

Chapter 4 Pupils' engagement

Chapter outline

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

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

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

Key findings

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

32 There was no equivalent question at Y5.

4.1 Mathematics Y5

4.1.1 Pupils' attitudes: liking the subject

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

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

Interpreting the data: indices and scales

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

Table 4.1 Pupils like learning mathematics

Reported by Students

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

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

Centre point of scale set at 10.

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

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

MS1

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

Tick **one** box for each row.

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I enjoy learning maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) I wish I did not have to study maths*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Maths is boring*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) I learn many interesting things in maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) I like maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

* Reverse coded

Source: Exhibit 8.1, international mathematics report

The international averages indicated that, as pupils' mathematics achievement increased, so did the extent to which they like the subject. The data cannot determine why this is so; it could be because pupils who like mathematics are better at it, or because pupils who are better at mathematics like it more. In England, the apparent differences in achievement of pupils in the different categories of liking mathematics are unlikely³⁴ to be significant.³⁵ However, the association was likely to be significant in some other countries, including the high performers of Singapore, Japan and Chinese Taipei.³⁶

4.1.2 Pupils' confidence

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

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

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

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

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

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

Table 4.2 Pupils confident in mathematics

Reported by Students

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

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

Centre point of scale set at 10.

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

MS3

How much do you agree with these statements about maths?

Tick one box for each row.

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I usually do well in maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Maths is harder for me than for many of my classmates*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) I am just not good at maths*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) I learn things quickly in maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) I am good at working out difficult maths problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) My teacher tells me I am good at maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) Maths is harder for me than any other subject*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

* Reverse coded

← Confident Somewhat Confident Not Confident →

10.6 8.5

Source: Exhibit 8.4, international mathematics report

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

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

4.1.3 Pupils' reported engagement in lessons

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

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

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

Table 4.3 Pupils engaged in mathematics lessons

Reported by Students

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

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

Centre point of scale set at 10.

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

MS2 _____

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

Tick one box for each row.

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

* Reverse coded

Engaged 10.2 Somewhat Engaged Not Engaged 7.4

Source: Exhibit 8.17, international mathematics report

4.1.4 Teachers' reported approaches to engaging pupils in lessons

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

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

Interpreting the data: scaled data from teachers

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

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

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

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

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

³⁸ These figures refer to countries and exclude benchmarking participants.

Table 4.4 Teaching to engage pupils in learning*Reported by Teachers*

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

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

Centre point of scale set at 10.

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

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

G15

How often do you do the following in teaching this class?

Tick **one** circle for each row.

Every or almost every lesson
About half the lessons
Some lessons
Never

a) Summarise what children should have learned from the lesson ----- ○ ----- ○ ----- ○ ----- ○

b) Relate the lesson to children's daily lives ----- ○ ----- ○ ----- ○ ----- ○

c) Use questioning to elicit reasons and explanations ----- ○ ----- ○ ----- ○ ----- ○

d) Encourage all children to improve their performance ----- ○ ----- ○ ----- ○ ----- ○

e) Praise children for good effort ----- ○ ----- ○ ----- ○ ----- ○

f) Bring interesting materials to class ----- ○ ----- ○ ----- ○ ----- ○

Most Lessons 9.1 About Half the Lessons 6.0 Some Lessons

Source: Exhibit 8.14, international mathematics report

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

4.2 Mathematics Y9

4.2.1 Pupils' attitudes: liking the subject

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

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

Table 4.5 Pupils like learning mathematics

Reported by students

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

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

Centre point of scale set at 10.

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

14

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

Tick one box for each row.

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I enjoy learning maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) I wish I did not have to study maths*.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Maths is boring*.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) I learn many interesting things in maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) I like maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

* Reverse coded

Like Learning Mathematics

Somewhat Like Learning Mathematics

Do Not Like Learning Mathematics

11.3 9.0

Source: Exhibit 8.2, international mathematics report

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

4.2.2 Comparison with TIMSS 2007: liking the subject

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

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

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

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

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

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

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

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

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

Source: data derived from 2007 and 2011 national datasets⁴¹

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

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

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

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

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

4.2.3 Pupils' attitudes: valuing the subject

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

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

Table 4.7 Pupils value mathematics

Reported by Students

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

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

Centre point of scale set at 10.

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

16 (continued)

How much do you agree with these statements about maths?

Tick **one** box for each row.

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
j) I think learning maths will help me in my daily life	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k) I need maths to learn other school subjects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l) I need to do well in maths to get into the college or university of my choice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m) I need to do well in maths to get the job I want	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n) I would like a job that involves using maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) It is important to do well in maths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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

Source: Exhibit 8.3, *international mathematics report*

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

4.2.4 Pupils' confidence

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

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

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

Table 4.8 Pupils confident in mathematics*Reported by Students*

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

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

Centre point of scale set at 10.

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

16

How much do you agree with these statements about maths?

Tick one box for each row.

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

* Reverse coded

Source: Exhibit 8.5, international mathematics report

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

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

4.2.5 Pupils' reported engagement in lessons

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

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

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

Table 4.9 Pupils engaged in mathematics lessons

Reported by Students

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

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

Centre point of scale set at 10.

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

15 _____

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

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

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

* Reverse coded

Engaged 11.4 Somewhat Engaged 8.3 Not Engaged

Source: Exhibit 8.18, international mathematics report

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

4.2.6 Teachers' reported approaches to engaging pupils

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

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

Table 4.10 Teaching to engage pupils in learning

Reported by Teachers

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

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

Centre point of scale set at 10.

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

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

14

How often do you do the following in teaching this class?

Tick **one** circle for each row.

Every or almost every lesson
About half the lessons
Some lessons
Never

a) Summarise what students should have learned from the lesson ☐ ☐ ☐ ☐

b) Relate the lesson to students' daily lives ☐ ☐ ☐ ☐

c) Use questioning to elicit reasons and explanations ☐ ☐ ☐ ☐

d) Encourage all students to improve their performance ☐ ☐ ☐ ☐

e) Praise students for good effort ☐ ☐ ☐ ☐

Most Lessons 8.7 About Half the Lessons 5.7 Some Lessons

Item b did not contribute to this scale.

Source: Exhibit 8.15, international mathematics report.

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

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

4.3 Science Y5

4.3.1 Pupils' attitudes: liking the subject

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

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

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

Table 4.11 Pupils like learning science

Reported by students

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

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

Centre point of scale set at 10.

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

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

MS4

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

Tick **one** box for each row.

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

* Reverse coded



Item c did not contribute to this scale.

Source: Exhibit 8.1, international science report.

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

4.3.2 Pupils' confidence

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

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

Table 4.12 Pupils confident in science*Reported by students*

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

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

Centre point of scale set at 10.

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

MS6

How much do you agree with these statements about science?

Tick **one** box for each row.

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

* Reverse coded

Source: Exhibit 8.4, international science report

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

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

4.3.3 Pupils' reported engagement in lessons

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

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

Table 4.13 Pupils engaged in science lessons

Reported by students

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

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

Centre point of scale set at 10.

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

MS5

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

Tick **one** box for each row.

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

* Reverse coded

Engaged Somewhat Engaged Not Engaged

10.1 7.4

Source: Exhibit 8.17, international science report

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

4.3.4 Teachers' reported approaches to engaging pupils

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

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

Table 4.14 Teaching to engage pupils in learning

Reported by Teachers

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

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

Centre point of scale set at 10.

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

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

G15

How often do you do the following in teaching this class?

Tick **one** circle for each row.

Every or almost every lesson
About half the lessons
Some lessons
Never

a) Summarise what children should have learned from the lesson ☐ ☐ ☐ ☐

b) Relate the lesson to children's daily lives ☐ ☐ ☐ ☐

c) Use questioning to elicit reasons and explanations ☐ ☐ ☐ ☐

d) Encourage all children to improve their performance ☐ ☐ ☐ ☐

e) Praise children for good effort ☐ ☐ ☐ ☐

f) Bring interesting materials to class ☐ ☐ ☐ ☐

Most Lessons About Half the Lessons Some Lessons
9.1 6.0

Source: Exhibit 8.14, international science report

While there appeared to be an association internationally⁴⁵ between frequency of using the listed engagement practices and pupil achievement, the apparent small difference in England is not likely to be statistically significant.

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

4.4 Science Y9

4.4.1 Pupils' attitudes: liking the subject

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

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

Table 4.15 Pupils like learning science

Reported by Students

For general/integrated science⁴⁶, students were scored according to their degree of agreement with five statements on the *Students Like Learning Science* scale. Students who **Like Learning Science** had a score on the scale of at least 10.8, which corresponds to their "agreeing a lot" with three of the five statements and "agreeing a little" with the other two, on average. Students who **Do Not Like Learning Science** had a score on the scale no higher than 8.4, which corresponds to their "disagreeing a little" with three of the five statements and "agreeing a little" with the other two, on average. All other students **Somewhat Like Learning Science**. For biology, chemistry, physics, and earth science, a comparable procedure was used.

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

Centerpoint of scale set at 10.

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

17

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

Tick one box for each row.

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

* Reverse coded

Item c did not contribute to this scale.

Source: Exhibit 8.2, international science report.

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

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

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

4.4.2 Comparison with TIMSS 2007: liking the subject

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

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

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

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

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

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

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

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

Source: data derived from 2007 and 2011 national datasets⁴⁸

4.4.3 Pupils' attitudes: valuing the subject

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

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

Table 4.17 Pupils value science

Reported by Students

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

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

Centre point of scale set at 10.

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

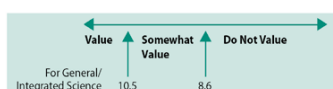
48 See Foy and Olson, 2009 and <http://timssandpirls.bc.edu/timss2011/index.html>

19 (continued)

How much do you agree with these statements about science?

Tick **one** box for each row.

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



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

Source: Exhibit 8.3, international science report.

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

4.4.4 Pupils' confidence

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

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

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

Table 4.18 Pupils confident in science*Reported by Students*

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

Students Confident in General/Integrated Science

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

Centre point of scale set at 10.

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

19

How much do you agree with these statements about science?

Tick one box for each row.

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

* Reverse coded

Confident Somewhat Confident Not Confident

For General/Integrated Science 11.5 9.0

Source: Exhibit 8.5, international science report

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

4.4.5 Pupils' reported engagement in lessons

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

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

Reported by Students

Students Engaged in General/Integrated Science Lessons

Centre point of scale set at 10.

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

Source: Exhibit 8.18, international science report

International and national reports available from www.nfer.ac.uk/timss

4.4.6 Teachers' reported approaches to engaging pupils

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

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

Table 4.20 Teaching to engage pupils in learning

Reported by Teachers

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

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

Centre point of scale set at 10.

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

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

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

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How often do you do the following in teaching this class?

Tick **one** circle for each row.

Every or almost every lesson
About half the lessons
Some lessons
Never

a) Summarise what students should have learned from the lesson ----- ○ — ○ — ○ — ○

b) Relate the lesson to students' daily lives ----- ○ — ○ — ○ — ○

c) Use questioning to elicit reasons and explanations ----- ○ — ○ — ○ — ○

d) Encourage all students to improve their performance --- ○ — ○ — ○ — ○

e) Praise students for good effort ----- ○ — ○ — ○ — ○

Most Lessons 8.7 About Half the Lessons 5.7 Some Lessons

Item b did not contribute to this scale.

Source: Exhibit 8.15, international science report

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