 'agreeing a little' with the other four
	Year 9: Scale score of at least 11.4	
Do not like learning mathematics	Year 5: Scale score no higher than 8.4	'Disagreeing a little' with five of the nine statements and 'agreeing a little' with the other four
	Year 9: Scale score no higher than 9.4	
Like learning mathematics	All pupils not in either of the categories above	

Source: TIMSS 2015.

Table E7: Category criteria for the extent to which year 5 and 9 pupils liked learning science

Category	Category criteria	
Very much like learning science	Year 5: Scale score of at least 9.6	'Agreeing a lot' with five of the nine statements and 'agreeing a little' with the other four
	Year 9: Scale score of at least 10.7	
Do not like learning science	Year 5: Scale score no higher than 7.6	'Disagreeing a little' with five of the nine statements and 'agreeing a little' with the other four
	Year 9: Scale score no higher than 8.3	
Like learning science	All pupils not in either of the categories above	

Source: TIMSS 2015.

Table E8: Category criteria for pupils taught maths in schools that emphasise academic success (based on headteacher questionnaire responses)

Category	Category criteria	
Very high emphasis	Year 5: Scale score of at least 13.0	Characterising seven of the 13 statements as very high and the other six as high
	Year 9: Scale score of at least 13.1	
Medium emphasis	Year 5: Scale score no higher than 9.2	Characterising seven of the 13 statements as medium and the other six as high
	Year 9: Scale score no higher than 9.6	
High emphasis	All pupils not in either of the categories above	

Source: TIMSS 2015.

Table E9: Category criteria for pupils taught science in schools that emphasise academic success (based on teacher questionnaire responses)

Category	Category criteria	
Very high emphasis	Year 5: Scale score of at least 12.9	Characterising seven of the 14 statements as very high and the other six as high
	Year 9: Scale score of at least 13.4	
Medium emphasis	Year 5: Scale score no higher than 9.2	Characterising seven of the 14 statements as medium and the other six as high
	Year 9: Scale score no higher than 9.8	
High emphasis	All pupils not in either of the categories above	

Source: TIMSS 2015.

Table E10: Category criteria for the extent to which year 5 pupils are taught in schools with school conditions and resources problems

Category	Category criteria	
Hardly any problems	Year 5: Scale score of at least 10.6	“not a problem” for four of the seven statements and “minor problems” for the other three
	Year 9: Scale score of at least 10.9	
Moderate to severe problems	Year 5: Scale score no higher than 8.2	“moderate problem” for four of the seven statements and “minor problem” for the other three
	Year 9: Scale score no higher than 8.5	
Minor problems	All pupils not in either of the categories above	

Source: TIMSS 2015.

Table E11: Category criteria for the impact of resource shortages on instruction in maths and science (year 5)

Category	Category criteria	
Not affected	Maths: Scale score of at least 11.1	‘Not at all’ reported for seven of the 13 resources and ‘a little’ for the other six, on average
	Science: Scale score of at least 11.2	‘Not at all’ reported for six of the 12 resources and ‘a little’ for the other six, on average
Affected a lot	Maths: Scale score no higher than 6.9	‘A lot’ reported for seven of the 13 resources and ‘a little’ for the other six, on average
	Science: Scale score no higher than 7.2	‘Not at all’ reported for six of the 12 resources and ‘a little’ for the other six, on average
Affected	All other pupils in schools	

Source: TIMSS 2015.

Table E12: Category criteria for the impact of resource shortages on the school's capacity to provide instruction in maths and science (year 9)

Category	Category criteria	
Not affected	Maths: Scale score of at least 11.1	'Not at all' reported for seven of the 13 resources and 'a little' for the other six, on average
	Science: Scale score of at least 11.2	
Affected a lot	Maths: Scale score no higher than 7.5	'A lot' reported for seven of the 13 resources and 'a little' for the other six, on average
	Science: Scale score no higher than 7.5	
Affected	All other pupils in schools	

Source: TIMSS 2015.

Table E13: Category criteria for school discipline problems (years 5 and 9)

Category	Category criteria	
Hardly any problems	Year 5: Scale score of at least 9.7	'Not a problem' reported for five of the 10 issues and 'minor problem' for the other five, on average
	Year 9: Scale score of at least 10.8	'Not a problem' reported for six of the 11 issues and 'minor problem' for the other five, on average
Moderate to severe problems	Year 5: Scale score no higher than 7.6	'Moderate problem' reported for five of the 10 issues and 'minor problem' for the other five, on average
	Year 9: Scale score of at least 8.0	'Moderate problem' reported for six of the 11 issues and 'minor problem' for the other five, on average
Minor problems	All other pupils in schools	

Source: TIMSS 2015.

Table E14: Category criteria for the extent to which pupils were taught in schools that were safe and orderly (years 5 and 9)

Category	Category criteria	
Very safe and orderly	Year 5: Scale score of at least 10.0	'Agreeing a lot' with four of the eight statements and 'agreeing a little' with the other four, on average
	Year 9: Scale score of at least 10.6	
Less than safe and orderly	Year 5: Scale score no higher than 6.7	'Disagreeing a little' with four of the eight statements and 'agreeing a little' with the other four, on average
	Year 9: Scale score no higher than 7.2	
Safe and orderly	All other pupils in schools	

Source: TIMSS 2015.

Table E15: Category criteria for the extent to which pupils were taught in schools in which they experienced bullying behaviours (years 5 and 9)

Category	Category criteria	
Almost never	Year 5: Scale score of at least 9.6	'Never' experiencing four of the eight bullying behaviours and experiencing each of the other four 'a few times a year', on average
	Year 9: Scale score of at least 9.3	'Never' experiencing five of the nine bullying behaviours and experiencing each of the other four behaviours 'a few times a year', on average
About weekly	Year 5: Scale score no higher than 8.0	Experiencing each of the four of the eight bullying behaviours 'once or twice a month' and experiencing each of the other four, 'a few times a year', on average
	Year 9: Scale score no higher than 7.3	Experiencing each of the five of the nine bullying behaviours 'once or twice a month' and experiencing each of the other four, 'a few times a year', on average
About monthly	All other pupils in schools	

Source: TIMSS 2015.

Table E16: Category criteria for pupils taught maths by teachers facing challenges

Category	Category criteria	
Few challenges	Year 5: Scale score of at least 10.4	'Disagreeing a little' with four of the eight statements and 'agreeing a little' with the other four, on average
	Year 9: Scale score of at least 10.3	
Many challenges	Year 5: Scale score no higher than 7.1	'Agreeing a lot' with four of the eight statements and 'agreeing a little' with the other four, on average
	Year 9: Scale score no higher than 6.7	
Some challenges	All other pupils in schools	

Source: TIMSS 2015.

Table E17: Category criteria for pupils taught by teachers satisfied with their jobs

Category	Category criteria	
Very Satisfied	Year 5: Scale score of at least 10.1	'Very often' reported for four of the seven statements and 'often' for the other three, on average
	Year 9: Scale score of at least 10.3	
Less than satisfied	Year 5: Scale score no higher than 6.6	'Sometimes' reported for four of the seven statements and 'often' for the other three, on average
	Year 9: Scale score of at least 7.0	
Satisfied	All other pupils in schools	

Source: TIMSS 2015 report.

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