5 Pupil engagement and attitudes

Chapter outline

This chapter summarises Year 6 (Y6, ages 9-10) pupils' attitudes towards mathematics and science in Northern Ireland, and their confidence in these subjects, compared with their performance as measured by TIMSS 2015. The chapter also explores pupil engagement in mathematics and science and teacher approaches for engaging pupils.

Within each sub-section, findings for mathematics are presented first, followed by findings for science. Outcomes for Northern Ireland are compared with those of other participating countries and with a subset of seven main comparator countries (Australia, England, Finland, Hong Kong, Poland, the Republic of Ireland and Singapore) where relevant.

Key findings

- In Northern Ireland and internationally, for both mathematics and science, pupils who most like the subject had higher average achievement scores.
- In Northern Ireland, and internationally, for both mathematics and science, pupils who were categorised as 'Very Confident' had higher achievement scores.
- Compared with the main sub-set of comparator countries, Northern Ireland had the largest percentage of pupils experiencing 'Very Engaging Teaching' in both mathematics and science.
- Pupils in Northern Ireland experiencing 'Very Engaging Teaching' or 'Engaging Teaching' in mathematics had higher average achievement scores. This was also the case internationally.
- How engaging pupils in Northern Ireland reported finding science teaching did not seem to relate to their average achievement.
- Internationally, four out of the five countries with the highest achievement in mathematics and science had among the lowest percentage of pupils who were 'Very Confident' and experienced 'Engaging Teaching' for both subjects.
- Compared with the international average, Northern Ireland had a lower percentage of pupils taught by teachers in mathematics and science who related their lessons to pupils' daily lives and used interesting materials in 'Every or Almost Every Lesson'.

5.1 Pupils' attitudes towards mathematics and science

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 reliable and valid than the responses to individual items.

5.1.1 Pupils' attitudes: liking the subject, mathematics

Table 5.1 shows the proportions of pupils categorised as very much liking, liking and not liking mathematics for Northern Ireland and for the comparator countries, together with the mean achievement score of pupils in each category of the scale. In this table, countries are listed in descending order of the proportion of pupils expressing the most positive attitude.

Pupils' attitudes were measured by their responses to nine statements about learning mathematics (included below Table 5.1). Responses to these nine statements were used to create the 'Students Like Learning Mathematics' scale, which categorises pupils into three bands: 'Very Much Like Learning Mathematics', 'Like Learning Mathematics', and 'Do Not Like Learning Mathematics'. (Details of how pupils were assigned to each band are provided in Table 5.1.) Construction of the scale has changed since 2011 so caution is called for when interpreting trends over time[25].

In 2015, 35 per cent of Y6 pupils in Northern Ireland were in the highest category of 'Very Much Like Learning Mathematics'. The majority of comparator countries had similar percentages of pupils categorised in the highest band of the 'Students Like Learning Mathematics' scale (Singapore 39 per cent, Republic of Ireland 38 per cent, Australia 37 per cent, and Hong Kong and Poland 35 per cent). However, in England, pupils report a more positive attitude to mathematics with 50 per cent of pupils categorised as 'Very Much Like Learning Mathematics'. This is a different picture to that in 2011, when Northern Ireland had fewer pupils in the higher band of the 'Students Like Learning Mathematics' scale than any of the comparator countries, except Finland.

In Northern Ireland, the average achievement score for pupils categorised in the 'Very Much Like Learning Mathematics' band in TIMSS 2015 was high, at 585. Twenty-seven per cent of Y6 pupils were in the 'Do Not Like Learning Mathematics' category and, at 547, the average achievement score for these pupils was lower than those who very much like learning mathematics. In Northern Ireland and internationally the data mirrors that from TIMSS 2011: that is, as liking of mathematics decreases, so does achievement. Although significance tests have not been conducted in the international analysis, based on the size of the

[25] In 2011, pupils answered five statements about learning mathematics and, based on their responses, they were categorised into three bands: 'Like Learning Mathematics', 'Somewhat Like Learning Mathematics' and 'Do Not Like Learning Mathematics'.

standard errors, the differences in achievement scores for Northern Ireland are likely to be statistically significant, but the direction of causality cannot be inferred from this data. It could be that pupils who like learning mathematics may perform better in the subject, but this relationship could also work in the opposite direction, that is, pupils who perform better in mathematics may have a more positive attitude to their lessons.

Table 5.1 Pupils like learning mathematics

Reported by pupils

Students were scored according to their degree of agreement with nine statements on the *Students Like Learning Mathematics* scale. Students who **Very Much Like Learning Mathematics** had a score on the scale of at least 10.1, 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 **Do Not Like Learning Mathematics** had a score no higher than 8.3, 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 **Like Learning Mathematics**.

Country	Very Much Like Learning Mathematics		Like Learning Mathematics		Do Not Like Learning Mathematics		Average Scale Score	Difference in Average Scale Score from 2011
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement		
England	50 (1.4)	555 (3.7)	32 (0.9)	546 (3.5)	17 (1.0)	523 (4.4)	10.1 (0.05)	0.3 (0.08) ▲
Singapore	39 (0.8)	640 (4.1)	38 (0.7)	611 (4.1)	23 (0.8)	591 (4.5)	9.6 (0.03)	-0.3 (0.05) ▼
Ireland, Rep. of	38 (1.2)	561 (3.0)	39 (0.9)	547 (2.6)	23 (1.1)	528 (3.2)	9.6 (0.05)	0.0 (0.08)
Australia	37 (1.0)	535 (4.7)	36 (0.8)	516 (3.1)	27 (0.7)	496 (4.2)	9.5 (0.04)	-0.2 (0.07) ▼
Northern Ireland	35 (1.1)	585 (4.0)	38 (1.0)	573 (3.8)	27 (1.1)	547 (4.4)	9.5 (0.05)	0.1 (0.08)
Hong Kong SAR	35 (1.1)	631 (3.2)	38 (1.0)	612 (3.6)	27 (1.2)	596 (3.8)	9.5 (0.05)	-0.5 (0.07) ▼
Poland	35 (1.0)	547 (2.9)	41 (1.1)	532 (2.7)	25 (1.3)	524 (3.2)	9.4 (0.05)	◊ ◊
Finland	28 (1.0)	550 (3.4)	41 (0.9)	537 (2.4)	31 (1.0)	521 (2.5)	9.2 (0.04)	0.0 (0.08)
International Avg.	46 (0.2)	521 (0.5)	35 (0.1)	495 (0.5)	19 (0.1)	483 (0.8)		

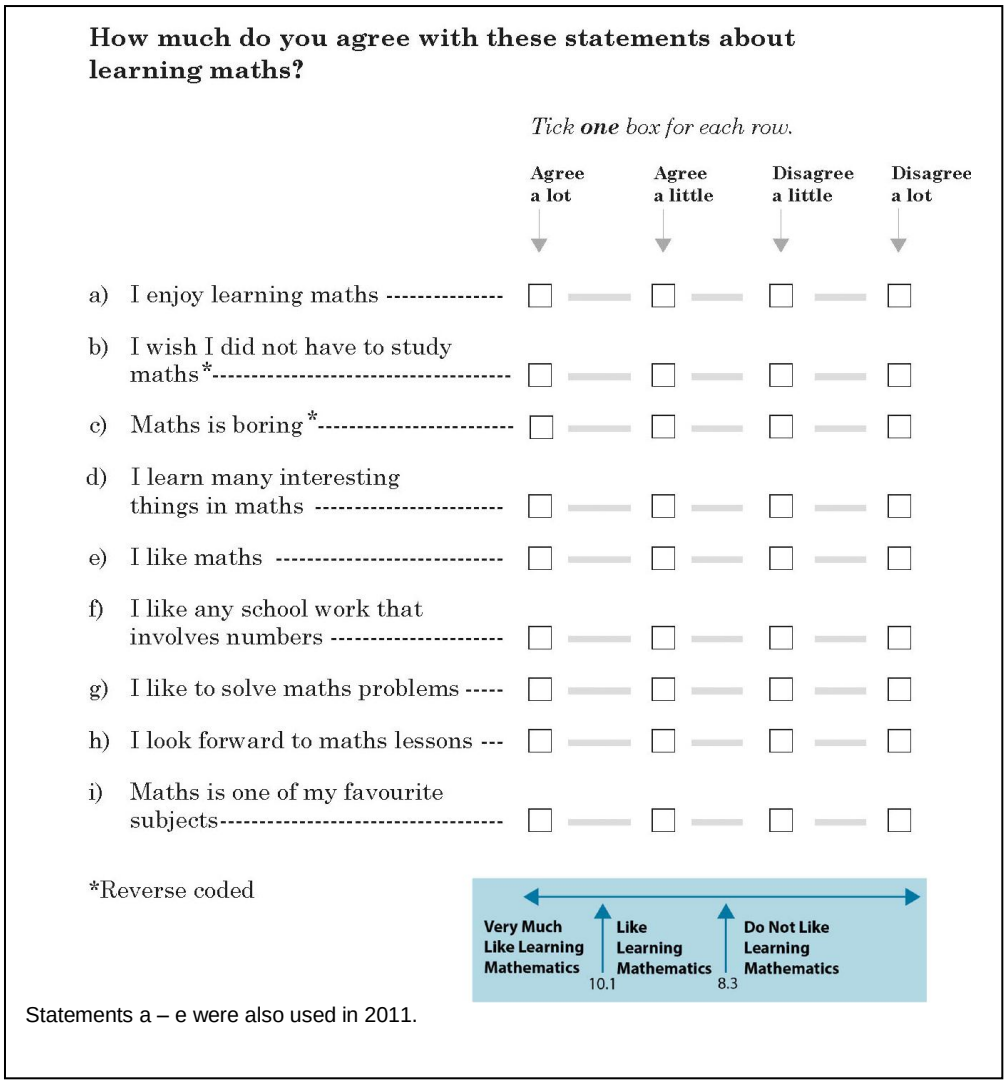
Centre point of scale set at 10.

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

▲ Significantly higher than 2011

▼ Significantly lower than 2011

Source: Exhibit 10.3, international mathematics report (Mullis et al., 2016a) and adapted from the international version of the TIMSS 2015 Pupil Questionnaire.



Source: Exhibit 10.3, international mathematics report (Mullis *et al.*, 2016a) and adapted from the international version of the TIMSS 2015 Pupil Questionnaire.

5.1.2 Pupils' attitudes: liking the subject, science

In Northern Ireland, over half of pupils (59 per cent) were in the highest category of the 'Students Like Learning Science' scale. This was a much higher percentage than for mathematics in Northern Ireland and an increase from 2011.

For this scale, pupils were scored according to their responses to nine statements about learning science. Based on their responses, they were categorised into three bands: 'Very Much Like Learning Science', 'Like Learning Science' and 'Do Not Like Learning Science'. The statements, and details on how pupils were assigned to bands, are provided in Table 5.2. As construction of the scale has changed since 2011, caution should be exercised when interpreting trends over time[26].

[26] In 2011, pupils answered five statements about learning science and, based on their responses, they were categorised into three bands: 'Like Learning Science', 'Somewhat Like Learning Science' and 'Do Not Like Learning Science'.

Among the comparator group of countries, Northern Ireland had the highest percentage of pupils in the 'Very Much Like Learning Science' band. It was followed by the Republic of Ireland (58 per cent), Hong Kong (57 per cent), Singapore (56 per cent), Australia (54 per cent), England (49 per cent), and Poland (48 per cent). Finland had the lowest percentage of pupils amongst the comparator countries classified in this band at 38 per cent. This was not the case in 2011 when, compared with Northern Ireland, the majority of comparator countries had a higher percentage of pupils in the highest band of the 'Students Like Learning Science' scale.

In Northern Ireland, the average achievement score for pupils in the 'Very Much Like Learning Science' category was 526, whereas the average achievement score for the 10 per cent of pupils in the 'Do Not Like Learning Science' category was lower at 500. As with mathematics, in Northern Ireland and internationally, the lower the level of liking science the lower the achievement score. This mirrors the results in TIMSS 2011. The differences in average achievement scores for each of the three bands are likely to be statistically significant. As noted above, the data cannot identify the direction of causality.

Table 5.2 Pupils like learning science

Reported by pupils

Students were scored according to their degree of agreement with nine statements on the *Students Like Learning Science* scale. Students who **Very Much Like Learning Science** had a score on the scale of at least 9.6, 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 **Do Not Like Learning Science** had a score no higher than 7.6, 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 **Like Learning Science**.

Country	Very Much Like Learning Science		Like Learning Science		Do Not Like Learning Science		Average Scale Score	Difference in Average Scale Score from 2011
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement		
Northern Ireland	59 (1.2)	526 (2.5)	32 (1.0)	515 (3.6)	10 (0.8)	500 (6.6)	10.2 (0.05)	0.4 (0.08) ▲
Ireland, Rep. of	58 (1.5)	539 (2.4)	31 (1.1)	519 (3.7)	11 (0.8)	506 (6.0)	10.2 (0.06)	-0.1 (0.09)
Hong Kong SAR	57 (1.0)	569 (3.4)	32 (0.9)	543 (3.4)	11 (0.6)	533 (4.9)	10.1 (0.05)	0.2 (0.07) ▲
Singapore	56 (0.9)	600 (3.8)	33 (0.7)	582 (4.2)	11 (0.5)	567 (5.1)	10.1 (0.04)	0.0 (0.05)
Australia	54 (1.2)	531 (2.7)	34 (0.9)	522 (3.6)	12 (0.6)	505 (6.2)	10.0 (0.05)	0.0 (0.07)
England	49 (1.2)	542 (2.9)	34 (0.8)	535 (3.1)	17 (0.9)	523 (4.1)	9.8 (0.06)	0.3 (0.09) ▲
Poland	48 (1.4)	553 (2.6)	40 (1.0)	543 (3.0)	12 (0.8)	543 (5.6)	9.6 (0.06)	◊ ◊
Finland	38 (1.1)	558 (2.9)	44 (0.8)	555 (2.4)	19 (0.9)	545 (3.9)	9.2 (0.05)	0.1 (0.07)
International Avg.	56 (0.2)	518 (0.5)	33 (0.1)	492 (0.6)	11 (0.1)	483 (1.1)		

Centre point of scale set at 10.

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

▲ Significantly higher than 2011

▼ Significantly lower than 2011

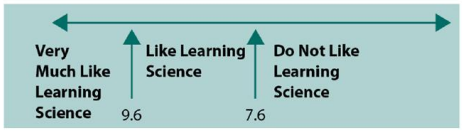
Source: Exhibit 10.3, international science report (Martin *et al.*, 2016a) and adapted from the international version of the TIMSS 2015 Pupil Questionnaire.

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

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

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I enjoy learning science	☐	☐	☐	☐
b) I wish I did not have to study science*	☐	☐	☐	☐
c) Science is boring*	☐	☐	☐	☐
d) I learn many interesting things in science	☐	☐	☐	☐
e) I like science	☐	☐	☐	☐
f) I look forward to learning science in school	☐	☐	☐	☐
g) Science teaches me how things in the world work	☐	☐	☐	☐
h) I like to do science experiments	☐	☐	☐	☐
i) Science is one of my favourite subjects	☐	☐	☐	☐

*Reverse coded



Statements a – e were also used in 2011.

Source: Exhibit 10.3, international science report (Martin *et al.*, 2016a) and adapted from the international version of the TIMSS 2015 Pupil Questionnaire.

5.2 Pupils' confidence in mathematics and science

5.2.1 Pupils' confidence in mathematics

In terms of confidence in mathematics among Y6 pupils in Northern Ireland, in TIMSS 2015 just under a third of pupils (31 per cent) were in the highest category of being 'Very Confident in Mathematics', with 46 per cent in the 'Confident in Mathematics' category, and 23 per cent categorised as 'Not Confident in Mathematics' (see Table 5.3). The percentage of pupils in the highest band of the scale has decreased slightly since 2011.

As with pupil attitudes, pupil confidence was measured by their responses to a set of nine statements about their mathematical skills and abilities. Pupils were then categorised into one of three bands. (Details of the statements used and how pupils were assigned to each

band are provided below Table 5.3). As construction of the scale has changed since 2011, caution should be exercised when interpreting trends over time.[27]

Among the comparator group of countries, Northern Ireland had the third highest percentage of pupils classified as 'Very Confident in Mathematics', the same as in 2011. Within this group of countries, England and the Republic of Ireland had the largest percentages of pupils in this category (both 37 per cent). Poland, Finland and Australia had lower percentages of pupils than Northern Ireland classified in the highest band, at 29 per cent, 28 per cent and 27 per cent respectively.

Among the highest performing countries in mathematics for this age group, overall levels of pupil confidence are fairly low. Four of the five countries with the highest mathematics achievement were among the five countries with the lowest percentage of pupils identifying themselves as 'Very Confident in Mathematics'. Of the comparator countries, Hong Kong and Singapore both had high mathematics achievement among 9- and 10-year-olds, but only 19 per cent of pupils, in both countries, identified themselves as being 'Very Confident in Mathematics'. The data from 2011 showed a similar relationship.

As with pupil attitudes, the findings show that, within each country, as pupil confidence decreases, so does achievement; pupil achievement in mathematics is higher among those pupils classified as having a higher level of confidence in the subject. In Northern Ireland, among the pupils who were classified as being 'Very Confident in Mathematics' in TIMSS 2015, the average achievement score was 614 and, among the pupils who were classified as 'Not Confident in Mathematics', the average achievement score was lower at 518. This reflects the results in TIMSS 2011. The differences in achievement data are likely to be statistically significant across the three categories although, as for pupil attitudes, the data cannot identify the direction of causality. It could be that pupils who are confident in mathematics are better at it, or it may be that pupils who are better at mathematics are more confident in the subject.

[27] In 2011, pupils answered seven statements about confidence in mathematics and, based on their responses, they were categorised into three bands: 'Confident in Mathematics', 'Somewhat Confident in Mathematics', and 'Not Confident in Mathematics'.

Table 5.3 Pupils confident in mathematics

Reported by pupils

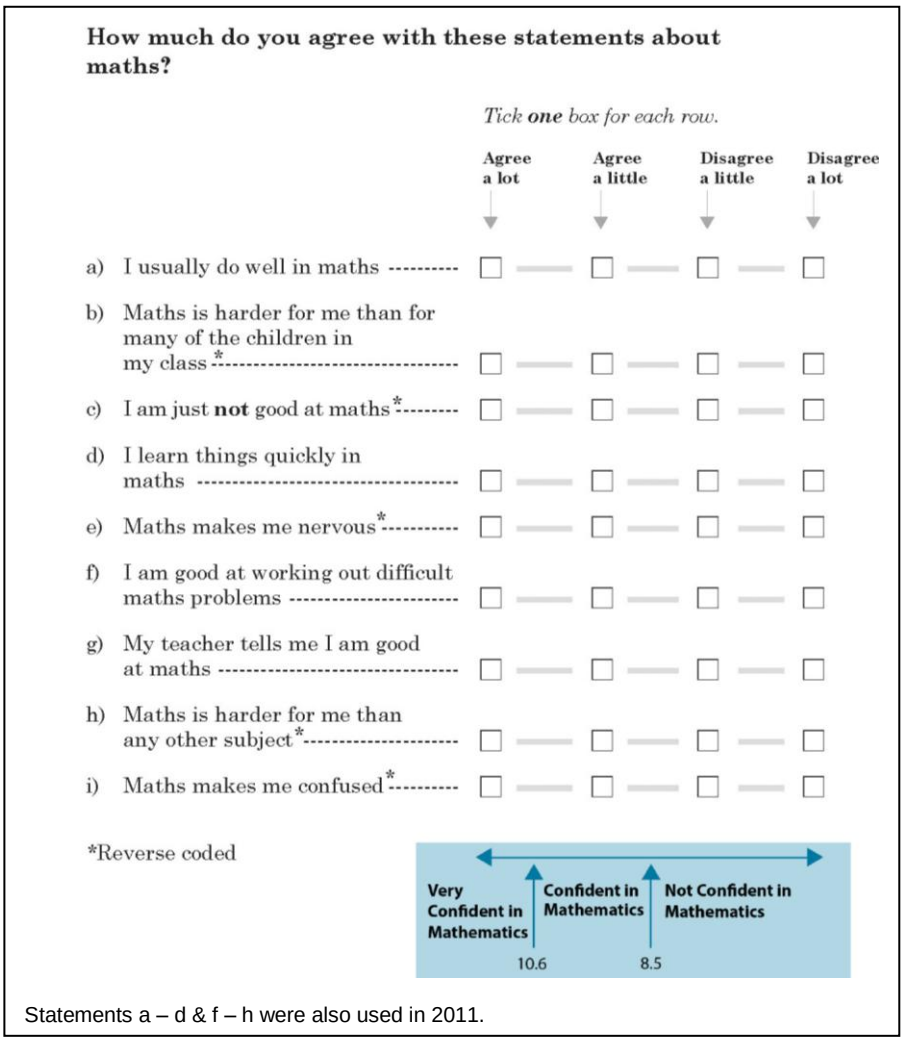
Students were scored according to their degree of agreement with nine statements on the *Students Confident in Mathematics* scale. Students **Very Confident in Mathematics** had a score on the scale of at least 10.6, which corresponds to their "agreeing a lot" with five of the nine statements and "agreeing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

Country	Very Confident in Mathematics		Confident in Mathematics		Not Confident in Mathematics		Average Scale Score	Difference in Average Scale Score from 2011
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement		
England	37 (1.1)	578 (4.7)	43 (1.0)	541 (3.4)	20 (0.9)	499 (3.3)	10.1 (0.05)	0.1 (0.06)
Ireland, Rep. of	37 (0.9)	583 (2.6)	45 (0.8)	539 (2.4)	18 (0.8)	498 (3.7)	10.2 (0.04)	-0.2 (0.07) ▼
Northern Ireland	31 (1.1)	614 (3.8)	46 (1.0)	568 (3.8)	23 (1.1)	518 (3.7)	9.9 (0.04)	-0.1 (0.07)
Poland	29 (0.9)	578 (2.9)	46 (1.1)	534 (2.3)	25 (1.0)	488 (2.7)	9.8 (0.04)	◊ ◊
Finland	28 (0.9)	572 (2.8)	51 (1.0)	532 (2.1)	20 (0.7)	493 (2.7)	9.8 (0.03)	-0.1 (0.05) ▼
Australia	27 (0.8)	569 (3.9)	46 (1.0)	514 (2.9)	27 (1.0)	473 (4.1)	9.7 (0.03)	-0.4 (0.05) ▼
Hong Kong SAR	19 (0.8)	660 (3.7)	45 (1.0)	622 (3.0)	36 (1.1)	583 (3.4)	9.3 (0.05)	-0.1 (0.06)
Singapore	19 (0.8)	681 (3.6)	42 (0.6)	633 (3.6)	39 (1.1)	572 (4.0)	9.2 (0.05)	0.0 (0.06)
International Avg.	32 (0.1)	546 (0.5)	45 (0.1)	502 (0.5)	23 (0.1)	460 (0.6)		

Centre point of scale set at 10.

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

Significantly higher than 2011 ▲
Significantly lower than 2011 ▼



How much do you agree with these statements about maths?

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

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I usually do well in maths	☐	☐	☐	☐
b) Maths is harder for me than for many of the children in my class*	☐	☐	☐	☐
c) I am just **not** good at maths*	☐	☐	☐	☐
d) I learn things quickly in maths	☐	☐	☐	☐
e) Maths makes me nervous*	☐	☐	☐	☐
f) I am good at working out difficult maths problems	☐	☐	☐	☐
g) My teacher tells me I am good at maths	☐	☐	☐	☐
h) Maths is harder for me than any other subject*	☐	☐	☐	☐
i) Maths makes me confused*	☐	☐	☐	☐

*Reverse coded

Statements a – d & f – h were also used in 2011.

Source: Exhibit 10.5, international mathematics report (Mullis *et al.*, 2016) and adapted from the international version of the TIMSS 2015 Pupil Questionnaire.

5.2.2 Pupils' confidence in science

In Northern Ireland, 36 per cent of pupils were categorised as being 'Very Confident in Science' in TIMSS 2015, with 45 per cent categorised as 'Confident in Science', and 19 per cent as 'Not Confident in Science' (see Table 5.4). These percentages are similar to those reported in the 2011 study. In 2015, confidence was measured by pupils' responses to nine statements on the 'Students Confident in Science' scale. Based on their responses, they were categorised into three bands. (Details of the statements and of how the scale was derived are provided below Table 5.4.) As construction of the scale has changed since 2011, caution should be exercised when interpreting trends over time[28].

As with mathematics, Northern Ireland had the third highest percentage of pupils classified as 'Very Confident in Science' in the comparator countries. In these countries, Poland and the Republic of Ireland had the largest percentage of pupils categorised as 'Very Confident in Science', with 39 per cent and 38 per cent respectively. Again, as with mathematics, levels of pupil confidence in the highest performing countries for this age group are fairly low. Four of the five countries with the highest science achievement were among the five countries with the lowest percentage of pupils identifying themselves as 'Very Confident in Science'. These include the comparator countries of Singapore and Hong Kong in which 9- to 10-year-olds perform very well overall in terms of science achievement, but where percentages of pupils found to be 'Very Confident in Science' are low, at 26 per cent and 25 per cent respectively.

As was the case in 2011, within each participating country pupil achievement was higher among those pupils with a higher level of confidence. In Northern Ireland, among those pupils who were found to be 'Very Confident in Science', the average achievement score was 534, while among pupils who identified themselves as 'Not Confident in Science', average achievement was lower at 492. The differences in achievement data are likely to be statistically significant across the three categories. This pattern is also true across the comparator countries, that is, within each country, as the level of pupils' confidence decreases, so do the average achievement scores.

[28] In 2011, pupils answered six statements about confidence in science and, based on their responses, they were categorised into three bands: 'Confident in Science', 'Somewhat Confident in Science' and 'Not Confident in Science'.

Table 5.4 Pupils confident in science

Reported by pupils

Students were scored according to their degree of agreement with seven statements on the *Students Confident in Science* scale. Students **Very Confident in Science** had a score on the scale of at least 10.2, 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 in Science** had a score no higher than 8.2, 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 **Confident in Science**.

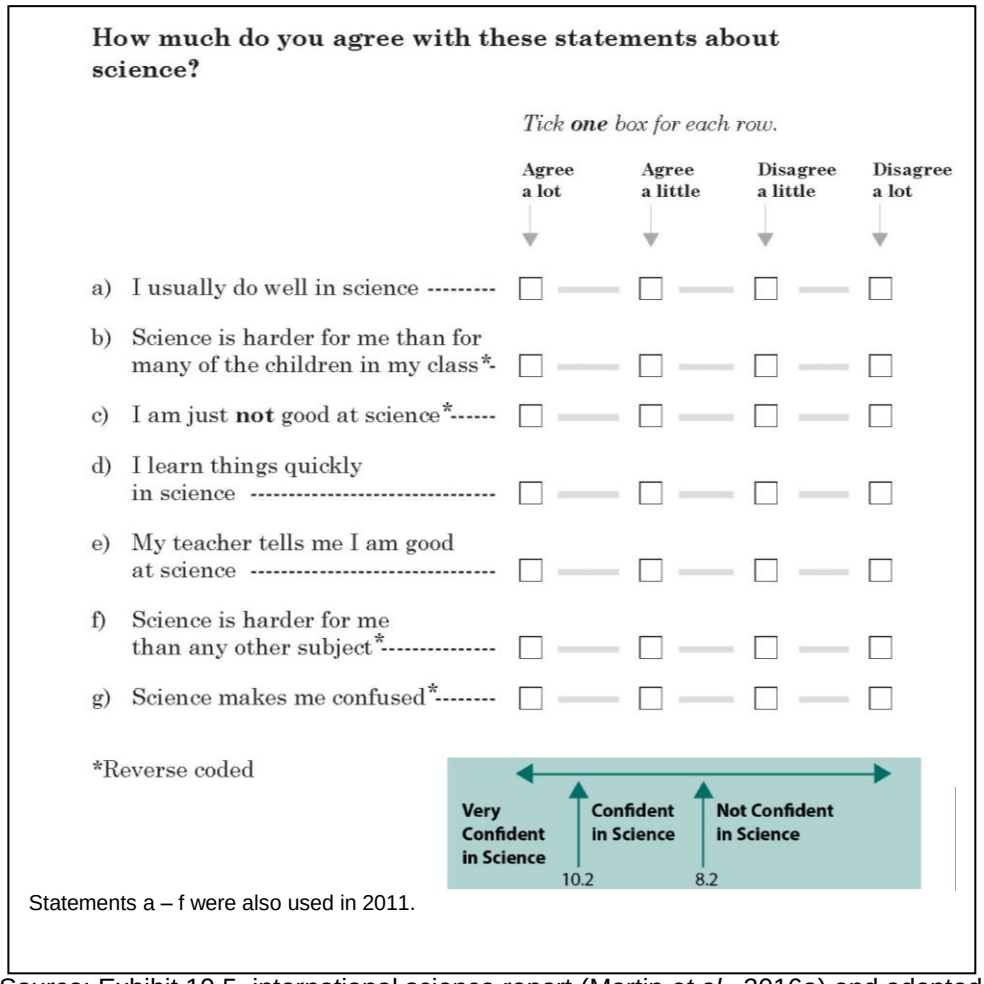
Country	Very Confident in Science		Confident in Science		Not Confident in Science		Average Scale Score	Difference in Average Scale Score from 2011
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement		
Poland	39 (1.1)	565 (2.6)	47 (1.0)	544 (2.6)	14 (0.8)	510 (4.8)	9.9 (0.05)	◊ ◊
Ireland, Rep. of	38 (1.4)	546 (2.9)	45 (1.2)	530 (2.9)	16 (0.7)	492 (4.0)	9.8 (0.05)	-0.3 (0.07) ▼
Northern Ireland	36 (1.2)	534 (3.1)	45 (1.1)	521 (2.7)	19 (0.8)	492 (4.5)	9.7 (0.04)	0.0 (0.07)
Australia	35 (0.9)	542 (3.5)	45 (0.8)	525 (2.7)	20 (0.8)	494 (4.2)	9.7 (0.04)	-0.2 (0.06) ▼
Finland	34 (1.0)	573 (2.9)	52 (0.9)	552 (2.5)	14 (0.7)	519 (3.9)	9.7 (0.03)	0.0 (0.05)
England	33 (1.0)	556 (3.0)	42 (0.8)	537 (2.6)	25 (0.9)	510 (3.7)	9.5 (0.05)	0.0 (0.07)
Singapore	26 (0.6)	621 (3.7)	43 (0.7)	596 (3.9)	31 (0.7)	559 (4.6)	9.2 (0.03)	0.1 (0.04)
Hong Kong SAR	25 (1.2)	588 (3.9)	48 (1.0)	558 (3.2)	27 (0.9)	526 (3.3)	9.3 (0.04)	0.2 (0.06) ▲
International Avg.	40 (0.2)	532 (0.5)	42 (0.1)	501 (0.5)	18 (0.1)	464 (0.8)		

Centre point of scale set at 10.

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

▲ Significantly higher than 2011

▼ Significantly lower than 2011



How much do you agree with these statements about science?

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

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

*Reverse coded

Statements a – f were also used in 2011.

Source: Exhibit 10.5, international science report (Martin *et al.*, 2016a) and adapted from the international version of the TIMSS 2015 Pupil Questionnaire.

5.3 Engaging pupils in learning in mathematics and science

5.3.1 Engagement in mathematics

Pupil engagement[29] was measured by their responses to ten statements about their mathematics lessons. (Table 5.5 provides further details of these statements.) Using responses to these statements, a 'Students' Views on Engaging Teaching in Mathematics Lessons' scale was created and pupils were categorised into three bands: 'Very Engaging Teaching in Mathematics Lessons', 'Engaging Teaching in Mathematics Lessons', and 'Less than Engaging Teaching in Mathematics Lessons'. (Details of how pupils were assigned to each band are provided below Table 5.5.) Table 5.5 shows that, in Northern Ireland, 74 per cent of pupils participating in TIMSS 2015 were classified as experiencing 'Very Engaging Teaching in Mathematics Lessons'; 22 per cent as experiencing 'Engaging Teaching in Mathematics Lessons'; and four per cent as experiencing 'Less than Engaging Teaching in Mathematics Lessons'. Across the group of comparator countries, Northern Ireland had the highest percentage of pupils in the highest band for engaging teaching. The Republic of Ireland and England both had 73 per cent of pupils in this band, followed by Australia, Finland and Poland with 63 per cent, 58 per cent and 57 per cent respectively.

Among the highest performing countries in mathematics for this age group, the overall levels of pupils experiencing engaging mathematics lessons were fairly low, as was the case for pupils' positive attitudes and confidence towards mathematics. Four of the five countries with the highest mathematics achievement were among the five countries with the lowest percentage of pupils experiencing 'Very Engaging Teaching in Mathematics Lessons'. Of the comparator countries, Hong Kong and Singapore both had high mathematics achievement among 9- to 10-year-olds, but only 50 per cent and 55 per cent respectively of pupils experiencing very engaging teaching.

In Northern Ireland in TIMSS 2015, pupils who experienced 'Very Engaging Teaching in Mathematics' and those who experienced 'Engaging Teaching in Mathematics' had similar average achievement scores, 572 and 570 respectively, while pupils who experienced 'Less than Engaging Teaching in Mathematics' had a lower average score of 549. Although significance tests have not been conducted in the international analysis, based on the size of the standard errors, these differences in achievement scores for Northern Ireland are unlikely to be statistically significant. The international averages indicate a mixed trend between experiencing engaging teaching in mathematics and mathematics achievement. The comparator countries of England, Poland and Australia follow a similar pattern to Northern Ireland, in that the average achievement scores of pupils categorised in the highest and middle bands of the engaging teaching scale are similar. For Singapore, Finland, the Republic of Ireland and Hong Kong, pupils who experienced 'Very Engaging Teaching in Mathematics' had a higher average achievement score than those who experienced ''Engaging Teaching' and 'Less Than Engaging Teaching in Mathematics'.

[29] Pupil engagement in mathematics for 2015 cannot be compared to 2011 as it is not the same scale; there are five additional statements and the data is scaled differently.

Table 5.5 Pupil engagement in mathematics lessons

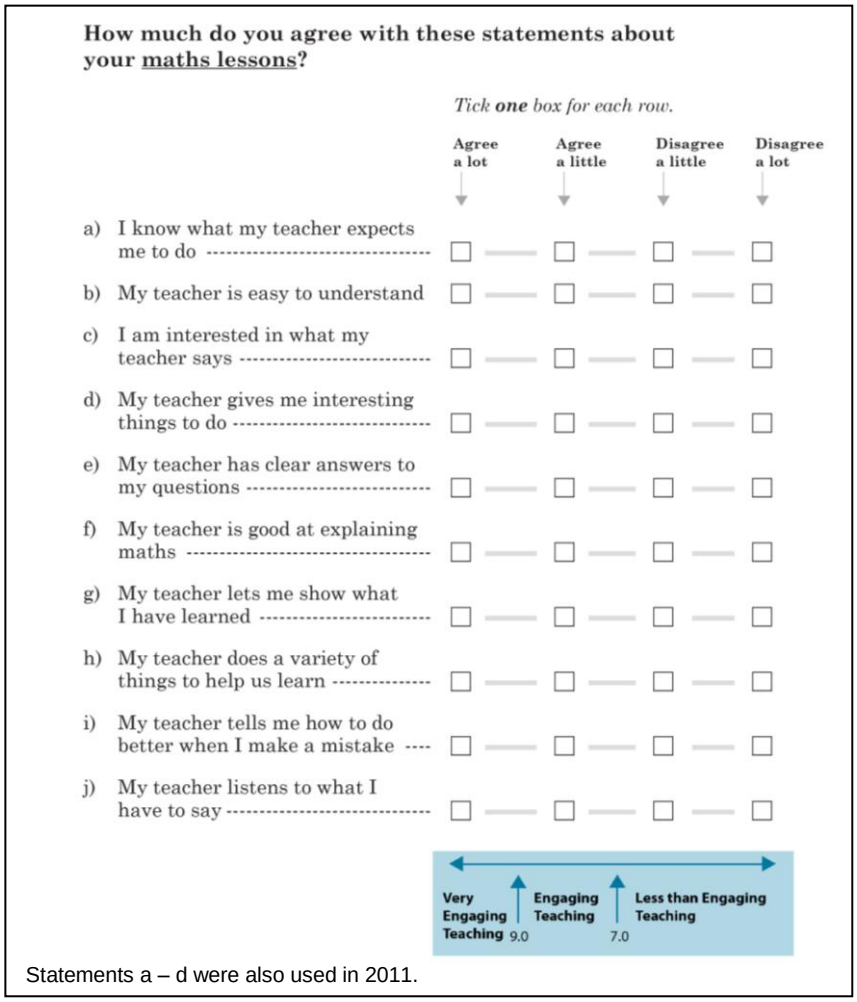
Reported by pupils

Students were scored according to their degree of agreement with ten statements on the *Students' Views on Engaging Teaching in Mathematics Lessons* scale. Students who experienced **Very Engaging Teaching** in mathematics lessons had a score on the scale of at least 9.0, which corresponds to their "agreeing a lot" with five of the ten statements and "agreeing a little" with the other five, on average. Students who experienced teaching that was **Less than Engaging** had a score no higher than 7.0, which corresponds to their "disagreeing a little" with five of the ten statements and "agreeing a little" with the other five, on average. All other students experienced **Engaging Teaching** in mathematics lessons.

Country	Very Engaging Teaching		Engaging Teaching		Less than Engaging Teaching		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland	74 (1.2)	572 (3.4)	22 (1.0)	570 (4.7)	4 (0.5)	549 (13.0)	10.2 (0.07)
Ireland, Rep. of	73 (1.3)	550 (2.2)	23 (1.1)	545 (4.0)	4 (0.4)	525 (7.3)	10.2 (0.06)
England	73 (1.3)	548 (3.3)	24 (1.2)	545 (3.7)	4 (0.4)	527 (8.1)	10.1 (0.06)
Australia	63 (1.2)	519 (3.5)	31 (0.9)	520 (3.5)	6 (0.4)	492 (6.8)	9.7 (0.05)
Finland	58 (1.1)	540 (2.3)	37 (1.0)	532 (2.8)	5 (0.5)	516 (6.2)	9.4 (0.04)
Poland	57 (1.3)	535 (2.3)	35 (1.0)	538 (2.9)	8 (0.8)	522 (5.6)	9.5 (0.06)
Singapore	55 (1.0)	625 (4.0)	37 (0.7)	613 (4.3)	7 (0.5)	592 (6.7)	9.3 (0.04)
Hong Kong SAR	50 (1.3)	621 (3.3)	38 (1.0)	612 (3.5)	11 (0.8)	591 (4.6)	9.2 (0.06)
International Avg.	68 (0.2)	510 (0.4)	26 (0.1)	498 (0.6)	5 (0.1)	481 (1.2)	

Centre point of scale set at 10.

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



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

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

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I know what my teacher expects me to do	☐	☐	☐	☐
b) My teacher is easy to understand	☐	☐	☐	☐
c) I am interested in what my teacher says	☐	☐	☐	☐
d) My teacher gives me interesting things to do	☐	☐	☐	☐
e) My teacher has clear answers to my questions	☐	☐	☐	☐
f) My teacher is good at explaining maths	☐	☐	☐	☐
g) My teacher lets me show what I have learned	☐	☐	☐	☐
h) My teacher does a variety of things to help us learn	☐	☐	☐	☐
i) My teacher tells me how to do better when I make a mistake	☐	☐	☐	☐
j) My teacher listens to what I have to say	☐	☐	☐	☐

Statements a – d were also used in 2011.

Source: Exhibit 10.1, international mathematics report (Mullis *et al.*, 2016a) and adapted from the international version of the TIMSS 2015 Pupil Questionnaire.

5.3.2 Engagement in science

Pupil engagement[30] was measured by pupils' responses to ten statements about their science lessons. Table 5.6 provides further details on these statements. Using responses to these statements, the 'Students' Views on Engaging Teaching in Science Lessons' scale was created and pupils were categorised into three bands: those experiencing 'Very Engaging Teaching in Science Lessons', 'Engaging Teaching in Science Lessons', and 'Less than Engaging Teaching in Science Lessons'. (Details of how pupils were assigned to each band are provided in Table 5.6.)

Table 5.6 shows that, in TIMSS 2015, 72 per cent of pupils in Northern Ireland were categorised as experiencing 'Very Engaging Teaching in Science Lessons'; 23 per cent as experiencing 'Engaging Teaching in Science Lessons'; and six per cent as experiencing 'Less Than Engaging Teaching in Science Lessons'. Among the comparator countries, Northern Ireland had the largest percentage of pupils in the highest category for engaging lessons in science and, as with mathematics, the Republic of Ireland and England followed closely, with 71 per cent and 70 per cent of pupils respectively experiencing 'Very Engaging Teaching in Science Lessons'. Australia and Poland both had 63 per cent of pupils in the highest band and Finland 60 per cent.

As with mathematics, among the highest performing countries in science for this age group, overall levels of pupils experiencing engaging science lessons were fairly low. Four of the five countries with the highest science achievement scores were among the five countries with the lowest percentage of pupils experiencing 'Very Engaging Teaching in Science Lessons'. Of the comparator countries, Hong Kong and Singapore both had high science achievement among 9- to 10-year-olds, but only 55 per cent and 56 per cent respectively of pupils experiencing 'Very Engaging Teaching in Science Lessons'. This shows that having high overall performance in science is not necessarily indicative of pupils reporting engaging teaching in science lessons.

In Northern Ireland, the average achievement for pupils who reported experiencing 'Very Engaging Teaching in Science' was slightly lower than for those who experienced 'Engaging Teaching' and 'Less than Engaging Teaching in Science' (the scores were 519, 522 and 526 respectively). Among the comparator countries there is a mixed pattern. In England and Poland the pattern mirrors what is seen in Northern Ireland. For example, pupils in Poland who experienced 'Very Engaging Teaching in Science', had an average achievement score of 546, compared with an average achievement score of 549 for pupils experiencing 'Less than Engaging Teaching in Science'. In the Republic of Ireland, Australia and Finland there was little difference in average achievement of pupils in the highest and middle categories (with all but Finland having a higher average achievement score for pupils experiencing 'Engaging Teaching' than 'Very Engaging Teaching'), but a lower average achievement of pupils in the lowest category. The average achievement of pupils in Singapore and Hong Kong declined as pupils had less experience of engaging teaching. Although no significance testing has been completed, based on the differences between the average achievement scores, this pattern is unlikely to be statistically significant.

[30] Pupil engagement in science for 2015 cannot be compared to 2011 as it is not the same scale; there are five additional statements and the data is scaled differently.

Table 5.6 Pupil engagement in science lessons

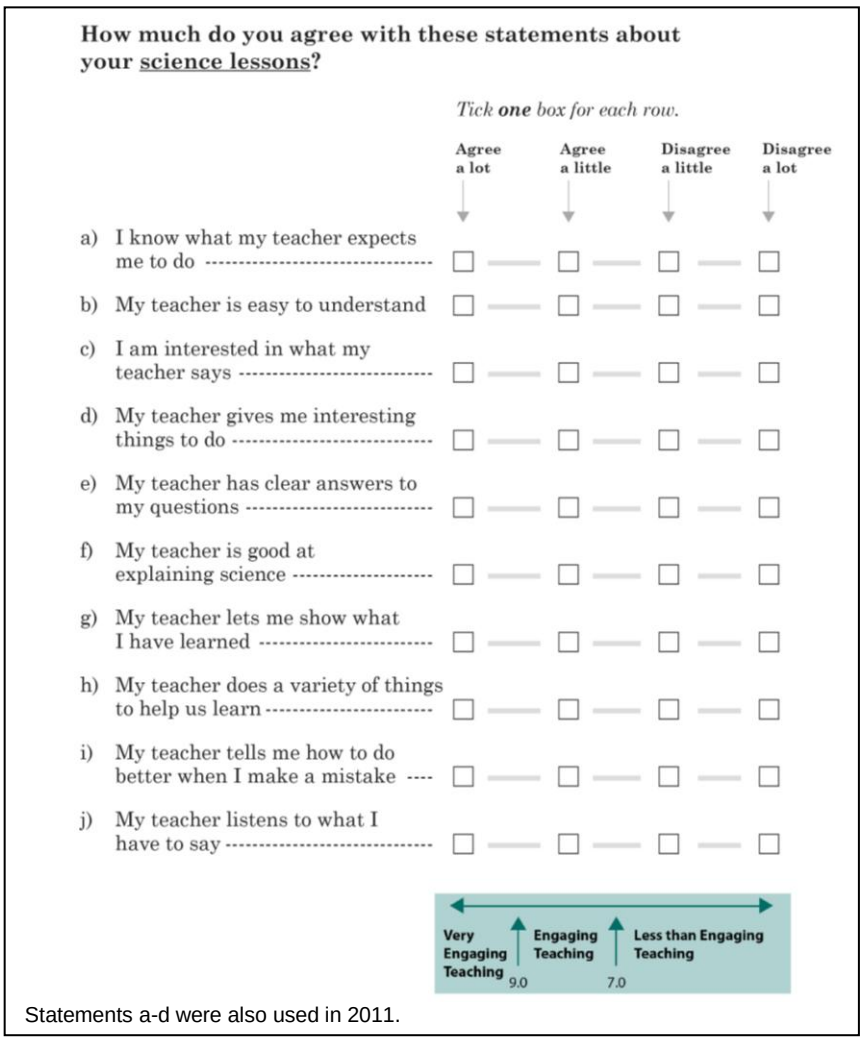
Reported by pupils

Students were scored according to their degree of agreement with ten statements on the *Students' Views on Engaging Teaching in Science Lessons* scale. Students who experienced **Very Engaging Teaching** in science lessons had a score on the scale of at least 9.0, which corresponds to their "agreeing a lot" with five of the ten statements and "agreeing a little" with the other five, on average. Students who experienced teaching that was **Less than Engaging** had a score no higher than 7.0, which corresponds to their "disagreeing a little" with five of the ten statements and "agreeing a little" with the other five, on average. All other students experienced **Engaging Teaching** in science lessons.

Country	Very Engaging Teaching		Engaging Teaching		Less than Engaging Teaching		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland	72 (1.2)	519 (2.7)	23 (0.9)	522 (3.3)	6 (0.8)	526 (7.4)	10.0 (0.06)
Ireland, Rep. of	71 (1.3)	529 (2.7)	24 (1.2)	533 (3.9)	5 (0.4)	520 (6.6)	10.0 (0.06)
England	70 (1.3)	534 (2.5)	24 (0.9)	544 (3.9)	6 (0.6)	535 (6.6)	9.9 (0.06)
Australia	63 (1.0)	524 (3.2)	29 (0.8)	528 (3.6)	8 (0.5)	517 (5.5)	9.7 (0.05)
Poland	63 (1.4)	546 (2.6)	29 (1.0)	550 (3.2)	7 (0.7)	549 (6.1)	9.8 (0.06)
Finland	60 (1.2)	556 (2.7)	34 (1.1)	554 (2.7)	6 (0.5)	532 (5.5)	9.4 (0.04)
Singapore	56 (0.9)	595 (3.9)	35 (0.7)	587 (4.2)	9 (0.6)	577 (5.8)	9.4 (0.04)
Hong Kong SAR	55 (1.2)	562 (3.6)	33 (0.9)	553 (3.0)	12 (0.8)	544 (4.8)	9.4 (0.06)
International Avg.	69 (0.2)	510 (0.5)	25 (0.1)	500 (0.7)	6 (0.1)	489 (1.3)	

Centre point of scale set at 10.

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



Source: Exhibit 10.1, international science report (Martin *et al.*, 2016a) and adapted from the international version of the TIMSS 2015 Pupil Questionnaire.

5.4 Teaching to engage pupils in learning mathematics and science

5.4.1 Teachers' reported approaches to engaging pupils in mathematics lessons

Interpreting the data: percentages in tables

The data in this section is derived from teacher reports. Reported percentages refer to pupils and can usually be interpreted as the percentage of pupils whose teachers reported a particular practice or circumstance.

Year 6 (Y6) pupils (aged 9-10) were sampled by class. In most cases therefore, the Y6 Teacher Questionnaire would have been completed by the class teacher of the sampled class. However, in some cases, it might have been completed by different teachers who teach these pupils mathematics and/or science separately. This means that the teacher-derived data for mathematics and science may differ slightly as the sample of teachers in each group is not necessarily the same, or the distribution of pupils within the sample of teachers may differ by subject.

In TIMSS 2015, teachers were asked how they engage pupils in mathematics lessons. The questions presented to teachers to measure pupil engagement have changed since the 2011 study; as a result direct comparisons cannot generally be made. That said, two questions on teachers' reported approaches to engaging pupils were presented to teachers in 2011 and 2015 and the results for these questions are reported in Table 5.7.

Teachers were asked how often they used particular instructional practices in their lessons. Table 5.7 shows the percentage of pupils taught by teachers who reported using these practices 'Every or Almost Every Lesson'. In 2015 in Northern Ireland, a slightly higher percentage of pupils were taught by teachers who reported relating the lesson to pupils' daily lives 'Every or Almost Every Lesson' than in 2011 (41 per cent and 37 per cent respectively). In terms of the percentages of teachers who reported bringing interesting materials to class, in 2015, 16 per cent of teachers reported using this instructional practice 'Every or Almost Every Lesson'. This was similar to 2011 (17 per cent).

In Northern Ireland, the percentage of pupils taught by teachers who report using these approaches is much lower than the international average, although the international average of pupils taught by teachers who reported bringing interesting materials to class 'Every or Almost Every Lesson' has fallen to 23 per cent in 2015 from 30 per cent in 2011. The international average for relating lessons to children's daily lives remained similar in 2011 and 2015.

Table 5.7 Teaching to engage pupils in learning mathematics

Country	Percentage of pupils whose teachers report using this approach 'Every or Almost Every Lesson'			
	Relate the lesson to children's daily lives		Bring interesting materials to class	
	2011 (%)	2015 (%)	2011 (%)	2015(%)
Northern Ireland	37	41	17	16
International Avg.	57	56	30	23

Sources: 2011 Mathematics Teacher Context Data Almanac by Mathematics Achievement questions ATBG15B and ATBG15F and 2015 Mathematics Teacher Context Data Almanac by Mathematics Achievement questions ATBG14A and ATBG14C

5.4.2 Teachers' reported approaches to engaging pupils in science lessons

As with mathematics, the questions presented to teachers to measure pupil engagement in science lessons in TIMSS 2015 differed from TIMSS 2011, and consequently how teachers engage pupils in science lessons cannot be directly compared across the two studies. That said, two questions on teachers' reported approaches to engaging pupils in science were presented to teachers in 2011 and 2015 and the results are shown in Table 5.8.

Teachers were asked how often they used particular instructional practices in their lessons and Table 5.8 shows the percentage of pupils taught by teachers who reported using these practices 'Every or Almost Every Lesson'. In 2015, a slightly higher percentage of pupils were taught by teachers who related the lessons to children's daily lives 'Every or Almost Every Lesson' than in 2011, 41 per cent and 37 per cent respectively. A similar percentage of pupils were taught by teachers who reported bringing interesting materials to class 'Every or Almost Every Lesson' in 2015 (16 per cent) as in 2011 (18 per cent).

Again, in Northern Ireland, the percentage of pupils taught by teachers who reported using these approaches 'Every of Almost Every Lesson' is much lower than the international average and, as for mathematics, there is a slight drop in the international average of pupils taught science by teachers who reported bringing interesting materials to class 'Every or Almost Every Lesson'. The international average for the proportion of teachers who reported relating lessons to children's daily lives 'Every or Almost Every Lesson' remains similar at 60 per cent in 2015 (61 per cent in 2011).

Table 5.8 Teaching to engage pupils in learning science

Country	Percentage of pupils whose teachers report using this approach 'Every or Almost Every Lesson'			
	Relate the lesson to children's daily lives		Bring interesting materials to class	
	2011 (%)	2015 (%)	2011 (%)	2015 (%)
Northern Ireland	37	41	18	16
International Avg.	61	60	33	28

Sources: 2011 Science Teacher Context Data Almanac by Science Achievement questions ATBG15B and ATBG15F and 2015 Science Teacher Context Data Almanac by Science Achievement questions ATBG14A and ATBG14C

5.5 Conclusion

Overall, pupils in Northern Ireland who were classified in the 'Very Much Like Learning Mathematics' / 'Very Much Like Learning Science' categories had the highest average achievement in the subject. This association between liking the subject and achievement was apparent in most countries participating in TIMSS 2015..

In TIMSS 2015 in Northern Ireland, pupils' attitudes towards mathematics and science were similar to those in 2011. However, in 2015, there was a slightly higher proportion of pupils in the highest band of the 'Students Like Learning Science' scale than in 2011.

In both mathematics and science, there was also an association between pupil confidence and achievement. Across the countries participating in TIMSS 2015, apart from the highest achieving countries, pupils who were classified as being 'Very Confident in Mathematics' / 'Very Confident in Science' generally had a higher average achievement score in mathematics / science, and Northern Ireland was no exception, both in 2015 and 2011.

In Northern Ireland, there was little difference between the achievement of pupils who reported experiencing 'Very Engaging Teaching in Mathematics Lessons' and those who reported experiencing 'Engaging Teaching in Mathematics Lessons'. However, those pupils experiencing 'Less than Engaging Teaching in Mathematics Lessons' had lower average achievement.

However, in Northern Ireland, the association between engaging teaching and achievement in science was different from that seen in mathematics. The average science achievement score for pupils who reported experiencing 'Very Engaging Teaching in Science Lessons' was lower than for those who experienced 'Less than Engaging Teaching in Science Lessons'. However, the differences here are unlikely to be statistically significant.

In terms of the practices used to engage pupils, compared with the international average, a lower percentage of pupils in Northern Ireland were taught by teachers who related lessons to their daily lives and used interesting materials in 'Every or Almost Every Lesson'

In a number of cases, the highest performing countries overall in mathematics and science had a low percentage of pupils categorised as *Very Confident* in the subject and experiencing *Engaging Teaching* in their lessons. This is evident in the data from the two highest achieving comparator countries, Hong Kong and Singapore.