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TIMSS 2015 in Northern Ireland:
Mathematics and Science

TIMSS 2015 in Northern Ireland: Mathematics and Science

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TIMSS 2015 in Northern Ireland: introduction

Report outline

This report summarises Year 6 (Y6) pupils' attainment in the 2015 TIMSS survey in Northern Ireland and explores the context of that attainment.

TIMSS is an international comparison study of mathematics and science at ages 9-10. (TIMSS also assesses ages 13-14, but Northern Ireland participated only at the younger age range.) TIMSS has a four-yearly cycle. Northern Ireland took part in TIMSS for the second time in the 2015 cycle having previously participated in 2011.

What TIMSS assesses at ages 9-10

TIMSS assesses content domains (mathematics and science) and cognitive domains (knowing, applying and reasoning) in both subjects. The content domains assessed at ages 9-10 are:

- Mathematics – Number, Geometric Shapes and Measures, Data Display
- Science – Life Science, Physical Science, Earth Science.

In science, the area of study related to the classification and properties of materials is included in the Physical Science content domain.

Countries with which Northern Ireland will mainly be compared in this report

The report compares the performance of Northern Ireland pupils with pupils aged 9-10 in all participating countries in TIMSS. Where possible, it also compares performance in Northern Ireland with that of the six countries which outperformed Northern Ireland in the Programme for International Student Assessment (PISA)[1] 2012, in all three subject domains (mathematics, science and reading). These countries are:

- Australia
- Finland
- Hong Kong
- Poland
- Republic of Ireland
- Singapore.

In addition, where applicable, the report compares performance with that in England as another constituent country of the UK.

Trend comparisons: TIMSS 2015 and TIMSS 2011

The report compares Northern Ireland's performance in TIMSS 2015 with performance in TIMSS 2011. Where possible, the report also explores whether the background factors that impact on attainment have changed between these two cycles of TIMSS. It should be noted that the contextual questionnaires (school questionnaire, teacher questionnaire, pupil questionnaire and home questionnaire) have undergone some changes since TIMSS 2011. In some cases the changes are minimal and comparisons with the 2011 findings are made but should be interpreted with caution. In other cases the changes to the questionnaires are more fundamental and, as a result, trend comparisons are not possible.

[1] PISA is an international comparison study assessing students' mathematics, science and reading skills at age 15.

1 Attainment in TIMSS 2015 in Northern Ireland

Chapter outline

This chapter summarises pupils' attainment in mathematics and science in Year 6 (Y6) at ages 9-10 in 2015. In each section, the relevant tables of data are presented, accompanied by discussion of the outcomes. Findings for mathematics are discussed followed by findings for science. Outcomes for Northern Ireland are compared with those of other relevant nations.

Key findings

- Pupils in Northern Ireland significantly[2] outperformed 42 of the 50 participating countries in mathematics and were significantly outperformed by five countries.
- The average score for science (520) is lower than for mathematics (570), although still above the TIMSS science international average[3]. Northern Ireland is outperformed by 22 countries in science and is in a group of seven countries scoring similarly.
- Compared with TIMSS 2011, five additional countries significantly outperformed Northern Ireland in the TIMSS 2015 science assessment. This included the comparator country the Republic of Ireland.
- Mathematics and science attainment for 9- and 10-year-olds in Northern Ireland has remained stable. Northern Ireland's mathematics and science scores in 2015 are not significantly different from scores in 2011.

1.1 Summary of attainment

Tables 1.1 and 1.2 below summarise Northern Ireland's attainment in each subject, taking account of the significance of any apparent differences in attainment. The tables for mathematics and science are presented consecutively and then discussed in turn.

[2] Throughout this report, the term 'significant' refers to statistical significance.
[3] Throughout this chapter 'international average' refers to the TIMSS scale centre point.

Interpreting the data: performance groups

The TIMSS achievement scales have a centre point of 500 and a standard deviation of 100. The scales are 'standardised' in this way to facilitate comparisons between countries and over time. The summaries below compare the average performance in Northern Ireland in the TIMSS scale for each subject with that of the other participating countries (57 countries[4] in total took part in TIMSS 2015). The summaries indicate whether average scores, which may appear similar, are statistically significantly different from each other.

Countries participating in TIMSS follow guidelines and strict sampling targets to provide samples that are nationally representative. In addition to the participating countries shown in these tables, TIMSS includes 'benchmarking participants'. These are regional entities which follow the same guidelines and targets to provide samples that are representative at regional level. Their results are not reported here but are included in the TIMSS international reports.

Table 1.1 TIMSS 2015 performance groups: mathematics at ages 9-10

HIGHER performance compared with Northern Ireland

Participants performing at a significantly higher level than Northern Ireland

Country	Scale score	Country	Scale score
Singapore	618	Chinese Taipei	597
Hong Kong	615	Japan	593
Korea	608		

SIMILAR performance compared with Northern Ireland

Participants performing at a similar level to Northern Ireland (not significantly different statistically)

Country	Scale score	Country	Scale score
Northern Ireland	**570**	Russian Federation	564

[4] Fifty countries and seven benchmarking participants administered the fourth grade assessments (ages 9-10). Each of these participating countries or entities administered the mathematics and science assessment, except Jordan and South Africa who participated in mathematics only. Armenia participated in the Grade 4 assessment but no data is available.

LOWER performance compared with Northern Ireland

Participants performing at a significantly lower level than Northern Ireland

Country	Scale score	Country	Scale score
Norway (5)*	549	Canada	511
Rep. of Ireland	547	Italy	507
England	546	Spain	505
Belgium (Flemish)	546	Croatia	502
Kazakhstan	544	Slovak Republic	498
Portugal	541	New Zealand	491
United States	539	France	488
Denmark	529	Turkey	483
Lithuania	535	Georgia	463
Finland	535	Chile	459
Poland	535	United Arab Emirates	452
Netherlands	530	Bahrain	451
Hungary	529	Qatar	439
Czech Republic	528	Iran	431
Bulgaria	524	Oman	425
Cyprus	523	Indonesia	397
Germany	522	Jordan	388
Slovenia	520	Saudi Arabia	383
Sweden	519	Morocco	377
Serbia	518	South Africa (5)*	376
Australia	517	Kuwait	353

*Norway and South Africa assessed fifth grade pupils.

Table 1.2 TIMSS 2015 performance groups: science at ages 9-10

HIGHER performance compared with Northern Ireland

Participants performing at a significantly higher level than Northern Ireland

Country	Scale score	Country	Scale score
Singapore	590	Hungary	542
Korea	589	Sweden	540
Japan	569	Norway (5)*	538
Russian Federation	567	England	536
Hong Kong	557	Bulgaria	536
Chinese Taipei	555	Czech Republic	534
Finland	554	Croatia	533
Kazakhstan	550	Rep. of Ireland	529
Poland	547	Germany	528
United States	546	Lithuania	528
Slovenia	543	Denmark	527

*Norway assessed fifth grade pupils.

SIMILAR performance compared with Northern Ireland

Participants performing at a similar level to Northern Ireland (not significantly different statistically)

Country	Scale score	Country	Scale score
Canada	525	**Northern Ireland**	**520**
Serbia	525	Spain	518
Australia	524	Netherlands	517
Slovak Republic	520	Italy	516

LOWER performance compared with Northern Ireland

Participants performing at a significantly lower level than Northern Ireland

Country	Scale score	Country	Scale score
Belgium (Flemish)	512	United Arab Emirates	451
Portugal	508	Qatar	436
New Zealand	506	Oman	431
France	487	Iran	421
Turkey	483	Indonesia	397
Cyprus	481	Saudi Arabia	390
Chile	478	Morocco	352
Bahrain	459	Kuwait	337
Georgia	451		

1.1.1 Mathematics attainment: TIMSS 2015

The TIMSS 2015 mathematics score for Y6 pupils in Northern Ireland was 570, above the centre point of the international scale (500) and ranking sixth[5] among participating nations.

Table 1.1 summarises Northern Ireland's performance internationally, taking account of the significance of any apparent differences in attainment. As was the case for TIMSS 2011, Northern Ireland was significantly outperformed by only five of the 50[6] participating countries (all Asian Pacific Rim countries). Only one country, the Russian Federation, performed similarly to Northern Ireland and both significantly outperformed the remaining 42 participating countries.

Overall, Northern Ireland's mathematics performance in TIMSS 2015 was similar to that in 2011.

1.1.2 Science attainment: TIMSS 2011

The TIMSS 2015 science score for Y6 pupils in Northern Ireland was 520, above the centre point of the international scale (500) and ranking 27th among participating nations.[7]

Table 1.2 summarises Northern Ireland's performance internationally, taking account of the significance of any apparent differences in attainment. Although Northern Ireland's average scale score for science was significantly above the international average, as was the case in 2011, pupils did less well comparatively in science than in mathematics at ages 9-10. Whereas five countries outperformed Northern Ireland in TIMSS mathematics, 22 did so in science, including all but one of the selected comparator countries (Australia performed similarly to Northern Ireland). There was some movement amongst the group of countries outperforming Northern Ireland in science, notably the movement of the Republic of Ireland into this group. In 2011 the performance of the Republic of Ireland was not significantly different in science to that of Northern Ireland.

Although the primary level curriculum in Northern Ireland[8] does not include science as a discrete subject - it is covered as part of 'The World Around Us'[9], comparison of the Key Stage 2 curriculum in Northern Ireland and the TIMSS Assessment Framework for science shows that all but one of the TIMSS science topics are included in the Northern Ireland Curriculum at this stage. This comparison also shows that almost two-thirds of Northern

[5] Rankings should be treated with caution as some apparent differences in attainment may not be statistically significant. See 'Interpreting the data: international rankings' in section 1.2 for more information. In absolute terms, Northern Ireland is ranked sixth, but the Russian Federation ranked seventh has an achievement score that is not significantly different from that of Northern Ireland (see Table 1.1).
[6] Armenia administered the Grade 4 assessment but no data is available, therefore data from 49 countries is available for comparison.
[7] As noted above, rankings should be treated with caution. In absolute terms, Northern Ireland is ranked 27th, but the countries ranked 23rd to 30th have achievement scores that, statistically, are not significantly different from that of Northern Ireland (see Table 1.2).
[8] See CCEA (2007) *The Northern Ireland Curriculum: KS1 and 2*.
[9] See the TIMSS 2015 Encyclopaedia (Mullis *et al.*, 2016b).

Ireland's pupils had been taught these topics before, or were engaged in study of the topics over the TIMSS assessment period (slightly lower than the average internationally).[10]

1.2 Attainment rankings: TIMSS 2015

Tables 1.3 to 1.4 below show the full rankings for each subject, indicating Northern Ireland's ranking in terms of international attainment in the subject concerned. The tables are presented consecutively and then discussed in turn.

Interpreting the data: international rankings

The mean scores on the TIMSS achievement scales (with 95 per cent confidence intervals) are shown graphically as the darkened areas on the achievement distributions, and listed (together with their standard errors) in the 'Average Scale Score' column of the tables. Arrows beside the scores indicate whether the average achievement in that country is significantly higher (upward arrow) or lower (downward arrow) than the TIMSS centre point of 500. The standard error refers to uncertainty in estimates resulting from random fluctuations in samples. The smaller the standard error, the better the score is as an estimate of the population's score. The distribution of attainment is discussed further in Chapter 3.

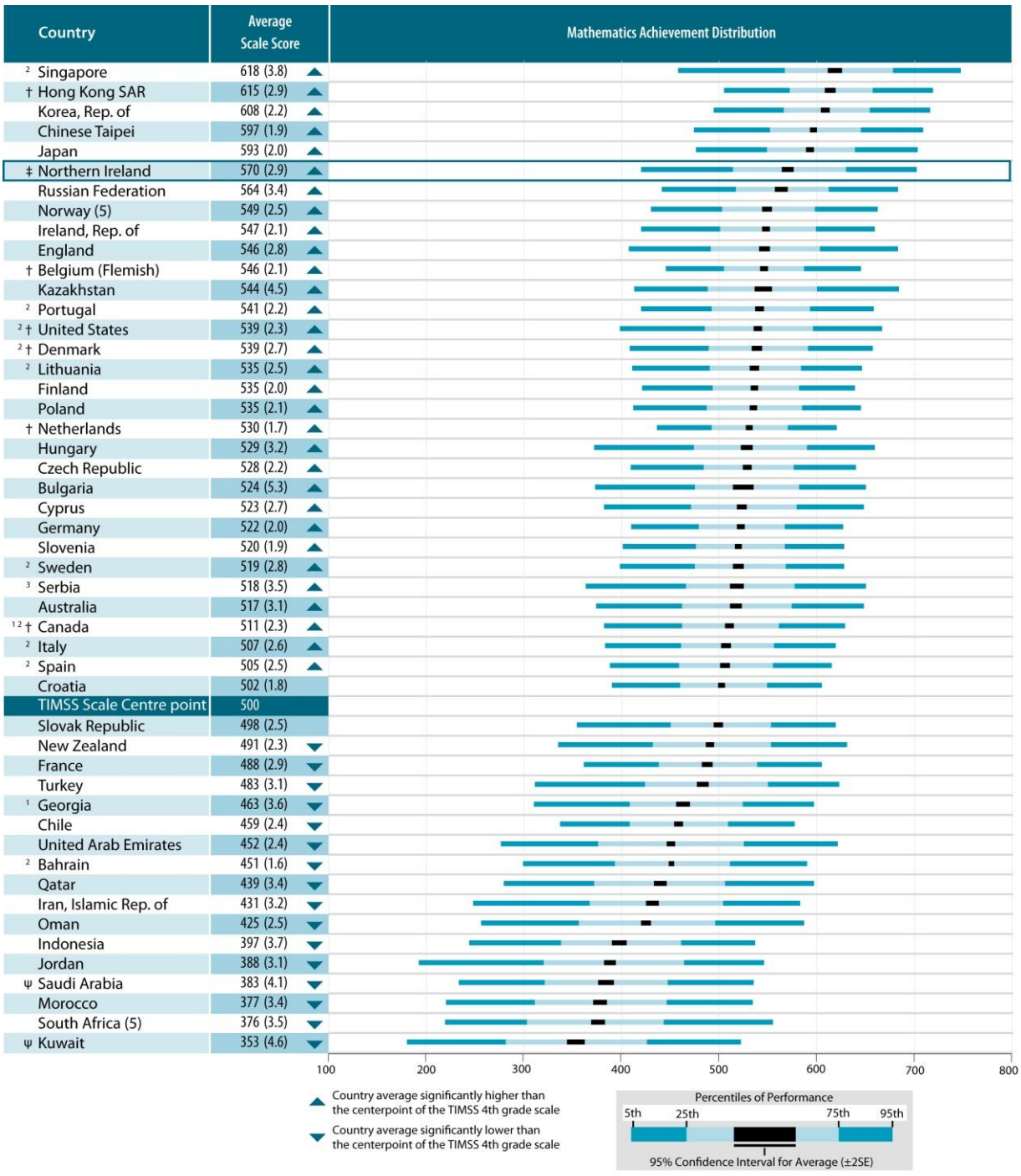
It is important to bear in mind that small differences may or may not be statistically significant, depending on the size of the standard error for each country. Tables 1.1 and 1.2 identified whether any given difference between Northern Ireland's scores and those of other countries is, or is not, statistically significant. More information is available in Chapter 1 of the international reports (Mullis *et al.*, 2016a; Martin *et al.*, 2016a).

Interpreting the data: participation notes

Northern Ireland almost met the sampling guidelines for participation rates only after replacement schools were included. As the sampling requirements were not quite achieved, further analysis of the sample was undertaken to ensure it was not biased. This further analysis demonstrated that the sample of participating schools for TIMSS 2015 was suitably representative of the Northern Ireland population as a whole and did not differ significantly on any of the stratification variables. Further details of the bias analysis are included in Appendix A.5.

[10] See Chapter 9 of this report for more information.

Table 1.3 Mean scores and distribution of mathematics achievement at ages 9-10, TIMSS 2015



Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, ‡, and ǂ.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.1, International mathematics report (Mullis *et al.*, 2016a).

Table 1.4 Mean scores and distribution of science achievement at ages 9-10, TIMSS 2015

ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, ‡, and ǂ.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.1, International science report (Martin *et al.*, 2016a).

Although the scores for both subjects in Northern Ireland are significantly above the international average, the ranking for mathematics is notably higher than for science. Sections 1.2.1 and 1.2.2 below outline this difference in more detail.

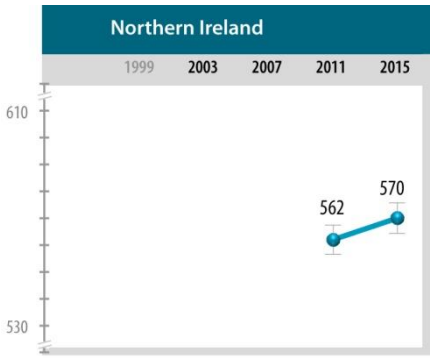
1.2.1 Mathematics attainment, TIMSS 2015

Table 1.3 emphasises how well Northern Ireland performed in TIMSS 2015 mathematics. The mean scale score of 570 is 48 scale points behind that of the highest performing country, Singapore, and 217 scale points ahead of the lowest performing country, Kuwait.

As was the case in 2011, only two of the comparator countries outperformed Northern Ireland (Singapore and Hong Kong at 618 and 615 respectively). The remaining comparator countries performed significantly less well than Northern Ireland in mathematics. Of these, the nearest scoring comparator countries were the Republic of Ireland (547) and England (546). This is a slightly different picture to that seen in 2011 where Finland was the nearest scoring comparator country. The lowest scoring comparator country in 2015 was Australia, with a scale score of 517, 53 points below Northern Ireland, but still 17 scale points above the international average.

Rankings can be volatile, varying according to the mix of countries participating in any given cycle. However, measurement of trends can indicate progress in a more stable fashion, since the outcomes from successive cycles of TIMSS are analysed on comparable scales. Figure 1.1 shows that mathematics attainment of 9- and 10-year-olds in Northern Ireland has remained stable since the last TIMSS cycle in 2011. Northern Ireland's score then was 562, and although this is 8 points lower, it is not significantly different statistically from the 2015 score of 570.

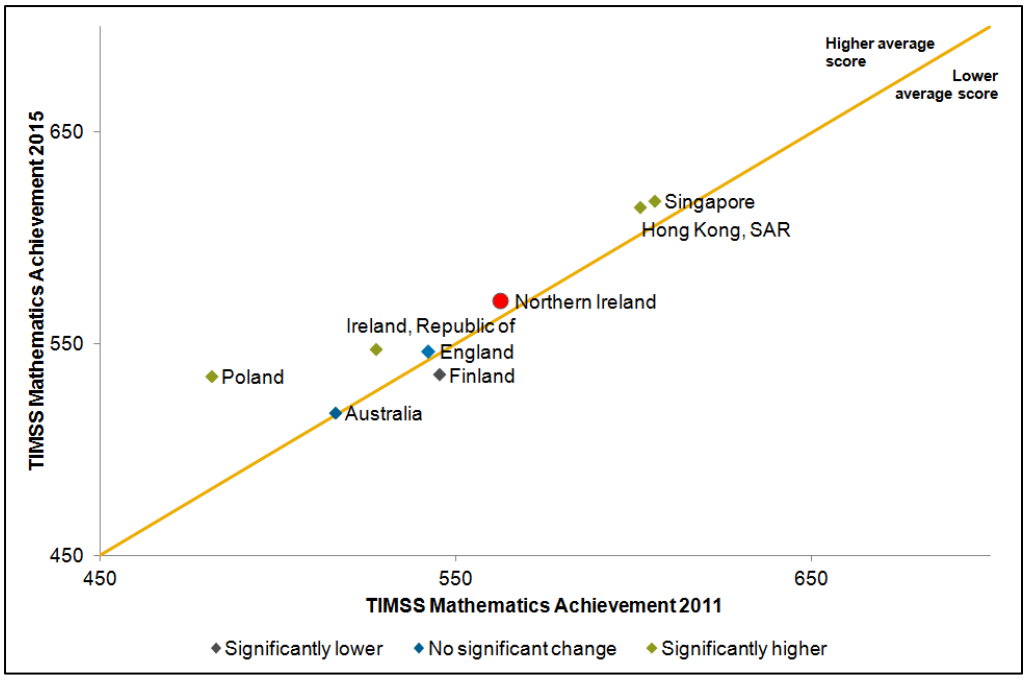
Figure 1.1 Trends in Y6 mathematics achievement in Northern Ireland



Source: Exhibit 1.5, International mathematics report (Mullis *et al.*, 2016a).

As shown in Figure 1.2, the majority of the comparator countries had higher scale scores in mathematics in 2015 compared with 2011. In Singapore, Hong Kong, the Republic of Ireland and Poland the overall mathematics achievement in 2015 was significantly higher than in 2011. In contrast, in Finland, mathematics achievement in 2015 was significantly lower than in 2011.

Figure 1.2 TIMSS mathematics achievement in 2015 compared with TIMSS 2011



1.2.2 Science attainment, TIMSS 2011

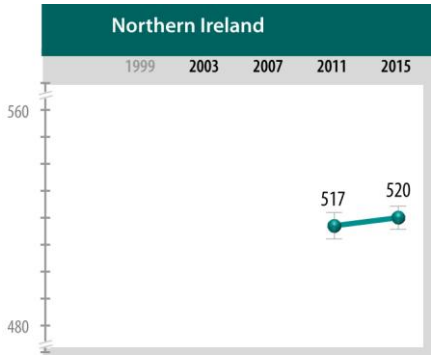
Table 1.4 shows that, as in 2011, Northern Ireland's average scale score for science is significantly above the international average (517 in 2011 and 520 in 2015); performance in science, however, compares somewhat less favourably than mathematics in international terms. In science, Northern Ireland is 70 scale points behind the highest performing country (Singapore), although still 183 scale points ahead of the lowest performing country (Kuwait).

In science, Northern Ireland was outperformed by six of the seven comparator countries (Singapore, Hong Kong, Finland, Poland, England and the Republic of Ireland, with scores between 590 and 529 respectively). Australia's performance, with a scale score of 524, was not significantly different. When examining Northern Ireland's performance against that of the comparator countries, the main change since 2011 is that the Republic of Ireland now outperforms Northern Ireland in science, having performed similarly in 2011.

As noted, rankings can be volatile, varying according to which countries have participated in the survey. A trend analysis can indicate progress in a more stable fashion since the outcomes from successive cycles of TIMSS are analysed on comparable scales. As shown in Figure 1.3, the science attainment of 9- and 10-year-olds in Northern Ireland has remained stable since the last round of TIMSS in 2011. Northern Ireland's score then was 517, not significantly different from its 2015 score of 520.

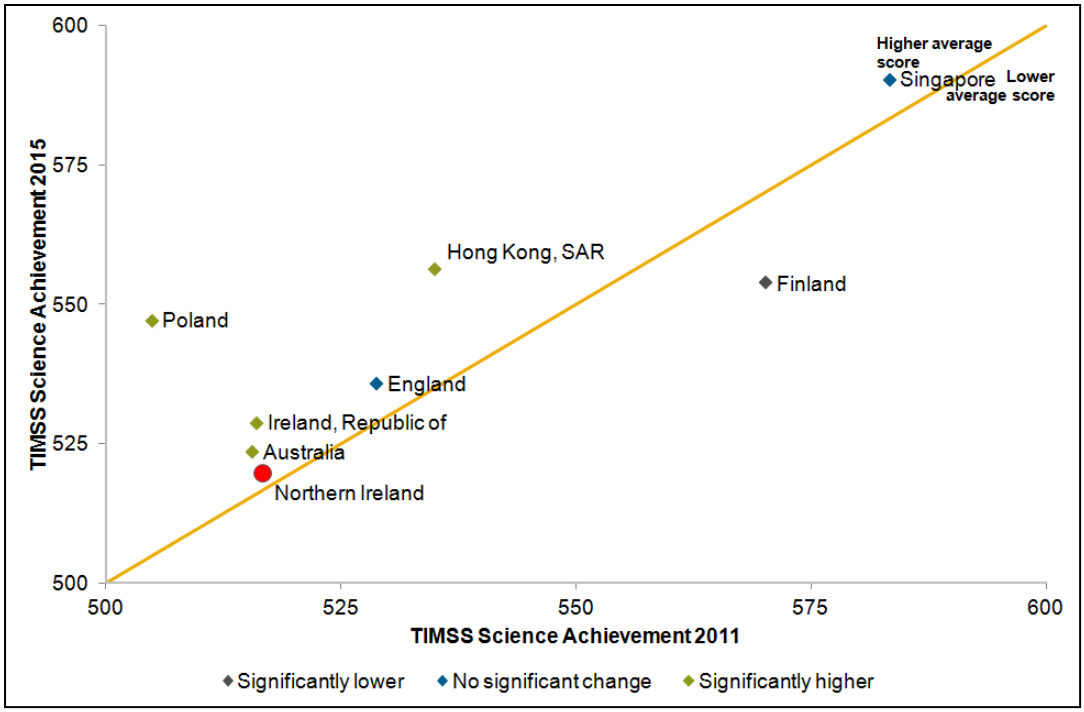
As is the case for mathematics, the majority of the comparator countries had higher scale scores in science in 2015 compared with 2011. Hong Kong, Poland the Republic of Ireland and Australia had significantly higher science achievement in 2015. In Finland, reflecting what was seen in mathematics, science achievement in 2015 was significantly lower than in 2011 (Figure 1.4).

Figure 1.3 Trends in Y6 science achievement in Northern Ireland



Source: Exhibit 1.5, International science report (Martin *et al.*, 2016a).

Figure 1.4 TIMSS science achievement in 2015 compared with TIMSS 2011



1.3 Conclusion

Pupils in Northern Ireland performed very well in TIMSS 2015 mathematics and were outperformed by only five of the 50 participating countries. Performance in science is notably weaker although still significantly above the international average.

Overall, mathematics and science achievement in Northern Ireland is similar to that in TIMSS 2011; Northern Ireland's scores in 2015 are not significantly different statistically from those in 2011. This shows that the performance of pupils in Northern Ireland in mathematics and science, as measured by the TIMSS assessments, has been stable between 2011 and 2015. This is in contrast to a number of the comparator countries, notably Hong Kong, Poland and the Republic of Ireland, where performance in both mathematics and science has improved significantly since 2011.

2 Attainment in TIMSS 2015 by gender

Chapter outline

This chapter summarises pupils' attainment by gender in mathematics and science in Year 6 (Y6, ages 9-10) in 2015. Findings for mathematics are discussed first, followed by findings for science. Outcomes for Northern Ireland are compared with those of the subset of main comparator nations which performed better than Northern Ireland in PISA 2012 in all three domains (Australia, Finland, Hong Kong, Poland, the Republic of Ireland, and Singapore), plus England as a comparator nation of the UK..

Key findings

- In Northern Ireland, there were no significant[11] gender differences in attainment for either mathematics or science.
- The lack of gender differences in attainment in Northern Ireland in both mathematics and science was apparent in both the 2011 and 2015 TIMSS cycles.

2.1 Attainment by gender in TIMSS

Tables 2.1 and 2.2 below show the international average scale scores for mathematics and science, ordered by the size of gender differences. The countries at the top of the tables have gender differences favouring girls, while those at the bottom of the tables have gender differences favouring boys. Countries towards the middle of the tables have smaller gender differences than those at either end of the tables. Outcomes for Northern Ireland are discussed for each subject in turn.

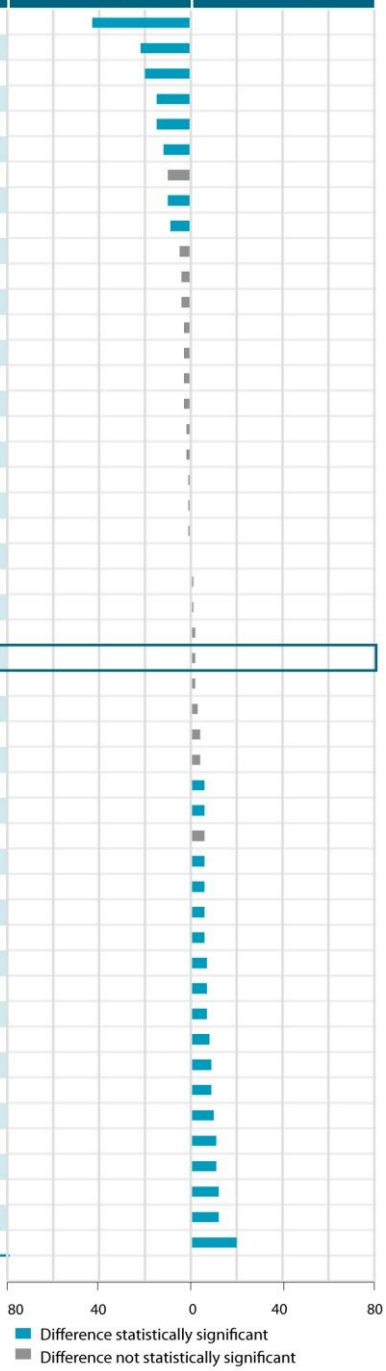
Interpreting the data: gender differences

The TIMSS achievement scales have a centre point of 500 and a standard deviation of 100. The tables show the direction and size of any gender difference for each country. Statistically significant differences are shown in colour in the 'Gender Difference' column while non-significant differences are greyed out.

[11] Throughout this report, the term 'significant' refers to statistical significance.

Table 2.1 TIMSS 2015 gender differences, mathematics at ages 9-10

Country	Girls		Boys		Difference (Absolute Value)	Gender Difference	
	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score		Girls Scored Higher	Boys Scored Higher
ψ Saudi Arabia	49 (1.0)	405 (4.4)	51 (1.0)	363 (6.5)	43 (7.7)		
Oman	50 (0.7)	436 (3.0)	50 (0.7)	415 (2.8)	22 (2.9)		
Jordan	46 (2.4)	399 (3.3)	54 (2.4)	379 (4.9)	20 (5.8)		
South Africa (5)	48 (0.8)	384 (3.8)	52 (0.8)	368 (4.4)	15 (4.2)		
2 Bahrain	50 (0.7)	459 (1.7)	50 (0.7)	443 (2.3)	15 (2.5)		
ψ Kuwait	51 (2.0)	359 (5.4)	49 (2.0)	347 (5.6)	12 (6.2)		
Iran, Islamic Rep. of	50 (0.9)	437 (4.5)	50 (0.9)	426 (4.5)	10 (6.3)		
Indonesia	48 (0.6)	403 (4.0)	52 (0.6)	393 (3.9)	10 (2.7)		
Finland	48 (0.8)	540 (2.3)	52 (0.8)	531 (2.6)	9 (2.9)		
Bulgaria	49 (0.8)	527 (5.7)	51 (0.8)	522 (5.1)	5 (2.9)		
Norway (5)	49 (0.9)	551 (2.6)	51 (0.9)	547 (3.1)	4 (2.9)		
2 Singapore	48 (0.5)	620 (3.9)	52 (0.5)	616 (4.3)	4 (3.0)		
United Arab Emirates	48 (2.2)	453 (3.9)	52 (2.2)	450 (3.4)	3 (5.4)		
1 Georgia	49 (0.9)	465 (3.9)	51 (0.9)	461 (4.4)	3 (4.0)		
3 Serbia	48 (0.8)	520 (3.7)	52 (0.8)	517 (4.7)	3 (4.7)		
Qatar	51 (2.5)	440 (4.1)	49 (2.5)	438 (4.9)	3 (5.9)		
2 Lithuania	50 (0.9)	537 (2.8)	50 (0.9)	534 (3.1)	2 (3.3)		
Kazakhstan	49 (0.8)	546 (4.6)	51 (0.8)	543 (4.8)	2 (2.8)		
Morocco	48 (0.7)	378 (3.5)	52 (0.7)	377 (3.9)	1 (2.8)		
2 Sweden	49 (1.0)	519 (3.2)	51 (1.0)	518 (3.2)	1 (3.0)		
Russian Federation	49 (0.9)	564 (3.7)	51 (0.9)	564 (3.7)	1 (2.8)		
Japan	50 (0.5)	593 (2.0)	50 (0.5)	593 (2.5)	0 (2.3)		
Chile	49 (1.7)	458 (2.8)	51 (1.7)	459 (3.0)	1 (3.2)		
Poland	50 (0.8)	534 (2.3)	50 (0.8)	536 (2.7)	1 (2.5)		
Turkey	49 (0.6)	482 (3.2)	51 (0.6)	484 (3.5)	2 (2.7)		
‡ Northern Ireland	50 (1.1)	569 (3.8)	50 (1.1)	571 (3.1)	2 (3.8)		
New Zealand	49 (0.7)	489 (2.8)	51 (0.7)	492 (2.6)	2 (2.8)		
Germany	48 (0.7)	520 (2.4)	52 (0.7)	523 (2.3)	3 (2.3)		
Ireland, Rep. of	47 (1.5)	545 (2.6)	53 (1.5)	549 (2.9)	4 (3.4)		
Slovenia	49 (0.8)	518 (2.1)	51 (0.8)	522 (2.4)	4 (2.6)		
Chinese Taipei	49 (0.6)	594 (2.2)	51 (0.6)	599 (2.3)	6 (2.5)		
† Belgium (Flemish)	50 (0.9)	543 (2.4)	50 (0.9)	549 (2.4)	6 (2.4)		
Hungary	49 (0.9)	526 (3.4)	51 (0.9)	532 (3.8)	6 (3.4)		
France	49 (0.7)	485 (3.2)	51 (0.7)	491 (3.2)	6 (2.8)		
2 † Denmark	49 (0.8)	536 (3.1)	51 (0.8)	542 (3.0)	6 (2.8)		
England	51 (0.7)	543 (3.0)	49 (0.7)	549 (3.3)	6 (2.9)		
Cyprus	49 (0.7)	520 (2.9)	51 (0.7)	526 (3.1)	6 (2.7)		
2 † United States	51 (0.6)	536 (2.3)	49 (0.6)	543 (2.6)	7 (1.9)		
Czech Republic	49 (0.9)	525 (3.0)	51 (0.9)	532 (2.5)	7 (3.2)		
Korea, Rep. of	48 (0.5)	604 (2.3)	52 (0.5)	612 (2.5)	7 (1.9)		
† Netherlands	50 (0.9)	526 (1.8)	50 (0.9)	534 (2.2)	8 (2.2)		
Australia	49 (1.0)	513 (3.1)	51 (1.0)	522 (3.9)	9 (3.5)		
1 2 † Canada	49 (0.5)	506 (2.5)	51 (0.5)	515 (2.6)	9 (2.1)		
† Hong Kong SAR	46 (1.5)	609 (3.8)	54 (1.5)	619 (2.8)	10 (3.3)		
2 Portugal	49 (0.8)	536 (2.4)	51 (0.8)	547 (2.5)	11 (2.2)		
Slovak Republic	48 (0.9)	493 (3.0)	52 (0.9)	504 (2.6)	11 (2.6)		
2 Spain	49 (0.9)	499 (2.7)	51 (0.9)	511 (2.7)	12 (2.4)		
Croatia	49 (0.8)	496 (2.1)	51 (0.8)	508 (2.3)	12 (2.7)		
2 Italy	49 (0.7)	497 (2.7)	51 (0.7)	517 (3.0)	20 (2.7)		
International Avg.	49 (0.2)	505 (0.5)	51 (0.2)	505 (0.5)			

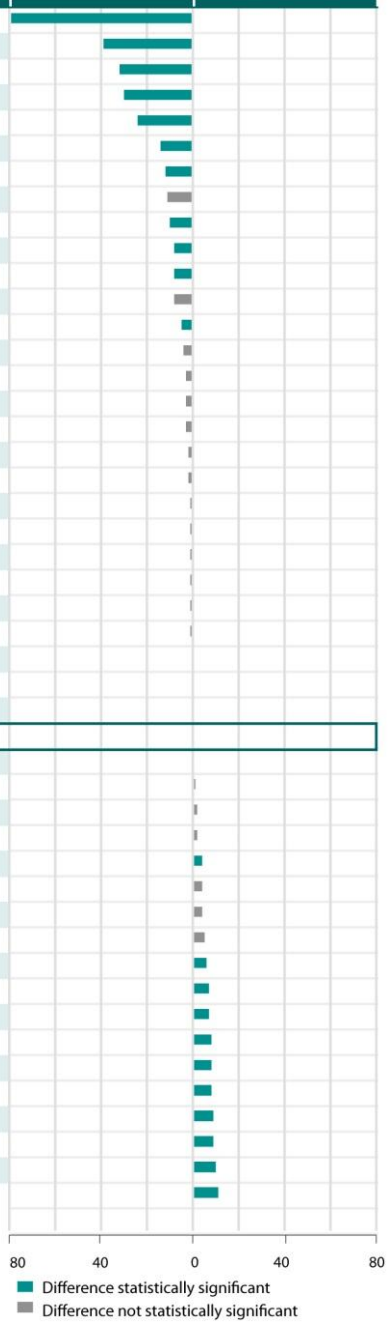


ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, ‡, and ǂ.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.10, International mathematics report (Mullis *et al.*, 2016a).

Table 2.2 TIMSS 2015 gender differences, science at ages 9-10

Country	Girls		Boys		Difference (Absolute Value)	Gender Difference
	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score		Girls Scored Higher / Boys Scored Higher
Saudi Arabia	49 (1.0)	431 (5.3)	51 (1.0)	352 (7.6)	79 (9.0)	
2 Bahrain	50 (0.8)	478 (3.0)	50 (0.8)	439 (3.5)	39 (4.0)	
Oman	50 (0.7)	447 (3.4)	50 (0.7)	415 (3.6)	32 (3.1)	
ψ Kuwait	51 (2.1)	352 (7.6)	49 (2.1)	322 (7.6)	30 (9.1)	
Qatar	51 (2.5)	448 (4.7)	49 (2.5)	424 (6.0)	24 (7.2)	
United Arab Emirates	48 (2.2)	459 (4.4)	52 (2.2)	444 (4.0)	14 (6.4)	
Finland	48 (0.8)	560 (2.3)	52 (0.8)	548 (2.9)	12 (2.5)	
Iran, Islamic Rep. of	49 (1.1)	427 (5.2)	51 (1.1)	415 (5.6)	11 (7.4)	
ψ Morocco	48 (0.8)	358 (4.7)	52 (0.8)	347 (5.7)	10 (4.9)	
Bulgaria	49 (0.8)	540 (6.3)	51 (0.8)	532 (5.9)	8 (2.9)	
2 Sweden	49 (1.0)	544 (4.1)	51 (1.0)	536 (3.5)	8 (2.7)	
Indonesia	48 (0.7)	401 (5.2)	52 (0.7)	393 (5.3)	8 (4.2)	
Kazakhstan	49 (0.8)	552 (4.5)	51 (0.8)	547 (4.7)	5 (2.7)	
1 Georgia	49 (0.9)	453 (3.9)	51 (0.9)	449 (4.6)	4 (4.1)	
New Zealand	49 (0.7)	507 (3.2)	51 (0.7)	504 (3.0)	3 (3.1)	
2 Lithuania	50 (0.9)	529 (2.9)	50 (0.9)	526 (3.1)	3 (3.4)	
3 Serbia	48 (0.8)	526 (3.6)	52 (0.8)	523 (4.9)	3 (4.6)	
1 2 † Canada	49 (0.5)	526 (2.8)	51 (0.5)	524 (3.0)	2 (2.2)	
† Belgium (Flemish)	50 (0.9)	512 (2.6)	50 (0.9)	511 (2.6)	2 (2.4)	
Poland	50 (0.8)	548 (2.5)	50 (0.8)	546 (3.0)	1 (2.8)	
Turkey	49 (0.6)	484 (3.3)	51 (0.6)	483 (4.0)	1 (3.1)	
† Netherlands	50 (0.9)	517 (2.8)	50 (0.9)	517 (3.0)	1 (2.4)	
Australia	49 (1.0)	524 (3.3)	51 (1.0)	523 (3.4)	1 (3.4)	
England	51 (0.7)	536 (3.0)	49 (0.7)	536 (2.6)	1 (2.8)	
Norway (5)	49 (0.9)	538 (3.1)	51 (0.9)	537 (3.1)	1 (3.2)	
2 Singapore	48 (0.5)	591 (3.7)	52 (0.5)	590 (4.2)	0 (2.8)	
Russian Federation	49 (0.9)	567 (3.1)	51 (0.9)	567 (3.7)	0 (2.7)	
France	49 (0.7)	487 (3.1)	51 (0.7)	487 (2.9)	0 (2.4)	
‡ Northern Ireland	50 (1.1)	520 (3.0)	50 (1.1)	520 (2.8)	0 (3.7)	
Cyprus	49 (0.7)	481 (2.8)	51 (0.7)	481 (2.9)	0 (2.6)	
Chile	49 (1.7)	477 (3.0)	51 (1.7)	478 (3.4)	1 (3.3)	
Germany	48 (0.7)	527 (2.7)	52 (0.7)	529 (2.6)	2 (2.3)	
Croatia	49 (0.8)	532 (2.7)	51 (0.8)	534 (2.2)	2 (2.8)	
2 † United States	51 (0.6)	544 (2.4)	49 (0.6)	548 (2.5)	4 (2.0)	
2 † Denmark	49 (0.8)	525 (2.5)	51 (0.8)	529 (2.6)	4 (2.8)	
Japan	50 (0.5)	567 (2.0)	50 (0.5)	571 (2.3)	4 (2.4)	
Ireland, Rep. of	47 (1.5)	526 (2.9)	53 (1.5)	531 (2.9)	5 (3.4)	
2 Spain	49 (0.9)	515 (2.9)	51 (0.9)	521 (2.9)	6 (2.7)	
Slovenia	49 (0.8)	539 (2.4)	51 (0.8)	546 (3.1)	7 (2.7)	
2 Portugal	49 (0.8)	504 (2.5)	51 (0.8)	512 (2.4)	7 (2.2)	
Hungary	49 (0.9)	538 (3.5)	51 (0.9)	546 (3.9)	8 (3.1)	
Czech Republic	49 (0.9)	530 (2.8)	51 (0.9)	538 (2.7)	8 (2.6)	
Slovak Republic	48 (0.9)	516 (3.2)	52 (0.9)	524 (2.7)	8 (2.7)	
Chinese Taipei	49 (0.6)	551 (2.2)	51 (0.6)	560 (2.4)	9 (2.9)	
2 Italy	49 (0.7)	512 (3.1)	51 (0.7)	521 (2.8)	9 (2.5)	
† Hong Kong SAR	46 (1.5)	551 (3.9)	54 (1.5)	561 (3.3)	10 (3.9)	
Korea, Rep. of	48 (0.5)	584 (2.3)	52 (0.5)	595 (2.3)	11 (2.4)	
International Avg.	49 (0.1)	508 (0.5)	51 (0.1)	504 (0.6)		



ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, ‡, and ǂ.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.10, International science report (Martin *et al.*, 2016a).

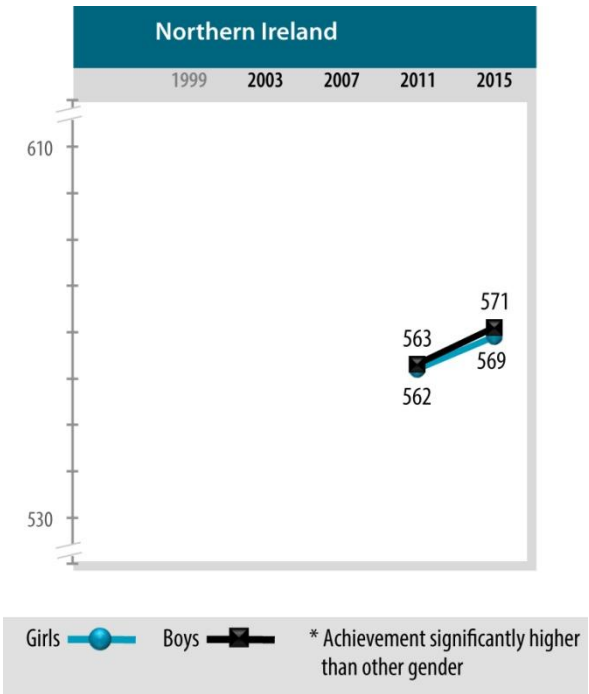
2.1.1 Gender differences in mathematics attainment

Northern Ireland is near the middle of Table 2.1, with no significant gender difference in mathematics attainment in Y6. Boys in Northern Ireland scored an average of 571 for mathematics and girls an average of 569.

Of the 50[12] participating countries, just over half (26 countries) had a significant gender difference. In eight countries this gender difference favoured girls, while in the remaining 18 countries it favoured boys. Northern Ireland was one of 23 countries showing no overall gender difference for mathematics attainment at this age, including Poland, the Republic of Ireland and the high performers of Japan and Singapore. In contrast, England, Australia and the high performers of Hong Kong, Korea and Chinese Taipei all had significant gender differences for mathematics attainment, favouring boys; in contrast, Finland had a significant gender difference favouring girls.

There has been no change in the gender difference in Y6 maths attainment in Northern Ireland since 2011, as shown in Figure 2.1 below. Consistent with the 2011 results, in 2015 there was no statistically significant difference in the mathematics score for boys (571) and the score for girls (569).

Figure 2.1 Trends in mathematics achievement by gender



Source: Exhibit 1.12, International mathematics report (Mullis *et al.*, 2016a).

[12] Armenia administered the Grade 4 assessment but no data is available, therefore data from 49 countries is available for comparison.

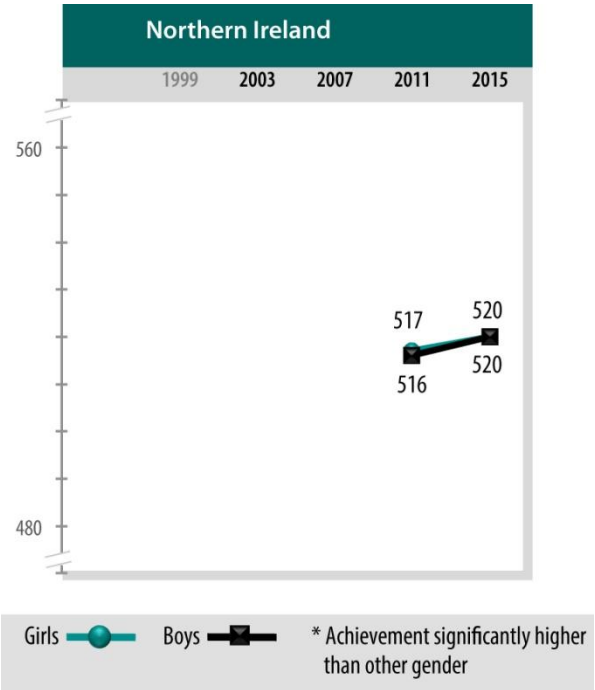
2.1.2 Gender differences in science attainment

Northern Ireland also has no significant gender difference in science attainment in Y6 (see Table 2.2). The average scale score for both boys and girls in science was 520. Just under half of the participating countries (22 of 47) showed a significant gender difference for science. Unlike mathematics, where more countries had a significant gender difference favouring boys, in science the number of countries with a gender difference favouring boys and the number of countries with a gender difference favouring girls was the same (11 in each case).

Northern Ireland was one of 25 countries showing no significant overall gender difference for science at this age. The other countries included Australia, the Republic of Ireland, England, Poland and the highest scorer Singapore. By contrast, the high performers of Hong Kong, Korea and Chinese Taipei all had a gender difference for science attainment in favour of boys, just as they had for mathematics. As was the case for mathematics, Finland has a gender difference for science attainment in favour of girls.

As shown in Figure 2.2, there has been no change in the gender difference in science attainment in Northern Ireland between 2011 and 2015. In both 2011 and 2015 there were no statistically significant differences in the science scores for girls and boys in Northern Ireland. In 2011, the girls' score of 517 compared with a score of 516 for boys; in 2015 the score for both boys and girls was 520.

Figure 2.2 Trends in science achievement by gender



Source: Exhibit 1.12, International science report (Martin *et al.*, 2016a).

2.2 Conclusion

Northern Ireland's high attainment in mathematics at ages 9-10 is achieved through equally high performance from girls and boys and, although overall performance in science is weaker, once again both girls and boys contribute equally to that attainment.

In addition, this equality of attainment in mathematics and science between boys and girls first seen in TIMSS 2011 has remained in TIMSS 2015.

3 Distribution of attainment in TIMSS 2015

Chapter outline

This chapter outlines the distribution of attainment in mathematics and science in Northern Ireland in Year 6 (Y6, ages 9-10) in TIMSS 2015. It describes the TIMSS 'benchmarks' of attainment and the proportions of Northern Ireland pupils reaching each benchmark, and provides examples of questions at each of the benchmarks.

In addition, the chapter shows the score distributions for mathematics and science for Northern Ireland and the subset of seven main comparator countries (Australia, England, Finland, Hong Kong, Poland, the Republic of Ireland and Singapore).

Key findings

- Over a quarter of pupils in Northern Ireland reached the 'Advanced International Benchmark' in mathematics, the sixth highest percentage internationally.
- Only 5 per cent of Northern Ireland's pupils reached the Advanced International Benchmark for science.
- For mathematics and science respectively, 3 per cent and 5 per cent failed to reach the 'Low International Benchmark'. In the countries performing better than Northern Ireland, the equivalent figures were 0 to 1 per cent for mathematics, and 0 to 10 per cent for science.
- For mathematics, there was a significant[13] increase in the percentage of pupils in Northern Ireland reaching the Advanced International Benchmark in TIMSS 2015 compared with 2011 (27 per cent in 2015; 24 per cent in 2011).
- For science, the distribution of attainment across the International Benchmarks has remained stable since 2011.
- In Northern Ireland there was a relatively wide spread of attainment for mathematics, whereas for science the difference between the scores of the highest and lowest attainers was smaller.

3.1 Distribution of attainment in TIMSS

In TIMSS, achievement outcomes for each country are reported as an average scale score, as outlined in Chapter 1. In addition to knowing how well pupils in Northern Ireland performed overall (Chapter 1) and across the different content and cognitive domains assessed in TIMSS (see Chapter 4), it is also important, for the purposes of teaching and learning, to examine the spread in performance between the highest and lowest achievers. Amongst countries with similar mean scores there may be differences in the numbers of high- and low-scoring pupils (the highest and lowest attainers). A country with a wide spread

[13] Throughout this report, the term 'significant' refers to statistical significance.

of attainment may have large proportions of pupils who are underachieving as well as pupils performing at the highest levels. A country with a lower spread of attainment may have fewer very high achievers but may also have fewer underachievers.

The first way of examining the spread of attainment is by looking at Northern Ireland's performance at each of the TIMSS 'International Benchmarks' (that is, the levels of attainment within the overall achievement).

Tables 3.1 and 3.2 below summarise the International Benchmarks for mathematics and science respectively.

Interpreting the data: International Benchmarks

The TIMSS achievement scale summarises pupil performance on a scale with a centre point of 500 and a standard deviation of 100, and reports achievement at four points along the scale as 'International Benchmarks'. The Advanced International Benchmark is set at a scale score of 625, the High International Benchmark at 550, the Intermediate International Benchmark at 475, and the Low International Benchmark at 400. The benchmark descriptions summarise what pupils scoring at the TIMSS International Benchmark typically know and can do in the target subject.

Table 3.1 Summary of International Benchmarks for mathematics, Y6

625	**Advanced International Benchmark**	●
	Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning. They can solve a variety of multi-step word problems involving whole numbers. Students at this level show an increasing understanding of fractions and decimals. They can apply knowledge of a range of two- and three-dimensional shapes in a variety of situations. They can interpret and represent data to solve multi-step problems.	
550	**High International Benchmark**	○
	Students can apply their knowledge and understanding to solve problems. They can solve word problems involving operations with whole numbers, simple fractions, and two-place decimals. Students demonstrate understanding of geometric properties of shapes and of angles that are less than or greater than a right angle. Students can interpret and use data in tables and a variety of graphs to solve problems.	
475	**Intermediate International Benchmark**	●
	Students can apply basic mathematical knowledge in simple situations. They demonstrate an understanding of whole numbers and some understanding of fractions and decimals. Students can relate two- and three-dimensional shapes and identify and draw shapes with simple properties. They can read and interpret bar graphs and tables.	
400	**Low International Benchmark**	○
	Students have some basic mathematical knowledge. They can add and subtract whole numbers, have some understanding of multiplication by one-digit numbers, and can solve simple word problems. They have some knowledge of simple fractions, geometric shapes, and measurement. Students can read and complete simple bar graphs and tables.	

Source: Exhibit 2.1, international mathematics report (Mullis et al., 2016a).

Table 3.2 Summary of International Benchmarks for science, Y6

625 Advanced International Benchmark

Students communicate understanding of life, physical, and Earth sciences and demonstrate some knowledge of the process of scientific inquiry. Students demonstrate knowledge of characteristics and life processes of a variety of organisms, communicate understanding of relationships in ecosystems and interactions between organisms and their environment, and communicate and apply knowledge of factors related to human health. They communicate understanding of properties and states of matter and physical and chemical changes, apply some knowledge of forms of energy and energy transfer, and show some knowledge of forces and an understanding of their effect on motion. Students communicate understanding of Earth's structure, physical characteristics, processes, and history and show knowledge of Earth's revolution and rotation. Students demonstrate basic knowledge and skills related to scientific inquiry, recognizing how a simple experiment should be set up, interpreting the results of an investigation, reasoning and drawing conclusions from descriptions and diagrams, and evaluating and supporting an argument.

550 High International Benchmark

Students communicate and apply knowledge of the life, physical, and Earth sciences in everyday and abstract contexts. Students communicate knowledge of characteristics of plants, animals, and their life cycles, and apply knowledge of ecosystems and of humans' and organisms' interactions with their environment. Students communicate and apply knowledge of states and properties of matter, and of energy transfer in practical contexts, as well as showing some understanding of forces and motion. Students apply knowledge of Earth's structure, physical characteristics, processes, and history and show basic understanding of the Earth-Moon-Sun system. Students compare, contrast, and make simple inferences using models, diagrams, and descriptions of investigations, and provide brief descriptive responses using science concepts, both in everyday and abstract contexts.

475 Intermediate International Benchmark

Students show basic knowledge and understanding of life, physical, and Earth sciences. Students demonstrate some knowledge of life processes of plants and humans, communicate and apply knowledge of the interaction of living things with their environments as well as impacts humans can have on their environment, and communicate knowledge of basic facts related to human health. They apply knowledge about some properties of matter and about some facts related to electricity and to energy transfer, and apply elementary knowledge of forces and motion. They show some understanding of Earth's physical characteristics and demonstrate some basic knowledge of Earth in the solar system. Students interpret information in diagrams, apply factual knowledge to everyday situations, and provide simple explanations for biological and physical phenomena.

400 Low International Benchmark

Students show basic knowledge of life and physical sciences. Students demonstrate some basic knowledge of behavioral and physical characteristics of plants and animals as well as of the interaction of living things with their environments, and apply knowledge of some facts related to human health. Students show basic knowledge of states of matter and physical properties of matter. They interpret simple diagrams, complete simple tables, and provide short, fact-based written responses.

Source: Exhibit 2.1, international science report (Martin et al., 2016a).

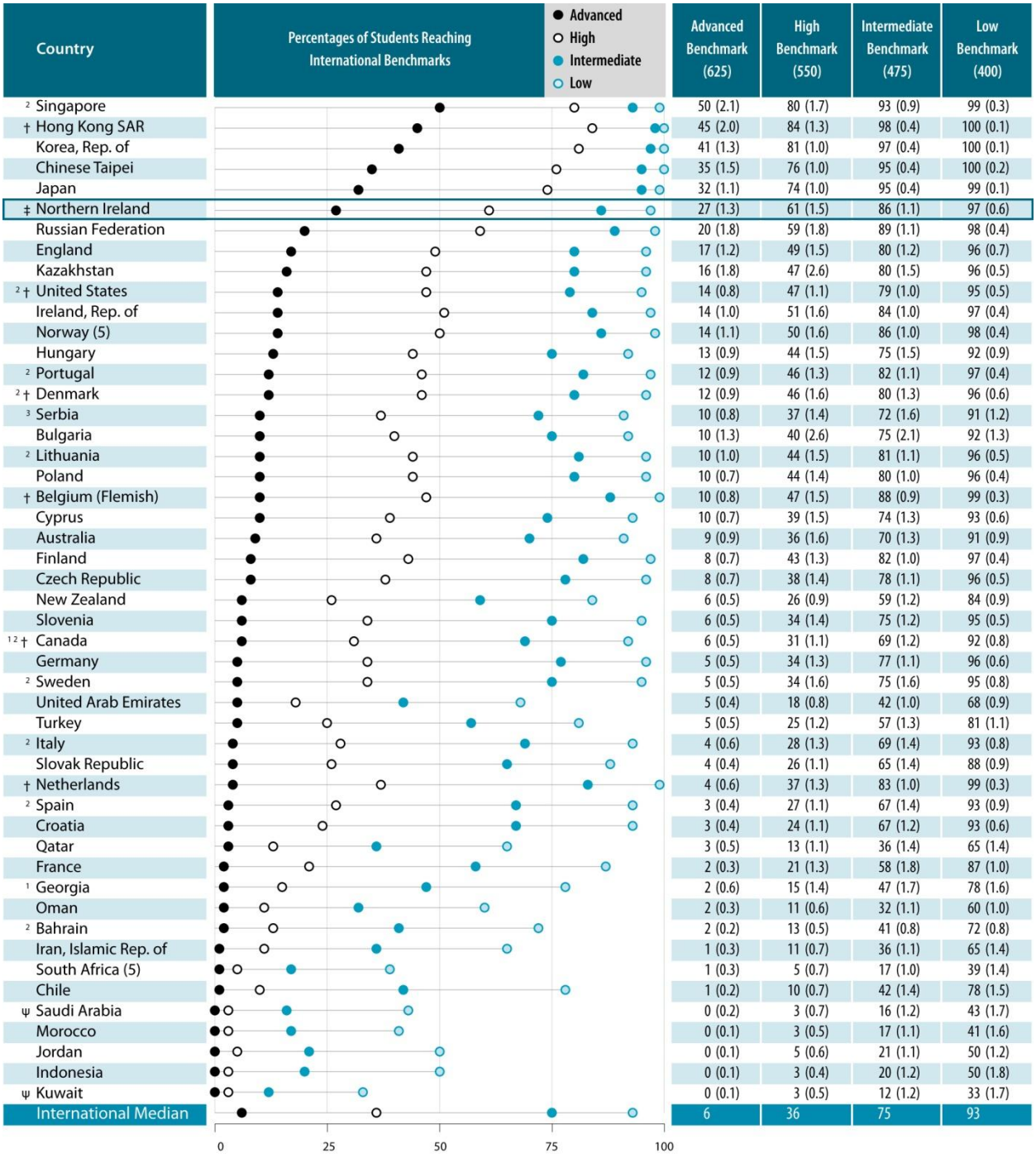
Further detail about each benchmark is given in the relevant international report (Mullis *et al.*, 2016a (mathematics); Martin *et al.*, 2016a (science)).

Tables 3.3 and 3.4 show the percentage of pupils reaching each benchmark for mathematics and science in Northern Ireland. The outcomes for Northern Ireland are then discussed for each subject in turn.

Interpreting the data: performance at the International Benchmarks

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

Table 3.3 Percentages reaching each benchmark for mathematics, Y6



Country	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
[2] Singapore	50 (2.1)	80 (1.7)	93 (0.9)	99 (0.3)
† Hong Kong SAR	45 (2.0)	84 (1.3)	98 (0.4)	100 (0.1)
Korea, Rep. of	41 (1.3)	81 (1.0)	97 (0.4)	100 (0.1)
Chinese Taipei	35 (1.5)	76 (1.0)	95 (0.4)	100 (0.2)
Japan	32 (1.1)	74 (1.0)	95 (0.4)	99 (0.1)
‡ Northern Ireland	27 (1.3)	61 (1.5)	86 (1.1)	97 (0.6)
Russian Federation	20 (1.8)	59 (1.8)	89 (1.1)	98 (0.4)
England	17 (1.2)	49 (1.5)	80 (1.2)	96 (0.7)
Kazakhstan	16 (1.8)	47 (2.6)	80 (1.5)	96 (0.5)
[2] † United States	14 (0.8)	47 (1.1)	79 (1.0)	95 (0.5)
Ireland, Rep. of	14 (1.0)	51 (1.6)	84 (1.0)	97 (0.4)
Norway (5)	14 (1.1)	50 (1.6)	86 (1.0)	98 (0.4)
Hungary	13 (0.9)	44 (1.5)	75 (1.5)	92 (0.9)
[2] Portugal	12 (0.9)	46 (1.3)	82 (1.1)	97 (0.4)
[2] † Denmark	12 (0.9)	46 (1.6)	80 (1.3)	96 (0.6)
[3] Serbia	10 (0.8)	37 (1.4)	72 (1.6)	91 (1.2)
Bulgaria	10 (1.3)	40 (2.6)	75 (2.1)	92 (1.3)
[2] Lithuania	10 (1.0)	44 (1.5)	81 (1.1)	96 (0.5)
Poland	10 (0.7)	44 (1.4)	80 (1.0)	96 (0.4)
† Belgium (Flemish)	10 (0.8)	47 (1.5)	88 (0.9)	99 (0.3)
Cyprus	10 (0.7)	39 (1.5)	74 (1.3)	93 (0.6)
Australia	9 (0.9)	36 (1.6)	70 (1.3)	91 (0.9)
Finland	8 (0.7)	43 (1.3)	82 (1.0)	97 (0.4)
Czech Republic	8 (0.7)	38 (1.4)	78 (1.1)	96 (0.5)
New Zealand	6 (0.5)	26 (0.9)	59 (1.2)	84 (0.9)
Slovenia	6 (0.5)	34 (1.4)	75 (1.2)	95 (0.5)
[1 2] † Canada	6 (0.5)	31 (1.1)	69 (1.2)	92 (0.8)
Germany	5 (0.5)	34 (1.3)	77 (1.1)	96 (0.6)
[2] Sweden	5 (0.5)	34 (1.6)	75 (1.6)	95 (0.8)
United Arab Emirates	5 (0.4)	18 (0.8)	42 (1.0)	68 (0.9)
Turkey	5 (0.5)	25 (1.2)	57 (1.3)	81 (1.1)
[2] Italy	4 (0.6)	28 (1.3)	69 (1.4)	93 (0.8)
Slovak Republic	4 (0.4)	26 (1.1)	65 (1.4)	88 (0.9)
† Netherlands	4 (0.6)	37 (1.3)	83 (1.0)	99 (0.3)
[2] Spain	3 (0.4)	27 (1.1)	67 (1.4)	93 (0.9)
Croatia	3 (0.4)	24 (1.1)	67 (1.2)	93 (0.6)
Qatar	3 (0.5)	13 (1.1)	36 (1.4)	65 (1.4)
France	2 (0.3)	21 (1.3)	58 (1.8)	87 (1.0)
[1] Georgia	2 (0.6)	15 (1.4)	47 (1.7)	78 (1.6)
Oman	2 (0.3)	11 (0.6)	32 (1.1)	60 (1.0)
[2] Bahrain	2 (0.2)	13 (0.5)	41 (0.8)	72 (0.8)
Iran, Islamic Rep. of	1 (0.3)	11 (0.7)	36 (1.1)	65 (1.4)
South Africa (5)	1 (0.3)	5 (0.7)	17 (1.0)	39 (1.4)
Chile	1 (0.2)	10 (0.7)	42 (1.4)	78 (1.5)
ψ Saudi Arabia	0 (0.2)	3 (0.7)	16 (1.2)	43 (1.7)
Morocco	0 (0.1)	3 (0.5)	17 (1.1)	41 (1.6)
Jordan	0 (0.1)	5 (0.6)	21 (1.1)	50 (1.2)
Indonesia	0 (0.1)	3 (0.4)	20 (1.2)	50 (1.8)
ψ Kuwait	0 (0.1)	3 (0.5)	12 (1.2)	33 (1.7)
International Median	6	36	75	93

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

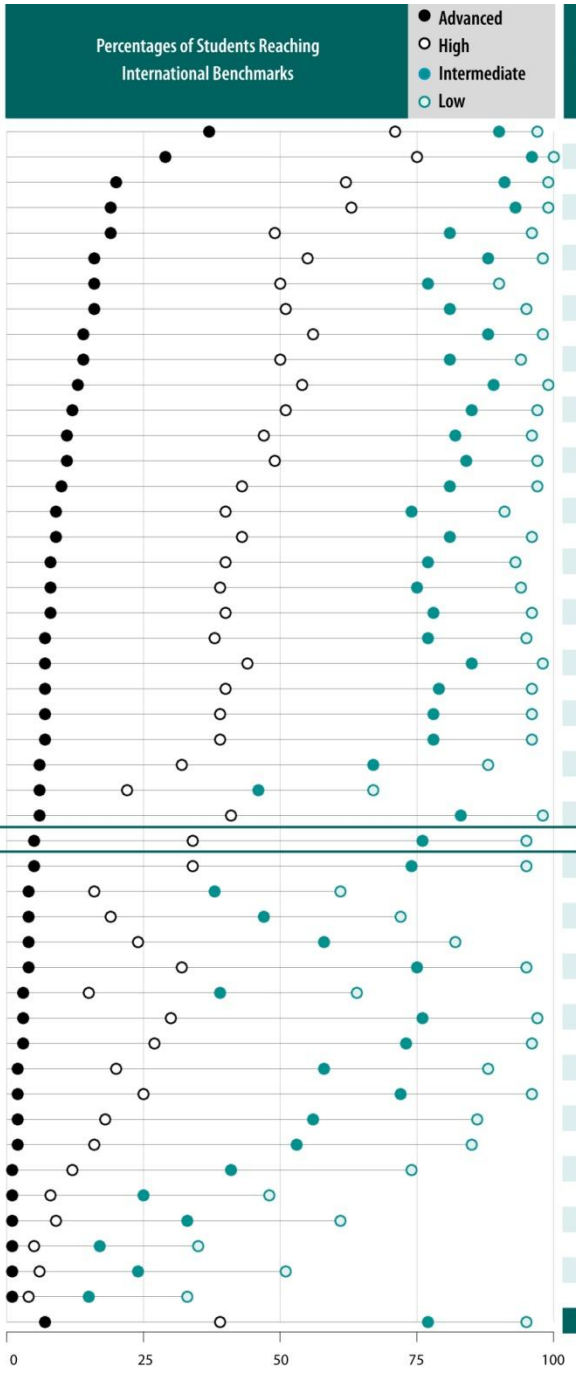
See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, ‡, and ǂ.

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

Source: Exhibit 2.2, international mathematics report (Mullis *et al.*, 2016a).

Table 3.4 Percentages reaching each benchmark for science, Y6

Country	Percentages of Students Reaching International Benchmarks (Advanced, High, Intermediate, Low)	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
² Singapore		37 (2.0)	71 (1.8)	90 (1.1)	97 (0.5)
Korea, Rep. of		29 (1.6)	75 (1.1)	96 (0.5)	100 (0.1)
Russian Federation		20 (1.5)	62 (2.0)	91 (1.0)	99 (0.3)
Japan		19 (0.9)	63 (1.3)	93 (0.5)	99 (0.2)
Kazakhstan		19 (1.7)	49 (2.5)	81 (1.4)	96 (0.6)
† Hong Kong SAR		16 (1.2)	55 (1.8)	88 (1.1)	98 (0.4)
Bulgaria		16 (1.5)	50 (2.5)	77 (2.2)	90 (1.5)
²† United States		16 (0.8)	51 (1.1)	81 (0.9)	95 (0.5)
Chinese Taipei		14 (0.7)	56 (1.2)	88 (0.8)	98 (0.3)
Hungary		14 (1.1)	50 (1.5)	81 (1.6)	94 (0.9)
Finland		13 (0.9)	54 (1.4)	89 (0.9)	99 (0.4)
Poland		12 (0.9)	51 (1.4)	85 (1.3)	97 (0.4)
² Sweden		11 (1.1)	47 (2.1)	82 (1.5)	96 (0.8)
Slovenia		11 (0.9)	49 (1.4)	84 (1.0)	97 (0.5)
England		10 (0.8)	43 (1.5)	81 (1.2)	97 (0.5)
Slovak Republic		9 (0.6)	40 (1.4)	74 (1.2)	91 (0.8)
Czech Republic		9 (0.7)	43 (1.4)	81 (1.1)	96 (0.6)
³ Serbia		8 (0.7)	40 (1.5)	77 (1.7)	93 (1.1)
Australia		8 (0.7)	39 (1.6)	75 (1.4)	94 (0.8)
Germany		8 (0.6)	40 (1.7)	78 (1.3)	96 (0.6)
¹²† Canada		7 (0.5)	38 (1.2)	77 (1.4)	95 (0.7)
Norway (5)		7 (0.9)	44 (1.8)	85 (1.1)	98 (0.6)
Ireland, Rep. of		7 (0.9)	40 (1.6)	79 (1.2)	96 (0.6)
² Lithuania		7 (0.8)	39 (1.6)	78 (1.2)	96 (0.5)
²† Denmark		7 (0.6)	39 (1.5)	78 (1.3)	96 (0.5)
New Zealand		6 (0.6)	32 (1.1)	67 (1.4)	88 (0.9)
United Arab Emirates		6 (0.4)	22 (0.9)	46 (1.0)	67 (0.9)
Croatia		6 (0.7)	41 (1.3)	83 (1.1)	98 (0.4)
‡ Northern Ireland		5 (0.6)	34 (1.3)	76 (1.3)	95 (0.6)
² Spain		5 (0.5)	34 (1.3)	74 (1.6)	95 (0.7)
Oman		4 (0.4)	16 (0.8)	38 (1.2)	61 (1.0)
² Bahrain		4 (0.4)	19 (0.9)	47 (1.2)	72 (1.0)
Turkey		4 (0.5)	24 (1.1)	58 (1.4)	82 (1.2)
² Italy		4 (0.5)	32 (1.5)	75 (1.7)	95 (0.7)
Qatar		3 (0.5)	15 (1.2)	39 (1.7)	64 (1.6)
† Netherlands		3 (0.4)	30 (1.5)	76 (1.4)	97 (0.6)
† Belgium (Flemish)		3 (0.4)	27 (1.5)	73 (1.4)	96 (0.6)
France		2 (0.3)	20 (1.2)	58 (1.6)	88 (1.1)
² Portugal		2 (0.3)	25 (1.2)	72 (1.5)	96 (0.6)
Cyprus		2 (0.3)	18 (1.1)	56 (1.4)	86 (1.0)
Chile		2 (0.2)	16 (1.2)	53 (1.5)	85 (1.2)
¹ Georgia		1 (0.6)	12 (1.3)	41 (1.7)	74 (1.7)
Saudi Arabia		1 (0.3)	8 (0.9)	25 (1.4)	48 (1.8)
Iran, Islamic Rep. of		1 (0.3)	9 (0.8)	33 (1.5)	61 (1.7)
ψ Morocco		1 (0.3)	5 (0.7)	17 (1.3)	35 (1.8)
Indonesia		1 (0.2)	6 (0.7)	24 (1.8)	51 (2.1)
ψ Kuwait		1 (0.2)	4 (0.6)	15 (1.4)	33 (1.9)
International Median		7	39	77	95



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

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, ‡, and ǂ.

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

Source: Exhibit 2.2, international science report (Martin *et al.*, 2016a).

3.1.1 Distribution in mathematics attainment: TIMSS 2015 International Benchmarks

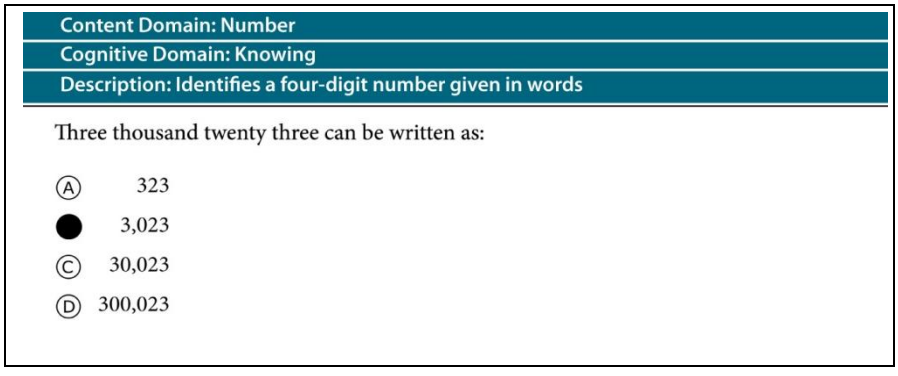
In Northern Ireland, 27 per cent of Y6 pupils reached the Advanced International Benchmark in mathematics, with a further 34 per cent reaching the High International Benchmark (i.e. 61 per cent in total reaching at least the High International Benchmark). This compared with 76 to 80 per cent reaching at least the High International Benchmark in the highest scoring Pacific Rim countries. The country with the most pupils reaching the Advanced International Benchmark was Singapore, with 50 per cent reaching that level in mathematics.

Compared with 2011 there has been a significant increase in the percentage of pupils in Northern Ireland reaching the Advanced International Benchmark (in 2011, this was 24 per cent). Among the subset of main comparator countries, Singapore, Hong Kong and the Republic of Ireland also had a significant increase in the percentage of pupils reaching this International Benchmark (an increase of 7 per cent, 8 per cent and 5 per cent respectively). In Finland on the other hand, the percentage of pupils reaching the Advanced International Benchmark has decreased significantly since 2011 from 12 to 8 per cent.

At the other end of the scale, 97 per cent of pupils in Northern Ireland reached at least the Low International Benchmark for Y6 mathematics, with 3 per cent achieving below that level. In the five countries performing better than Northern Ireland, 99 or 100 per cent of pupils reached at least the Low International Benchmark. This closely mirrors the findings from 2011.

Figures 3.1 to 3.4 below provide examples of mathematics items from TIMSS 2015 at each of the International Benchmarks. These items cover a range of the mathematics content and cognitive domains. Chapter 4 provides more information.

Figure 3.1 Example mathematics item – Low International Benchmark



Source: Exhibit 2.4.1, international mathematics report (Mullis *et al.*, 2016a).

Figure 3.2 Example mathematics item – Intermediate International Benchmark

Content Domain: Data Display
Cognitive Domain: Applying
Description: Reads data from a table

The table below shows the sizes of large snakes.

Type of snake	Weight (kilograms)	Length (meters)
Boa Constrictor	27	4
Burmese Python	90	5 to 7
Green Anaconda	227	6 to 9
King Cobra	9	4

A. James saw a snake that was 8 meters long. Which type of snake could it be?

Answer: Green Anaconda

B. Naima saw a snake that was 6 meters long and weighed about 80 kilograms. Which type of snake could it be?

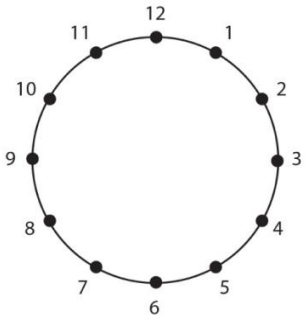
Answer: Burmese Python

Source: Exhibit 2.5.4, international mathematics report (Mullis *et al.*, 2016a).

Figure 3.3 Example mathematics item – High International Benchmark

Content Domain: Geometric Shapes and Measures
Cognitive Domain: Reasoning
Description: Draws a specified geometric shape by connecting dots on a circle

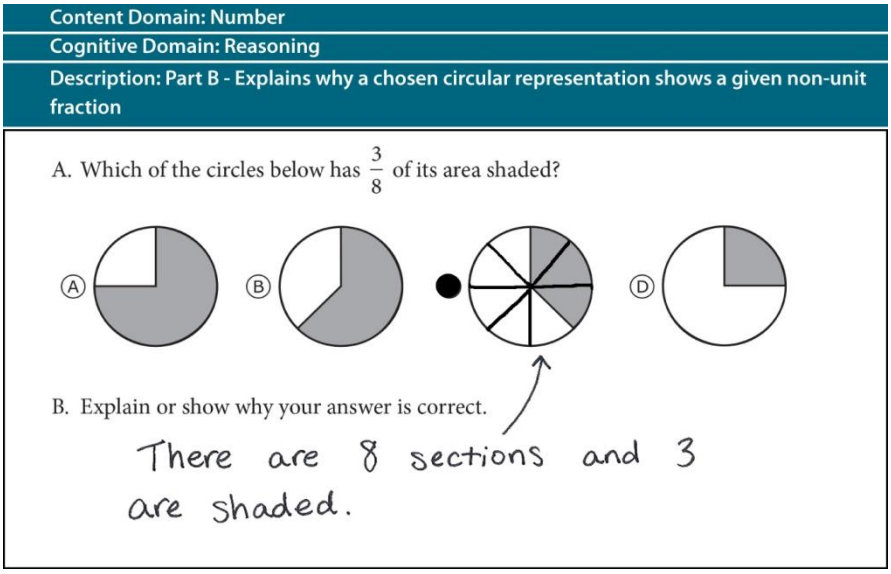
In the circle, draw a triangle with all sides the same length.



What points did you connect? 12, 4, 8, 12

Source: Exhibit 2.6.3, international mathematics report (Mullis *et al.*, 2016a).

Figure 3.4 Example mathematics item – Advanced International Benchmark



Source: Exhibit 2.7.2, international mathematics report (Mullis *et al.*, 2016a).

3.1.2 Distribution in science attainment: TIMSS 2015 International Benchmarks

For Y6 science, 5 per cent of pupils in Northern Ireland reached the Advanced International Benchmark, with a further 29 per cent achieving the High International Benchmark (making a total of 34 per cent reaching at least the High International Benchmark). This distribution of attainment at the highest International Benchmarks is similar to that achieved by Northern Ireland pupils in 2011.

Among the three highest scoring countries, the percentage reaching at least the High International Benchmark ranged from 62 to 75 per cent. The country with the most pupils reaching the Advanced International Benchmark was, again, Singapore, with 37 per cent reaching that level in science. All seven comparator countries had a higher percentage of pupils reaching the Advanced International Benchmark than Northern Ireland. This ranged from 37 to 7 per cent.

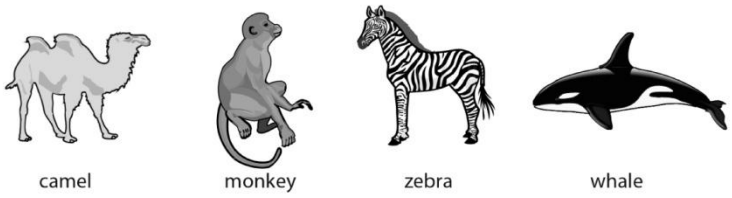
For science, 95 per cent of pupils in Northern Ireland reached at least the Low International Benchmark for Y6, with 5 per cent achieving below that level. Again, this was similar to the distribution in 2011. Among the three highest performers, the comparable percentages reaching at least the Low International Benchmark were 97 to 100 per cent. Compared with Northern Ireland, Australia was the only country among the subset of main comparator countries with a higher percentage of pupils failing to reach the Low International Benchmark.

Figures 3.5 to 3.8 below provide examples of science items from TIMSS 2015 at each of the International Benchmarks. These items cover a range of the science content and cognitive domains. Chapter 4 provides more information on this.

Figure 3.5 Example science item – Low International Benchmark

Content Domain: Life Science
Cognitive Domain: Knowing
Description: Completes a table by matching diagrams of animals to their ecosystems

The pictures below show four animals.



camel monkey zebra whale

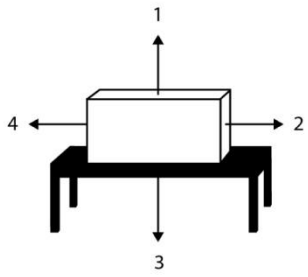
In the table below, write the name of the animal beside the ecosystem in which it is most likely to be found.

Ecosystem	Name of Animal
Tropical rain forest	monkey
Desert	camel
Ocean	whale
Grassland	zebra

Source: Exhibit 2.4.2, international science report (Martin *et al.*, 2016a).

Figure 3.6 Example science item – Intermediate International Benchmark

Content Domain: Physical Science
Cognitive Domain: Applying
Description: Identifies the direction of the force of Earth's gravity in a diagram



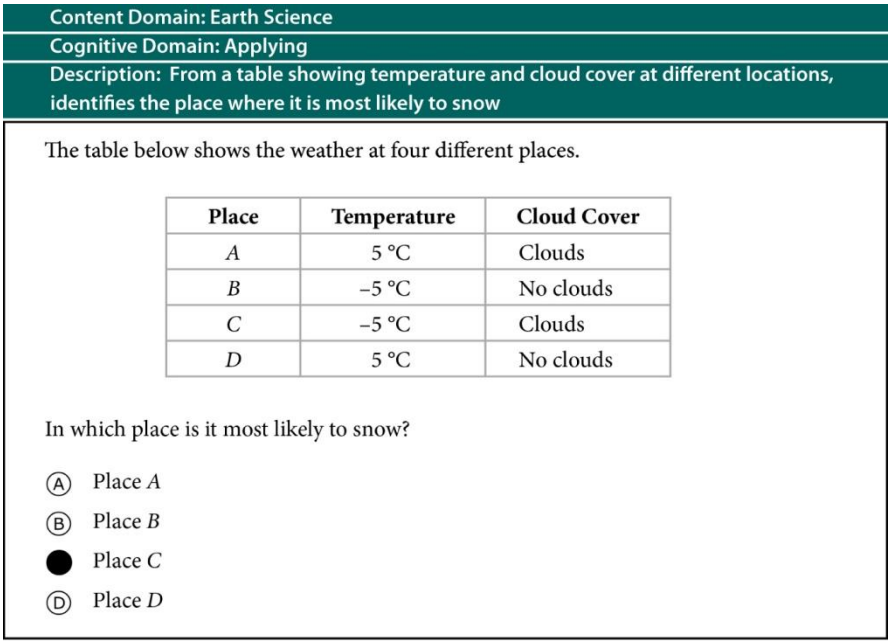
Look at the block on the table.

Which arrow shows the direction of the force of Earth's gravity?

Ⓐ 1
Ⓑ 2
● 3
Ⓓ 4

Source: Exhibit 2.5.3, international science report (Martin *et al.*, 2016a).

Figure 3.7 Example science item – High International Benchmark



Content Domain: Earth Science
Cognitive Domain: Applying
Description: From a table showing temperature and cloud cover at different locations, identifies the place where it is most likely to snow

The table below shows the weather at four different places.

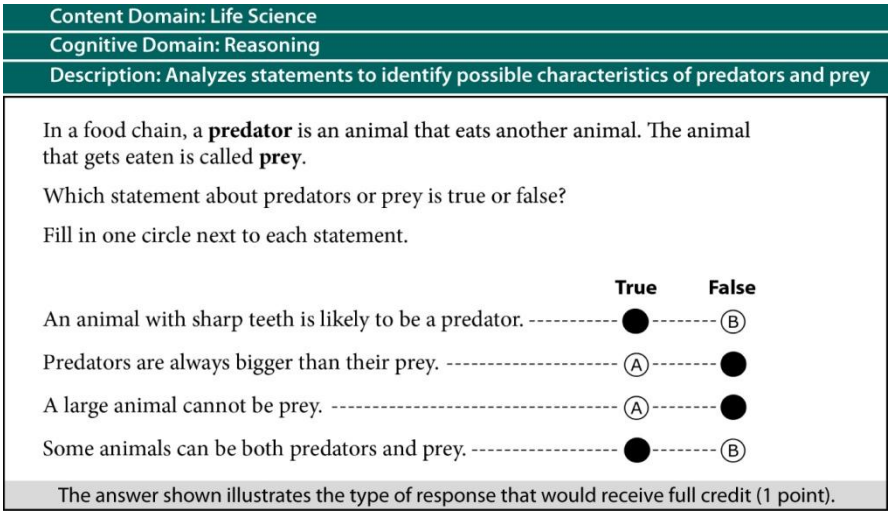
Place	Temperature	Cloud Cover
A	5 °C	Clouds
B	−5 °C	No clouds
C	−5 °C	Clouds
D	5 °C	No clouds

In which place is it most likely to snow?

Ⓐ Place *A*
Ⓑ Place *B*
● Place *C*
Ⓓ Place *D*

Source: Exhibit 2.5.5, international science report (Martin *et al.*, 2016a).

Figure 3.8 Example science item – Advanced International Benchmark



Content Domain: Life Science
Cognitive Domain: Reasoning
Description: Analyzes statements to identify possible characteristics of predators and prey

In a food chain, a **predator** is an animal that eats another animal. The animal that gets eaten is called **prey**.

Which statement about predators or prey is true or false?

Fill in one circle next to each statement.

	True	False
An animal with sharp teeth is likely to be a predator.	●	Ⓑ
Predators are always bigger than their prey.	Ⓐ	●
A large animal cannot be prey.	Ⓐ	●
Some animals can be both predators and prey.	●	Ⓑ

The answer shown illustrates the type of response that would receive full credit (1 point).

Source: Exhibit 2.7.1, international science report (Martin *et al.*, 2016a).

3.1.3 Distribution in mathematics attainment: score distribution

The second way in which the spread of performance can be examined is by looking at the distribution of TIMSS scale scores. Table 1.3 in Chapter 1 shows the TIMSS mathematics scores achieved by pupils at different percentiles. The 5th percentile is the score at which 5 per cent of pupils score lower, while the 95th percentile is the score at which 5 per cent score higher. The difference between the highest and lowest attainers at the 5th and 95th percentiles is a better measure of the spread of scores for comparing countries than using the lowest and highest scoring pupils, as the latter comparison may be affected by a small

number of pupils in a country with unusually high or low scores. Comparison of the 5th and the 95th percentiles gives a better indication of the typical spread of attainment.

The score of pupils in mathematics in Northern Ireland at the 5th percentile was 420, while the score at the 95th percentile was 702; a difference of 282 score points. Table 3.5 shows the difference for mathematics between the highest and lowest attaining pupils (95th percentile – 5th percentile) in Northern Ireland and the seven comparator countries. Among these countries only Singapore had a wider score distribution than Northern Ireland, with a difference of 288 score points between the highest and lowest attainers. Of the comparator countries, Hong Kong and Finland had the narrowest gaps between the highest and lowest attainers at 216 and 218 respectively.

Table 3.5 Y6 mathematics score difference between the highest and lowest attainers

Country	Y6 mathematics scale score	
	Average scale score	Range[1]
Singapore	618	288
Hong Kong	615	216
Republic of Ireland	547	239
England	546	275
Finland	535	218
Poland	535	234
Australia	517	275
Northern Ireland	**570**	**282**

[1] Difference between the highest and lowest attaining pupils (95th percentile – 5th percentile)

3.1.4 Distribution in science attainment: score distribution

As mentioned above, comparing the TIMSS scores at the 5th and the 95th percentiles gives a better indication of the typical spread of attainment. Table 1.4 in Chapter 1 shows the TIMSS science scores achieved by pupils at different percentiles.

The science score of pupils in Northern Ireland at the 5th percentile was 397, while the score of those at the 95th percentile was 627; a difference of 230 score points. This is a much narrower score distribution than that seen in mathematics. Table 3.6 shows the difference between the highest and lowest attaining pupils in science (95th percentile – 5th percentile) in Northern Ireland and the seven comparator countries. Three of these countries - England, the Republic of Ireland and Hong Kong had the same score distribution as Northern Ireland. As with mathematics, Singapore had the widest score distribution with a difference of 282 score points, followed by Australia (250 score points).

Table 3.6 Y6 science score difference between the highest and lowest attainers

Country	Y6 science scale score	
	Average scale score	Range[1]
Singapore	591	282
Hong Kong	557	230
Finland	554	209
Poland	547	225
England	536	230
Republic of Ireland	529	230
Australia	524	250
Northern Ireland	**520**	**230**

[1] Difference between the highest and lowest attaining pupils (95th percentile – 5th percentile)

3.2 Conclusion

Patterns in Northern Ireland's attainment in mathematics and science overall are reflected in the patterns of distribution of attainment: just as pupils scored better in mathematics than in science, so more pupils reached at least the High International Benchmark in mathematics than in science. Correspondingly, the 'tail' of low performance for each subject is relatively small, but marginally greater in science than for mathematics.

Since 2011, the distribution of attainment for science has remained relatively stable with similar percentages of pupils reaching each of the International Benchmarks. For mathematics, there has been a significant increase in the percentage of pupils reaching the Advanced International Benchmark. There is also a difference in the spread of score distributions for the two subjects. Mathematics has a relatively wide score distribution, whereas for science the difference in scores between the highest and lowest attainers is smaller and similar to that of four of the comparator countries (England, Hong Kong, Poland and the Republic of Ireland).

4 Attainment by content and skill in Northern Ireland

Chapter outline

This chapter focuses on performance in Northern Ireland in mathematics and science in Year 6 (Y6, ages 9-10) in TIMSS 2015. It summarises pupils' mathematics and science attainment across the TIMSS content and cognitive domains.

TIMSS assesses content domains in mathematics and science, and the cognitive domains of Knowing, Applying and Reasoning in both subjects. Sections 4.1 to 4.4 provide more information about each of these domains. The international reports (Mullis *et al.*, 2016a; Martin *et al.*, 2016a) provide further information about international performance in these domains.

This chapter also reports any gender differences across these domains. Findings for mathematics are presented first, followed by findings in science.

- In the mathematics content domains, pupils in Northern Ireland performed significantly[14] better on Number and less well on Geometric Shapes and Measures.
- In the mathematics cognitive domains, they performed better on Knowing and Applying and less well on Reasoning.
- In the science content domains, they did less well on Physical Science.
- In the science cognitive domains, there was no significant difference between pupils' performance in each of the cognitive domains and overall science performance.
- Since the last TIMSS survey in 2011, there has been some change in Northern Ireland's performance across the content and cognitive domains for both mathematics and science. Most notably:
    - improved performance on Data Display, Applying and Reasoning items in mathematics
    - improved performance on Earth Science and Reasoning items in science.
- For both mathematics and science, most countries participating in TIMSS 2015 demonstrated gender differences in performance in the content or cognitive domains. Northern Ireland was unusual in having no significant gender differences in performance in either the mathematics or science content or cognitive domains.

[14] Throughout this report, the term 'significant' refers to statistical significance.

4.1 The content and cognitive domains in TIMSS 2015

Mathematics: what TIMSS assesses at ages 9-10

The content domains assessed for Y6 mathematics are:

- Number - Whole Number; Fractions and Decimals; Expressions; Simple Equations and Relationships
- Geometric Shapes and Measures - Points, Lines and Angles; Two- and Three-dimensional Shapes
- Data Display – Reading, Interpreting and Representing.

The cognitive domains are:

- Knowing – Recall; Recognize; Classify/Order; Compute; Retrieve; Measure
- Applying – Determine; Represent/Model; Implement
- Reasoning – Analyze; Integrate/Synthesize; Evaluate; Draw Conclusions; Generalize; Justify.

More information is available in the TIMSS Assessment Framework[15].

[15] Mullis *et al*., 2013.

Science: what TIMSS assesses at ages 9-10

The content domains assessed in Y6 science are:

- Life Science – Characteristics and Life Processes of Organisms; Life Cycles, Reproduction and Heredity; Organisms, Environment and their Interaction; Ecosystems; Human Health
- Physical Science – Classification and Properties of Matter and Changes in Matter; Forms of Energy and Energy Transfer; Forces and Motion
- Earth Science - Earth's Structure, Physical Characteristics and Resources; Earth's Processes and History; Earth in the Solar System.
- The cognitive domains are:
- Knowing – Recall/Recognize; Describe; Provide Examples
- Applying – Compare/Contrast/Classify; Relate; Use Models; Interpret Information; Explain
- Reasoning – Analyze; Synthesize; Formulate Questions / Hypothesize / Predict; Design Investigations; Evaluate; Draw Conclusions; Generalize; Justify.

More information is available in the TIMSS Assessment Framework[16].

Although the primary level curriculum in Northern Ireland (CCEA, 2007) does not include science as a discrete subject, it is covered as part of 'The World Around Us'[17]. While there are some differences between the Key Stage 2 curriculum in Northern Ireland (8- to 11-year-olds) and the TIMSS Assessment Framework for science, all but one of the TIMSS science topics are included in the Northern Ireland Curriculum. Chapter 1 of this report gives more information.

Interpreting the data: numerical scales

In this section, pupils' attainment across the TIMSS content and cognitive domains for each subject is discussed. To allow this comparison, scale scores are generated for each domain for each subject. It is important to note that the scale scores representing the domains are not directly comparable since they represent different constructs. However, each sub-scale can be compared directly with the overall mean scale score for the subject from which it is drawn, and this allows comparison of the relative strengths and weaknesses of each country for each domain. Differences between the scale score and the mean in each case are rounded to the nearest whole number.

[16] Mullis *et al.,* 2013.
[17] See the TIMSS 2015 Encyclopaedia (Mullis *et al.*, 2016b).

4.2 Attainment by content domains

4.2.1 Attainment in the mathematics content domains

Northern Ireland's mean scale score for mathematics in TIMSS 2015 was 570.

The pattern of performance in 2015 across the content domains was different from 2011. In 2015, pupils in Northern Ireland scored significantly above the overall mean score in the content domain of Number (with a mean scale score of 574). This was the also the case in 2011. However, Northern Ireland scored significantly below the overall mean in the content domain of Geometric Shapes and Measures (566). The score on Data Display (567) was similar to the score for mathematics overall (see Table 4.1). In contrast in 2011, the score on Geometric Shapes and Measures was similar to the score for mathematics overall and the score for Data Display was significantly below it.

In terms of trends over time, in 2015 Northern Ireland's mean score for Data Display was significantly higher than the mean score in 2011 (567 and 555 respectively). For the other content domains the mean scores in 2015 were statistically similar to those in 2011 (see Table 4.2).

The general pattern internationally was for countries to perform more highly on Number than on the other content domains, relative to their mean performance. There was more variability in performance on Data Display and Geometric Shapes and Measures, with some countries significantly exceeding their mean score in these domains, and others doing less well.

As was the case in 2011, there were no clear patterns of content domain performance among the subset of Northern Ireland's main comparator countries (Australia, England, Finland, Hong Kong, Poland, the Republic of Ireland, and Singapore): all had different relative strengths and weaknesses. However, in contrast to 2011, Finland no longer has a 'flat' profile suggesting equal strength across all three domains. In 2015 it showed more varied performance across the domains. Hong Kong now has a flat profile, scoring similarly to its mean score in all three domains. This was also the case in Poland in 2015, but this was not a comparator country in 2011[18].

[18] See Exhibits 3.1 and 3.5, international mathematics report (Mullis *et al.*, 2016a).

Table 4.1 Y6 attainment in the mathematics content domains

Country	Overall Mathematics Average Scale Score	Number (89 items)		Geometric Shapes and Measures (56 items)		Data Display (24 items)	
		Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score
‡ Northern Ireland	570 (2.9)	574 (3.1)	4 (1.0) ▲	566 (3.3)	-4 (2.0) ▼	567 (3.8)	-4 (2.4)

▲ Subscale score significantly higher than overall mathematics score
▼ Subscale score significantly lower than overall mathematics score

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.1, international mathematics report (Mullis *et al.*, 2016a).

Table 4.2 Difference in attainment in the mathematics content domains between 2011 and 2015

Instructions: Read across the row to determine if the performance in the row year is significantly higher (▲) or significantly lower (▼) than the performance in the column year.

Country		Number Average Scale Score	Number Differences Between Years		Geometric Shapes and Measures Average Scale Score	Geometric Shapes and Measures Differences Between Years		Data Display Average Scale Score	Data Display Differences Between Years	
			2011	2007		2011	2007		2011	2007
Northern Ireland										
‡	2015	574 (3.1)	8		566 (3.3)	6		567 (3.8)	12 ▲	
†	2011	566 (2.9)			560 (3.2)			555 (2.9)		

▲ More recent year significantly higher
▼ More recent year significantly lower

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.5, international mathematics report (Mullis *et al.*, 2016a).

4.2.2 Attainment in the science content domains

Northern Ireland's mean scale score for science in TIMSS 2015 was 520. Pupils in Northern Ireland scored similarly to this mean in the science content domains of Life Science (with a mean scale score of 521) and Earth Science (522), but significantly lower in Physical Science (514) (see Table 4.3). This is a different pattern from 2011, where pupils in Northern Ireland performed significantly lower in Earth Science and the scores in the other two domains were similar to overall science performance. Since 2011, Northern Ireland's performance in Earth Science has improved significantly while performance in the other two content domains has remained stable (see Table 4.4).

For TIMSS 2015, the general pattern internationally was for countries to perform less well in Earth Science than in the other content domains, relative to their mean performance. Over half of the TIMSS countries had lower relative scores in Earth Science at this age range. There was more variability in performance in Life Science and Physical Science, with some countries significantly exceeding their mean score in these domains, and others doing less

well. This is a slightly different pattern to that in 2011 where over half of the TIMSS countries had lower relative scores in Earth Science and / or Physical Science.[19]

As was the case in 2011, there were no common patterns of performance among the subset of comparator countries. Each, again, had its individual profile of relative strengths and weaknesses.

Table 4.3 Y6 attainment in the science content domains

Country	Overall Science Average Scale Score	Life Science (74 items)		Physical Science (61 items)		Earth Science (33 items)	
		Average Scale Score	Difference from Overall Science Score	Average Scale Score	Difference from Overall Science Score	Average Scale Score	Difference from Overall Science Score
‡ Northern Ireland	520 (2.2)	521 (2.7)	1 (1.7)	514 (2.6)	-6 (1.6) ▼	522 (3.0)	2 (2.1)

▲ Subscale score significantly higher than overall science score
▼ Subscale score significantly lower than overall science score

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.1, international science report (Martin *et al.*, 2016a).

Table 4.4 Difference in attainment in the science content domains between 2011 and 2015

Instructions: Read across the row to determine if the performance in the row year is significantly higher (▲) or significantly lower (▼) than the performance in the column year.

Country		Life Science Average Scale Score	Life Science Differences Between Years		Physical Science Average Scale Score	Physical Science Differences Between Years		Earth Science Average Scale Score	Earth Science Differences Between Years	
			2011	2007		2011	2007		2011	2007
Northern Ireland										
‡	2015	521 (2.7)	3		514 (2.6)	-6		522 (3.0)	15 ▲	
†	2011	519 (2.9)			520 (3.2)			507 (2.7)		

▲ More recent year significantly higher
▼ More recent year significantly lower

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.5, international science report (Martin *et al.*, 2016a).

4.3 Attainment by cognitive domains

4.3.1 Attainment in the mathematics cognitive domains

As was the case with the content domains, there were some differences in the profile of scores in the cognitive domains for Northern Ireland (see Table 4.5). Relative to their overall mathematics score of 570, pupils did significantly better on Knowing (with a mean scale score of 582) and Applying (with a mean scale score of 575), but less well on Reasoning

[19] See Exhibits 3.1 and 3.5, international science report (Martin *et al.*, 2016a).

(550). This was a slightly different pattern to that in 2011 where pupils' performance in the Applying domain was similar to the overall score.

Looking at performance over time (Table 4.6), the performance of pupils in Northern Ireland has improved significantly on both Applying and Reasoning questions in mathematics since 2011.

Northern Ireland's performance in Reasoning relative to its overall mathematics score reflects the general trend internationally, with approximately two-fifths of the participating nations having lower scores for Reasoning relative to their mean. Relative performance on Knowing and Applying was more variable across countries.

As in 2011, comparator countries showed different patterns of relative strength and weakness across the cognitive domains. For example, performance in the TIMSS mathematics cognitive domains in Hong Kong showed a similar pattern to that for pupils in Northern Ireland (relatively higher performance on Knowing and Applying but relatively lower performance on Reasoning). Pupils in Singapore, England and the Republic of Ireland showed relatively higher performance on Knowing, relatively lower performance on Reasoning and similar relative performance on Applying)[20]. In contrast pupils in Finland and Poland showed relatively higher performance on Reasoning.

Table 4.5 Y6 attainment in the mathematics cognitive domains

Country	Overall Mathematics Average Scale Score	Knowing (64 items)		Applying (72 items)		Reasoning (33 items)	
		Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score
‡ Northern Ireland	570 (2.9)	582 (3.9)	11 (1.6) ▲	575 (3.2)	5 (1.2) ▲	550 (3.3)	-21 (1.9) ▼

▲ Subscale score significantly higher than overall mathematics score
▼ Subscale score significantly lower than overall mathematics score

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.3, international mathematics report (Mullis *et al.*, 2016a).

[20] See Exhibits 3.3 and 3.7, international mathematics report (Mullis *et al.*, 2016a).

Table 4.6 Y6 Difference in attainment in the mathematics cognitive domains between 2011 and 2015

Instructions: Read across the row to determine if the performance in the row year is significantly higher (▲) or significantly lower (▼) than the performance in the column year.

Country		Knowing Average Scale Score	Knowing Differences Between Years 2011	Knowing Differences Between Years 2007	Applying Average Scale Score	Applying Differences Between Years 2011	Applying Differences Between Years 2007	Reasoning Average Scale Score	Reasoning Differences Between Years 2011	Reasoning Differences Between Years 2007
Northern Ireland										
‡	2015	582 (3.9)	2		575 (3.2)	11 ▲		550 (3.3)	12 ▲	
†	2011	580 (3.4)			565 (2.9)			538 (3.4)		

▲ More recent year significantly higher
▼ More recent year significantly lower

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.7, international mathematics report (Mullis *et al.*, 2016a).

4.3.2 Attainment in the science cognitive domains

In contrast to the pattern of performance in 2011, Northern Ireland showed a 'flat' profile in TIMSS science 2015, scoring similarly to its mean score of 520 in all three cognitive domains (see Table 4.7). This is also a contrast to pupils' performance in mathematics where there was more varied performance across the cognitive domains.

In terms of trends over time, a significant improvement in the mean score on Reasoning in science between 2011 and 2015 mirrors that in mathematics for this domain (Table 4.8).

Internationally, as with mathematics, there was a mixed picture, with strengths and weaknesses in performance across the cognitive domains varying across the subset of main comparator countries. However, over a quarter of countries participating in TIMSS science 2015 showed a flat profile of performance across the cognitive domains, including the comparator countries of England, Finland and the Republic of Ireland. This is in contrast to 2011, where Australia was the only main comparator country to show a flat profile[21].

Table 4.7 Y6 attainment in the science cognitive domains

Country	Overall Science Average Scale Score	Knowing (67 items) Average Scale Score	Knowing (67 items) Difference from Overall Science Score	Applying (66 items) Average Scale Score	Applying (66 items) Difference from Overall Science Score	Reasoning (35 items) Average Scale Score	Reasoning (35 items) Difference from Overall Science Score
‡ Northern Ireland	520 (2.2)	518 (2.9)	-1 (1.7)	519 (2.9)	-1 (1.9)	520 (2.6)	0 (1.7)

▲ Subscale score significantly higher than overall science score
▼ Subscale score significantly lower than overall science score

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.3, international science report (Martin *et al.*, 2016a).

[21] See Exhibits 3.3 and 3.7, international science report (Martin *et al.*, 2016a).

Table 4.8 Y6 Difference in attainment in the mathematics cognitive domains between 2011 and 2015

Instructions: Read across the row to determine if the performance in the row year is significantly higher (▲) or significantly lower (▼) than the performance in the column year.

Country		Knowing Average Scale Score	Knowing Differences Between Years 2011	Knowing Differences Between Years 2007	Applying Average Scale Score	Applying Differences Between Years 2011	Applying Differences Between Years 2007	Reasoning Average Scale Score	Reasoning Differences Between Years 2011	Reasoning Differences Between Years 2007
Northern Ireland										
‡	2015	518 (2.9)	1		519 (2.9)	-3		520 (2.6)	17 ▲	
†	2011	517 (3.1)			521 (2.8)			503 (3.2)		

▲ More recent year significantly higher
▼ More recent year significantly lower

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.7, international science report (Martin *et al.*, 2016a).

4.4 Performance by gender

4.4.1 Attainment by gender in mathematics content and cognitive domains

As was the case in 2011, there were no statistically significant gender differences in performance across the Y6 mathematics content domains (see Table 4.9) or cognitive domains (Table 4.10) for pupils in Northern Ireland. This equality of attainment between boys and girls across both TIMSS mathematics domains is relatively unusual internationally.

On average, the international pattern for the content domains in TIMSS 2015 was for boys to perform significantly better than girls in Number, and for girls to perform significantly better than boys in Geometric Shapes and Measures, and in Data Display. This mirrors TIMSS 2011. For the cognitive domains, the lack of a statistically significant gender difference in performance in Northern Ireland reflected what was seen internationally, with no significant gender difference in the international average for any of the cognitive domains (see Table 4.10).

Among the comparator countries, there was also no significant gender difference in performance in the mathematics content or cognitive domains in both Poland and Singapore. For the five remaining comparator countries the picture was more varied. However, with the exception of Finland, the other comparator countries demonstrated significant gender differences in performance in one or more of the mathematics content and cognitive domains, favouring boys[22].

[22] See Exhibits 3.9 and 3.11, international mathematics report (Mullis *et al.*, 2016a).

Table 4.9 Gender differences, Northern Ireland and international averages, in the Y6 mathematics content domains

Country	Number		Geometric Shapes and Measures		Data Display	
	Girls	Boys	Girls	Boys	Girls	Boys
‡ Northern Ireland	573 (4.1)	576 (3.1)	564 (4.1)	568 (3.9)	566 (4.5)	567 (4.2)
International Avg.	505 (0.5)	507 (0.5) ▲	504 (0.5) ▲	503 (0.6)	505 (0.6) ▲	499 (0.6)

▲ Average significantly higher than other gender

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.9, international mathematics report (Mullis *et al.*, 2016a).

Table 4.10 Gender differences, Northern Ireland and international averages, in the Y6 mathematics cognitive domains

Country	Knowing		Applying		Reasoning	
	Girls	Boys	Girls	Boys	Girls	Boys
‡ Northern Ireland	577 (5.4)	587 (3.9)	576 (4.3)	575 (3.2)	548 (4.6)	551 (3.5)
International Avg.	504 (0.5)	505 (0.5)	504 (0.5)	505 (0.5)	504 (0.6)	504 (0.6)

▲ Average significantly higher than other gender

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.11, international mathematics report (Mullis *et al.*, 2016a).

4.4.2 Attainment by gender in science content and cognitive domains

As was the case for mathematics, there were no gender differences in Northern Ireland for either set of science domains (see Table 4.11 and Table 4.12). In terms of the content domains, this reflects a change since 2011 when girls significantly outperformed boys in Life Science.

Internationally, the pattern of gender differences across the content domains has changed since 2011, when girls did significantly better than boys in Life Science and boys did significantly better in Physical Science and Earth Science. In 2015, the international averages showed no significant difference in the performance of boys and girls in Physical Science (see Table 4.11). (Boys still outperform girls in Earth Science and girls still outperform boys in Life Science internationally.)

There were some gender differences among the group of comparator countries, mostly with girls outperforming boys in Life Science and boys outperforming girls in Earth Science (mirroring the international average). All of the comparator countries showed a significant gender difference in one or two of the science content domains.[23]

For the science cognitive domains, there was a more varied picture internationally. The international averages showed no significant gender difference overall for Knowing, but that Applying and Reasoning items were generally answered better by girls (see Table 4.12). Five of the comparator countries showed some gender differences, not corresponding to the international patterns, while two of the comparator countries (Australia and England), like

[23] See Exhibit 3.9, international science report (Martin *et al.*, 2016a).

Northern Ireland, demonstrated no gender differences in performance in the science cognitive domains.[24]

Table 4.11 Gender differences in the Y6 science content domains

Country	Life Science		Physical Science		Earth Science	
	Girls	Boys	Girls	Boys	Girls	Boys
‡ Northern Ireland	524 (3.5)	518 (3.3)	510 (3.6)	518 (3.1)	522 (4.0)	522 (3.7)
International Avg.	513 (0.6) ▲	502 (0.6)	505 (0.6)	505 (0.6)	498 (0.7)	501 (0.7) ▲

▲ Average significantly higher than other gender

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.9, international science report (Martin *et al.*, 2016a).

Table 4.12 Gender differences in the Y6 science cognitive domains

Country	Knowing		Applying		Reasoning	
	Girls	Boys	Girls	Boys	Girls	Boys
‡ Northern Ireland	516 (3.8)	521 (3.3)	518 (3.2)	520 (3.9)	524 (3.1)	516 (4.1)
International Avg.	504 (0.6)	505 (0.7)	508 (0.6) ▲	504 (0.6)	510 (0.6) ▲	498 (0.7)

▲ Average significantly higher than other gender

See Appendix C.1 for target population coverage notes 1, 2, and 3. See Appendix C.7 for sampling guidelines and sampling participation notes †, and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.11, international science report (Martin *et al.*, 2016a).

4.5 Conclusion

Chapter 1 indicated that Northern Ireland's pupils scored above the international average in TIMSS 2015 in both mathematics and science, performing particularly well in mathematics. Even so, within this overall high achievement, areas of relative strength and weakness can be identified, as outlined in this chapter.

In terms of content domains, there were areas of strength alongside less well developed areas for both subjects. In mathematics, pupils performed significantly better on Number and less well on Geometric Shapes and Measures. In science, they did less well on Physical Science.

For the cognitive domains, in mathematics, Northern Ireland's pupils performed less well on the more complex Reasoning items than on the more straightforward Knowing and / or Applying items. This was not uncommon internationally with 20 of the participating countries demonstrating weaker performance on Reasoning items compared with their overall mathematics achievement. This included four of the comparator countries: Singapore, Hong Kong, the Republic of Ireland and England. However, Northern Ireland's performance on Reasoning items has improved significantly since 2011.

In contrast, in science, there were no significant differences between the performance in each of the cognitive domains and the overall science performance of pupils in Northern Ireland. They performed similarly on the straightforward Knowing and Applying items and the more complex Reasoning items.

[24] See Exhibit 3.11, international science report (Martin *et al.*, 2016a).

There have been some changes in the profile of Northern Ireland's performance in the content and cognitive domains since the last cycle of TIMSS in 2011. In mathematics, there has been an improvement in performance on Data Display items and on Knowing and Applying items. However, pupils in 2015 did significantly less well on complex Reasoning items. In science, pupils demonstrated an improvement in Earth Science as well as in the cognitive domains of Applying and Reasoning.

Pupils in Northern Ireland did not conform to international trends in terms of gender differences in their performance in mathematics and science. There were no gender differences in either subject indicating that, for pupils in Northern Ireland, there is equality of attainment in mathematics and science as measured by TIMSS 2015.

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)		

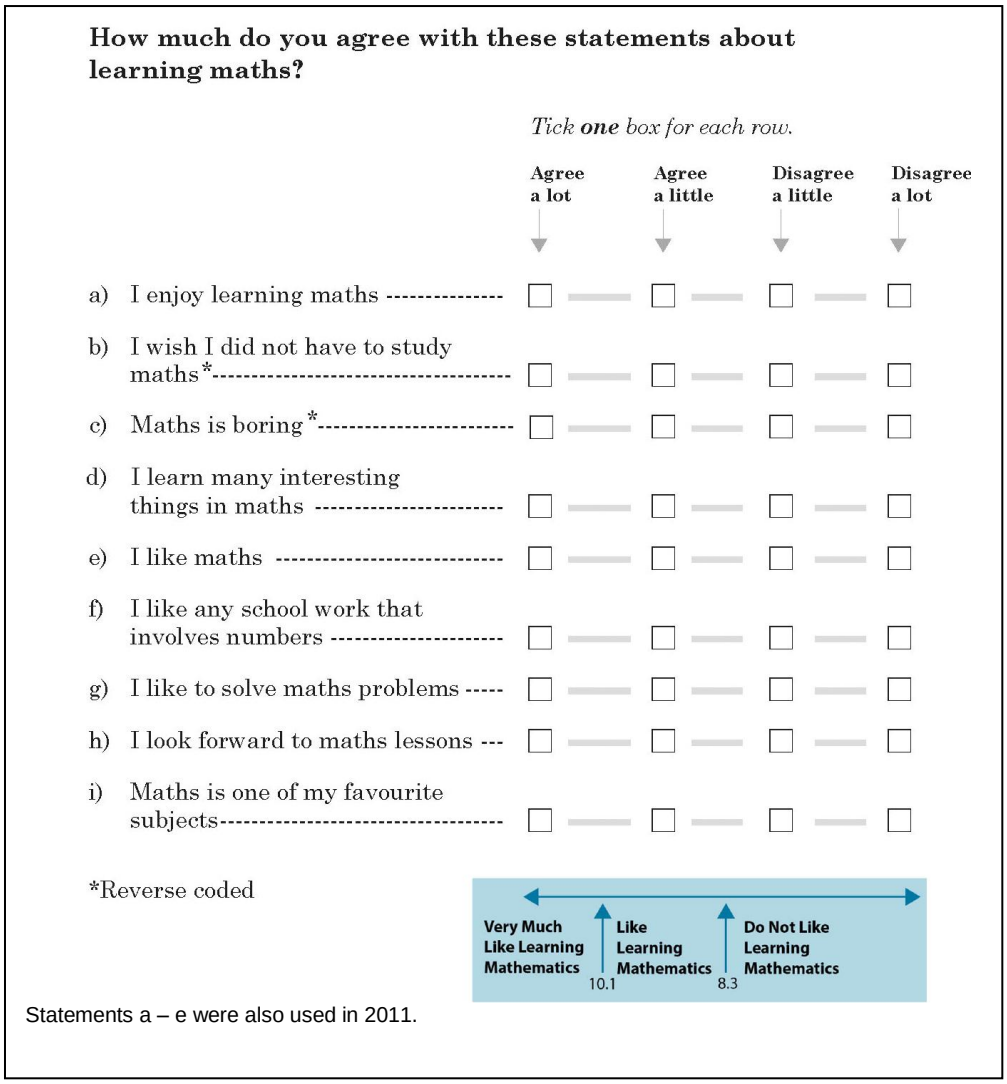
Centre point of scale set at 10.

( ) 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

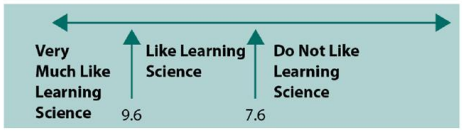
Source: Exhibit 10.3, international science report (Martin *et al.*, 2016a) and adapted from the international version of the TIMSS 2015 Pupil Questionnaire.

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

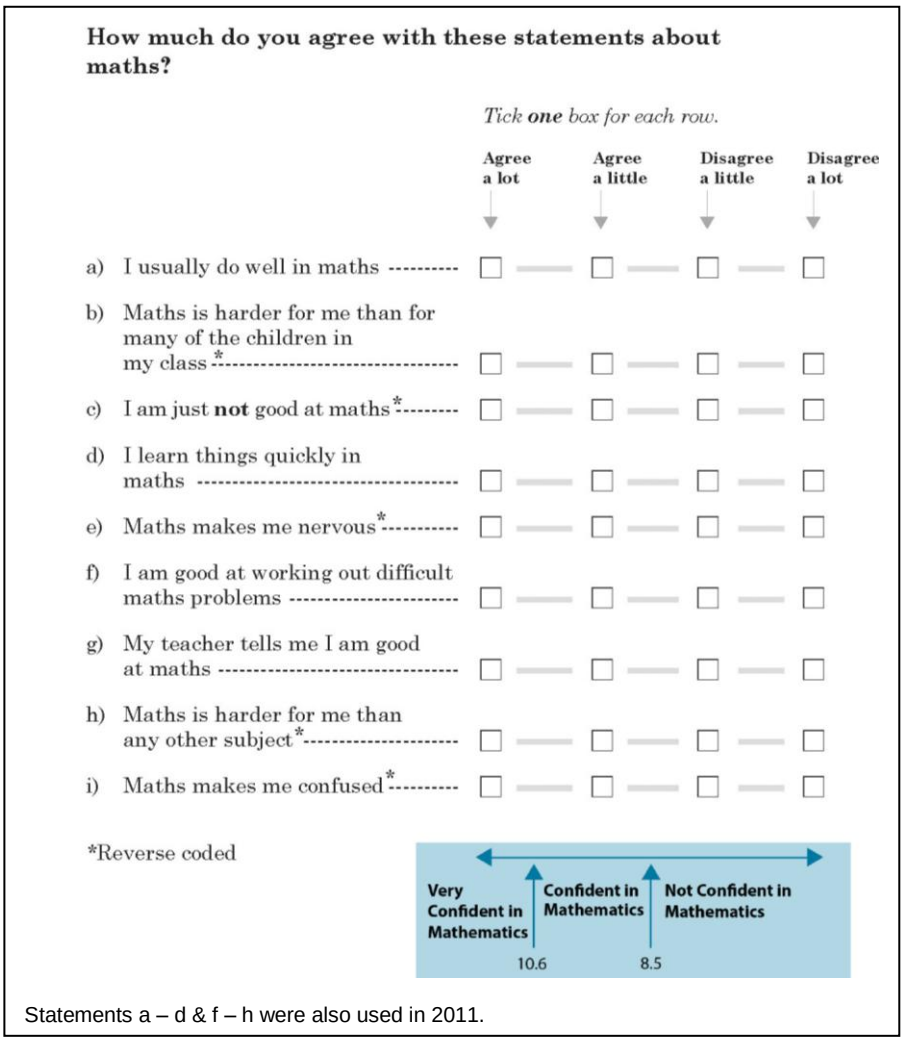
Students were scored according to their degree of agreement with nine statements on the *Students Confident in Mathematics* scale. Students **Very Confident in Mathematics** had a score on the scale of at least 10.6, which corresponds to their "agreeing a lot" with five of the nine statements and "agreeing 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**.

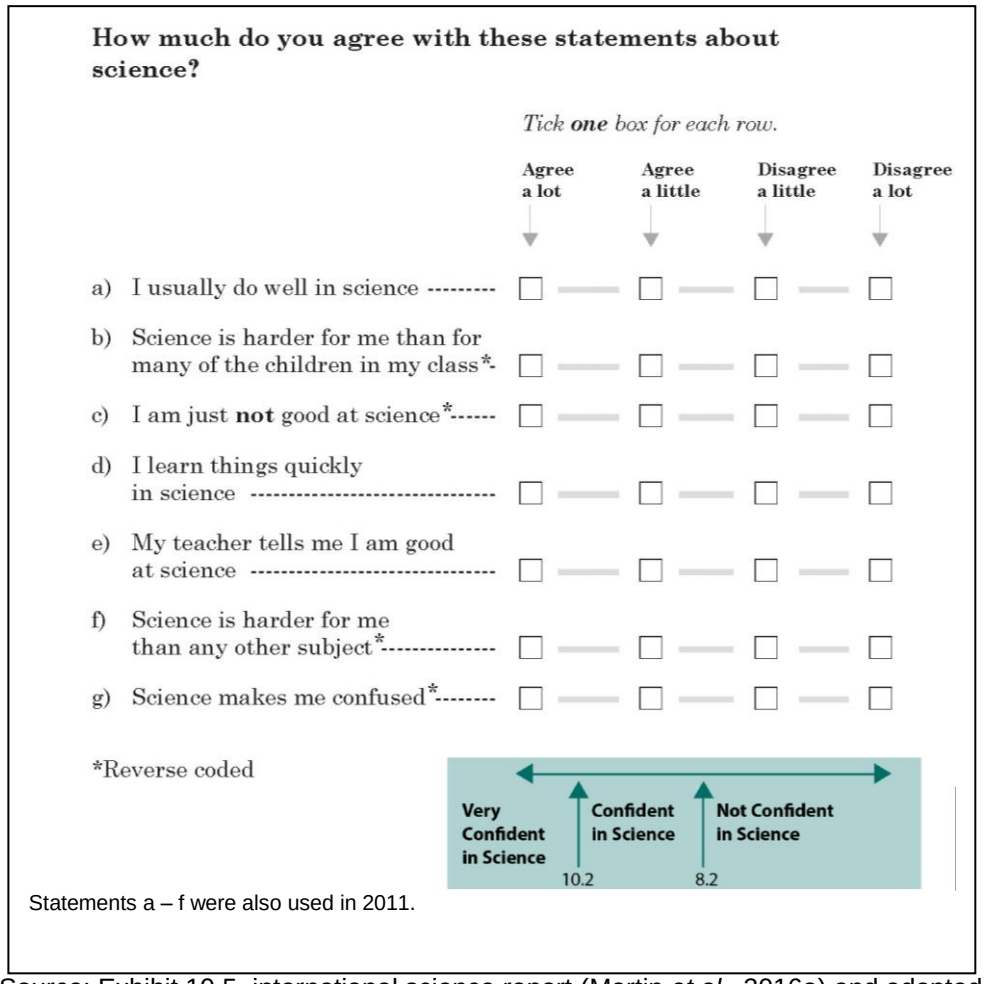
Country	Very Confident in Science		Confident in Science		Not Confident in Science		Average Scale Score	Difference in Average Scale Score from 2011
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement		
Poland	39 (1.1)	565 (2.6)	47 (1.0)	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

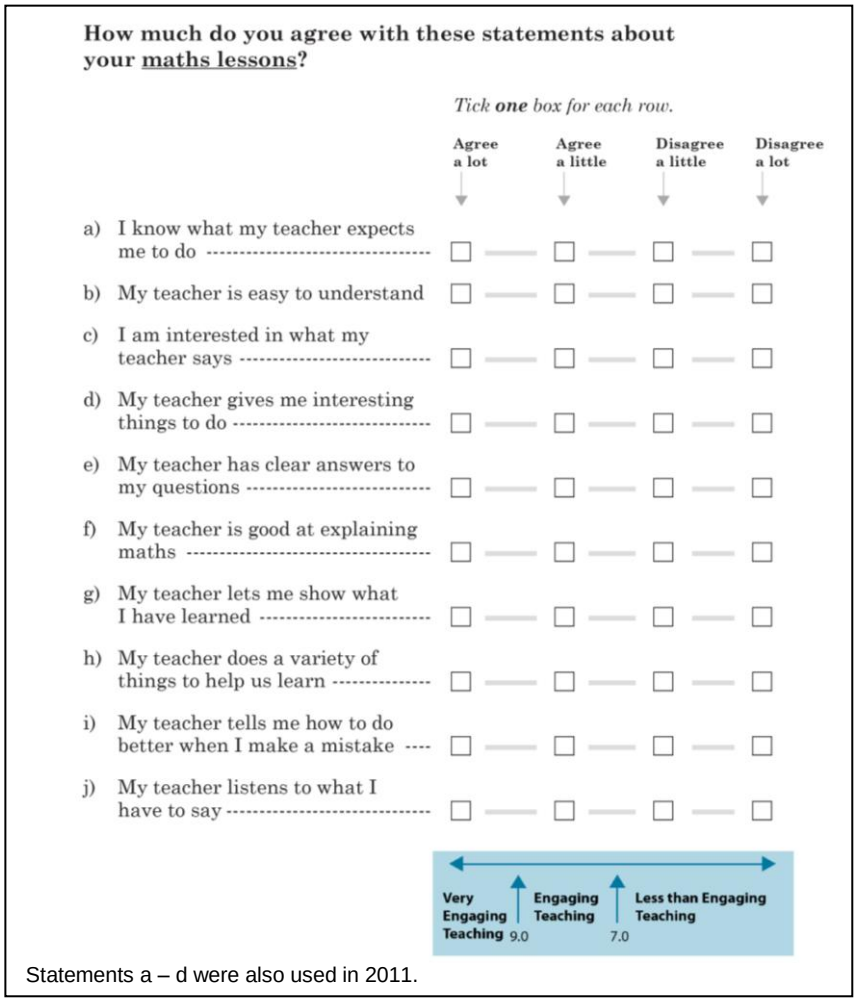
Reported by pupils

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

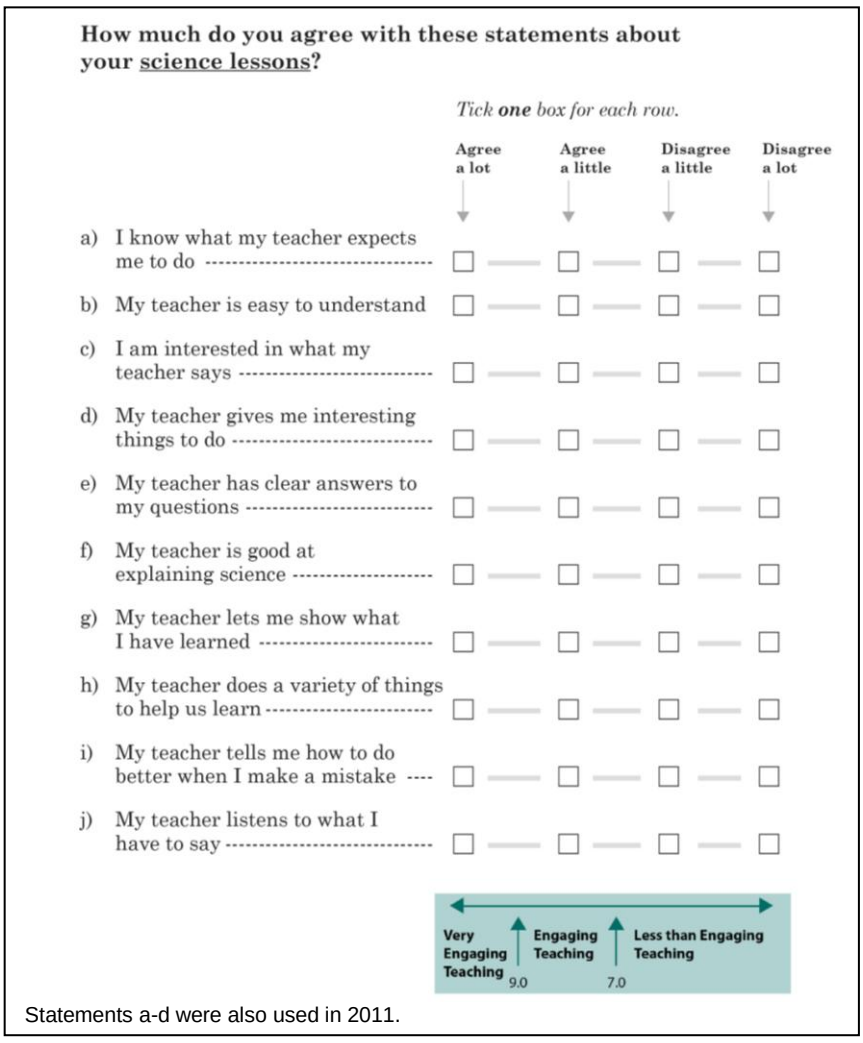
Reported by pupils

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.

6 Workforce

Chapter outline

This chapter presents findings relating to the education workforce, as reported by teachers and principals. Sections relate to principals' and teachers' qualifications, teachers' major areas of study during training and professional development. These are followed by sections that examine factors related to teaching and teaching practices including: the extent to which teachers collaborate in order to improve their teaching practice and levels of job satisfaction. Outcomes for Northern Ireland are compared with the international averages, and where relevant, with those of other countries.

Key findings

- In Northern Ireland, most pupils participating in TIMSS 2015 (83 per cent) attended schools where the principal has a postgraduate degree. This is considerably higher than the international average.
- On average, teachers in Northern Ireland were less qualified than teachers internationally. Whilst most pupils were taught by teachers who have a degree, only 16 per cent of pupils were taught by teachers who have a postgraduate degree. This is approximately 10 per cent lower than the international average, but is similar to a number of the main comparator group of countries, namely Australia, England, the Republic of Ireland and Singapore.
- In Northern Ireland, the majority of pupils were taught mathematics by teachers whose main area of study was primary education without specialisation in mathematics. The same was true of science, where three-quarters of pupils were taught by non-science specialists. The percentage of pupils in Northern Ireland taught by a teacher with a mathematics specialism was higher than the percentage of pupils taught by a science specialist (18 per cent and 12 per cent respectively).
- The level of participation in professional development activities in mathematics was higher in Northern Ireland than on average internationally. This was not the case for science, where levels of participation in professional development activities were relatively low (both in Northern Ireland and on average internationally).
- Teachers in Northern Ireland reported relatively frequent collaboration with colleagues to improve teaching.
- In Northern Ireland, 96 per cent of pupils had teachers who reported that they were 'Very Satisfied' or 'Satisfied' with their jobs. This mirrors the high level of job satisfaction reported in TIMSS 2011. However, higher levels of career satisfaction did not appear to be associated with increased pupil achievement.

Interpreting the data: percentages in tables

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

Year 6 (Y6) pupils (ages 9-10) were sampled by class. As a result, the Y6 Teacher Questionnaire would, in most cases, have been completed by the class teacher of the sampled class. In some cases, however, 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 because the distribution of pupils within the sample of teachers may differ by subject.

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.

6.1 Principals' and teachers' formal education

In order to discover the percentage of pupils attending schools run by principals with a high level of educational qualifications, and the percentage of pupils taught by teachers with a high level of educational qualifications, both principals and teachers were asked to indicate the highest level of formal educational qualification they had completed. (The findings are shown in Tables 6.1 and 6.2.)

In Northern Ireland, the majority of pupils participating in TIMSS 2015 (83 per cent) attended schools where the principal has a postgraduate university degree (for example a doctorate or master's). This is higher than the international average. Among the main comparator countries, only Poland and Finland had a higher percentage of pupils attending schools where the principal has a postgraduate degree.

In Northern Ireland, 16 per cent of pupils were taught by teachers who have a postgraduate university degree. This is lower than the international average, where 26 per cent to 28 per cent of pupils (for mathematics and science respectively) were taught by a teacher with a postgraduate degree. However, the percentage in Northern Ireland was similar to that in some of the comparator countries, namely Australia (12 per cent for mathematics and science), England (13 per cent for mathematics; 12 per cent for science), the Republic of Ireland (13 per cent) and Singapore (13 per cent). In Northern Ireland, nearly all of the

remaining pupils were taught by teachers who had completed a first degree but not a postgraduate degree (83 per cent).

Table 6.1 Principals' formal education

Country	Percent of Students by Principal Educational Level			Current Requirements	
	Completed Postgraduate University Degree**	Completed Bachelor's Degree or Equivalent but Not a Postgraduate Degree	Did Not Complete Bachelor's Degree	Teaching Experience	Completion of Specialized School Leadership Training Program
Northern Ireland r	83 (3.8)	16 (3.6)	1 (1.2)	●	○
International Avg.	48 (0.4)	46 (0.5)	6 (0.3)		

● Yes
○ No

* Based on countries' categorizations according to UNESCO's International Standard Classification of Education (Operational Manual for ISCED-2011).
** For example, doctorate, master's, or other postgraduate degree.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Sources: Exhibit 8.9, international mathematics report (Mullis *et al.*, 2016a) and Exhibit 8.9, international science report (Martin *et al.*, 2016a).

Principal reports are the same for mathematics and science.

Table 6.2 Teachers' formal education

Mathematics

Reported by teachers

Country	Percent of Students by Teacher Educational Level			
	Completed Postgraduate University Degree**	Completed Bachelor's Degree or Equivalent but Not a Postgraduate Degree	Completed Post-Secondary Education but Not a Bachelor's Degree	No Further than Upper-Secondary Education
Northern Ireland r	16 (3.3)	83 (3.4)	0 (0.0)	2 (0.9)
International Avg.	26 (0.3)	58 (0.4)	12 (0.3)	5 (0.2)

* Based on countries' categorizations according to UNESCO's International Standard Classification of Education (Operational Manual for ISCED-2011).
** For example, doctorate, master's, or other postgraduate degree.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Science

Reported by teachers

Country	Percent of Students by Teacher Educational Level			
	Completed Postgraduate University Degree**	Completed Bachelor's Degree or Equivalent but Not a Postgraduate Degree	Completed Post-Secondary Education but Not a Bachelor's Degree	No Further than Upper-Secondary Education
Northern Ireland r	16 (3.3)	83 (3.4)	0 (0.0)	2 (0.9)
International Avg.	28 (0.4)	57 (0.4)	11 (0.3)	4 (0.2)

* Based on countries' categorizations according to UNESCO's International Standard Classification of Education (Operational Manual for ISCED-2011).
** For example, doctorate, master's, or other postgraduate degree.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Sources: Exhibit 8.1, international mathematics report (Mullis *et al.*, 2016a) and Exhibit 8.1, international science report (Martin *et al.*, 2016a).

6.2 Teachers' educational emphasis / major areas of training

6.2.1 Mathematics: teachers' major area of study during training

In order to discover the percentage of pupils taught by subject specialists, in this case mathematics, teachers were asked to indicate their main area of study and whether they had specialised in any specific subjects during their post-secondary education. (The findings for teachers in Northern Ireland are shown in Table 6.3.)

In Northern Ireland, the majority of pupils participating in TIMSS 2015 (65 per cent) were taught mathematics by teachers whose main area of study was primary education without specialisation in mathematics. Eighteen per cent of pupils were taught mathematics by teachers who are mathematics specialists (17 per cent of the teachers had a specialism in mathematics and primary education, and a further 1 per cent, of teachers specialised in mathematics but not primary education). This is an increase of 7 per cent since 2011.

Among the comparator countries, Australia, England and the Republic of Ireland had a similar percentage of pupils taught by mathematics specialists. However, in Poland, Hong Kong and Singapore a much larger percentage of pupils were taught by mathematics specialists (100 per cent, 74 per cent and 73 per cent respectively).

There was not a clear pattern within individual countries, or on average, between being taught by a subject specialist and average achievement in mathematics at this level. In Northern Ireland, pupils taught by a subject specialist had higher average achievement. However, this difference is relatively small and unlikely to be statistically significant.

6.2.2 Science: teachers' major area of study during training

Almost three-quarters of pupils in Y6 in Northern Ireland were taught science by teachers whose main area of study was primary education (without specialisation in science) (Table 6.4). Only 12 per cent of pupils were taught science by teachers who are science specialists (3 per cent of these were taught by teachers with a specialism in science but not primary education; the remainder had teachers who specialised in science and primary education). This is very similar to the findings from 2011.

The picture among the comparator countries was varied. In the Republic of Ireland, a smaller percentage of pupils were taught by subject specialists – only 8 per cent. In England on the other hand, over a quarter of pupils were taught by a science specialist (10 per cent of these were taught by teachers with a specialism in science but not primary education, and 17 per cent had teachers who specialised in science and primary education). This is different from 2011, where the percentage of pupils taught by science specialists in Northern Ireland was similar to a number of the comparator countries.

Among the highest achieving countries for science the percentages of pupils taught by subject specialists was high. In Singapore, for example, 69 per cent of pupils were taught by science specialists. There was generally no clear association within individual countries between teacher specialisation during training and average achievement in science at this

level, but in Northern Ireland, there appears to be some association. Further analysis would be required to determine if the differences in achievement are statistically significant.

Table 6.3 Teachers' major area of study during training (mathematics)

Reported by teachers

Country	Major in Primary Education and Major (or Specialization) in Mathematics		Major in Primary Education but No Major (or Specialization) in Mathematics		Major in Mathematics but No Major in Primary Education		All Other Majors		No Formal Education Beyond Upper-Secondary*	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Northern Ireland r	17 (4.0)	581 (11.2)	65 (4.7)	572 (4.2)	1 (1.0)	~ ~	16 (3.7)	567 (5.6)	2 (0.9)	~ ~
International Avg.	27 (0.4)	505 (1.1)	46 (0.5)	512 (1.5)	14 (0.3)	487 (2.9)	8 (0.3)	495 (2.0)	5 (0.2)	434 (4.0)

* Countries have been increasing their certification requirements and providing professional development to teachers certified under earlier guidelines.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Source: Exhibit 8.3, international mathematics report (Mullis *et al.*, 2016a).

Table 6.4 Teachers' major area of study during training (science)

Reported by teachers

Country	Major in Primary Education and Major (or Specialization) in Science		Major in Primary Education but No Major (or Specialization) in Science		Major in Science but No Major in Primary Education		All Other Majors		No Formal Education Beyond Upper-Secondary*	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Northern Ireland r	9 (2.8)	541 (12.2)	71 (4.3)	519 (2.9)	3 (1.9)	528 (6.2)	15 (3.6)	518 (4.9)	2 (0.9)	~ ~
International Avg.	23 (0.5)	511 (1.3)	49 (0.5)	510 (1.6)	15 (0.3)	496 (2.7)	9 (0.3)	496 (2.3)	5 (0.2)	457 (3.7)

* Countries have been increasing their certification requirements and providing professional development to teachers certified under earlier guidelines.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students.

Source: Exhibit 8.3, international science report (Martin *et al.*, 2016).

6.3 Teachers' participation in professional development

6.3.1 Professional development in mathematics

In order to discover the percentage of pupils taught mathematics by teachers participating in professional development activities, teachers were asked to indicate what professional development activities in mathematics they had been involved in during the last two years. Teachers could indicate participating in more than one area of professional development. (The findings for teachers in Northern Ireland are shown in Table 6.5.) The areas of professional development covered by the questionnaire were:

- mathematics content
- mathematics pedagogy / instruction
- mathematics curriculum
- integrating information technology and mathematics

- improving students' critical thinking or problem solving skills
- mathematics assessment
- addressing individual students' needs.

Table 6.5 Teachers' participation in professional development in mathematics

Reported by teachers

Teachers could indicate participating in more than one area of professional development.

Country	Percent of Students by Teachers' Area of Professional Development						
	Mathematics Content	Mathematics Pedagogy/ Instruction	Mathematics Curriculum	Integrating Information Technology into Mathematics	Improving Students' Critical Thinking or Problem Solving Skills	Mathematics Assessment	Addressing Individual Students' Needs
Northern Ireland	r 50 (4.6)	r 63 (4.3)	r 54 (5.0)	r 40 (4.7)	r 46 (4.8)	r 57 (4.9)	r 45 (4.3)
International Avg.	43 (0.5)	45 (0.5)	40 (0.5)	36 (0.5)	41 (0.5)	36 (0.5)	42 (0.5)

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

Source: Exhibit 8.7, international mathematics report (Mullis *et al.*, 2016a).

In general, more pupils in Northern Ireland were taught by teachers who had been involved in a professional development activity in the last two years than was the case on average internationally. If, as research evidence suggests,[31] teacher involvement in content based professional development can influence pupil achievement in mathematics, the level of involvement in Northern Ireland in such activities is encouraging.

In Northern Ireland, at least 40 per cent of pupils were taught by teachers who had participated in one of the forms of mathematics professional development. The largest percentage of pupils were taught by teachers who had participated in a professional development activity on mathematics pedagogy / instruction (63 percent), nearly 20 per cent higher than the international average. The next most commonly attended area of professional development in Northern Ireland was mathematics assessment. Again, a much higher percentage of pupils in Northern Ireland were taught by teachers who had participated in a professional development activity on mathematics assessment than was the case on average internationally (57 per cent and 36 per cent respectively). Forty per cent of pupils were taught by teachers who had attended a professional development activity focusing on integrating information technology into mathematics – slightly above the international average (36 per cent).

Levels of participation in professional development in mathematics varied across the comparator countries. Finland had the lowest level of participation, with between 3 per cent and 24 per cent of pupils taught mathematics by a teacher who had participated in one of the activities covered in the Teacher Questionnaire. In Poland on the other hand, involvement in professional development in mathematics was more common, with 85 per cent of pupils having been taught by a teacher who had undertaken professional development on mathematics content, for example.

[31] Mullis and Martin (2013).

There was no clear pattern in the most commonly undertaken professional development activities across the comparator countries, perhaps reflecting different emphases on the importance of particular areas and / or existing skills of the teaching population.

6.3.2 Professional development in science

Teachers were asked to indicate what professional development activities in science they had been involved in during the last two years. As with mathematics, teachers could indicate participating in more than one area of professional development. (The findings for teachers in Northern Ireland are shown in Table 6.6.) The areas of professional development covered by the Teacher Questionnaire were:

- science content
- science pedagogy / instruction
- science curriculum
- integrating information technology and science
- improving students' critical thinking or inquiry skills
- science assessment
- addressing individual students' needs
- integrating science with other subjects.

Table 6.6 Teachers' participation in professional development in science

Reported by teachers

Teachers could indicate participating in more than one area of professional development.

Country	Percent of Students by Teachers' Area of Professional Development							
	Science Content	Science Pedagogy/ Instruction	Science Curriculum	Integrating Information Technology into Science	Improving Students' Critical Thinking or Inquiry Skills	Science Assessment	Addressing Individual Students' Needs	Integrating Science with Other Subjects
Northern Ireland	r 27 (4.1)	r 31 (4.2)	r 25 (4.0)	r 24 (4.3)	r 31 (4.1)	r 7 (2.5)	r 20 (3.7)	r 31 (4.1)
International Avg.	32 (0.5)	32 (0.5)	32 (0.5)	30 (0.5)	33 (0.5)	25 (0.4)	32 (0.5)	29 (0.5)

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

Source: Exhibit 8.7, international science report (Martin *et al.*, 2016a).

In Northern Ireland, compared with mathematics, there were relatively lower levels of participation in professional development in science. This was also the case on average internationally. Given the potential link between teacher involvement in professional development activities and achievement[32], this could be one of the contributing factors towards lower attainment in science in Northern Ireland.

Between 7 per cent and 31 per cent of pupils in Northern Ireland were taught science by a teacher who had participated in one of the activities covered in the Teacher Questionnaire. The most commonly attended areas of professional development in Northern Ireland were science pedagogy / instruction, improving critical thinking or inquiry skills, and integrating

[32] Mullis and Martin (2013).

science with other subjects; 31 per cent of pupils were taught science by a teacher who had participated in at least one of these areas. In contrast to mathematics, only 7 per cent of pupils were taught by teachers who had participated in a professional development activity on science assessment. This is much lower than the international average of 25 per cent.

As with mathematics, the levels of participation in professional development in science varied across the comparator countries, although this was generally lower than it was for mathematics activities. Once again, Finland had the lowest level of participation, with between 2 per cent and 12 per cent of pupils taught science by a teacher who had participated in one of the activities covered in the questionnaire. In Singapore on the other hand, involvement in professional development in science was more common, with 78 per cent of pupils having been taught by a teacher who had undertaken professional development on science pedagogy and instruction, for example. There was no clear pattern in the most commonly undertaken professional development activities in science across the comparator countries, perhaps reflecting different emphases in each of the countries.

6.4 Teacher reports of collaboration to improve teaching in each subject

Teachers were asked to indicate the extent to which they worked with their colleagues in particular aspects of teaching. Table 6.7 shows the percentage of pupils in Northern Ireland who were taught by teachers who reported having these types of interactions with other teachers 'Very Often' or 'Often'.

In general, teachers in Northern Ireland reported relatively high levels of collaboration with their colleagues. This was also the case internationally. For all but one of the interactions described in the questionnaire, over 50 per cent of pupils were taught mathematics by teachers who 'Very Often' or 'Often' work with their colleagues in that particular aspect of teaching. The same was true of science.

The most common interaction reported by teachers was working with colleagues to implement the curriculum; 77 per cent of pupils were taught mathematics / science by a teacher who was involved in that aspect of teaching 'Very Often' or 'Often'. This was a higher percentage than was seen on average internationally. However, teachers in Northern Ireland were not so frequently involved in visits to another classroom; only 24 per cent of pupils were taught mathematics / science by a teacher who visited other classrooms 'Very Often' or 'Often'. This is slightly lower than the international average (29 per cent for both mathematics and science).

Table 6.7 Collaborate to improve teaching

Mathematics

How often do you have the following types of interactions with other teachers?	Percentage of pupils	
	Northern Ireland (%)	International Average (%)
Discuss how to teach a particular topic	69	70
Collaborate in planning and preparing instructional materials	73	66
Share what I have learned about my teaching experiences	68	72
Visit another classroom to learn more about teaching	24	29
Work together to try out new ideas	60	53
Work as a group on implementing the curriculum	77	63
Work with teachers from other grades to ensure continuity in learning	52	50

Source: 2015 Mathematics Teacher Context Data Almanac by Mathematics Achievement questions ATBG09A – G.

Science

How often do you have the following types of interactions with other teachers?	Percentage of pupils	
	Northern Ireland (%)	International Average (%)
Discuss how to teach a particular topic	69	69
Collaborate in planning and preparing instructional materials	73	66
Share what I have learned about my teaching experiences	69	71
Visit another classroom to learn more about teaching	24	29
Work together to try out new ideas	60	53
Work as a group on implementing the curriculum	77	62
Work with teachers from other grades to ensure continuity in learning	52	49

Source: 2015 Science Teacher Context Data Almanac by Mathematics Achievement questions ATBG09A – G.

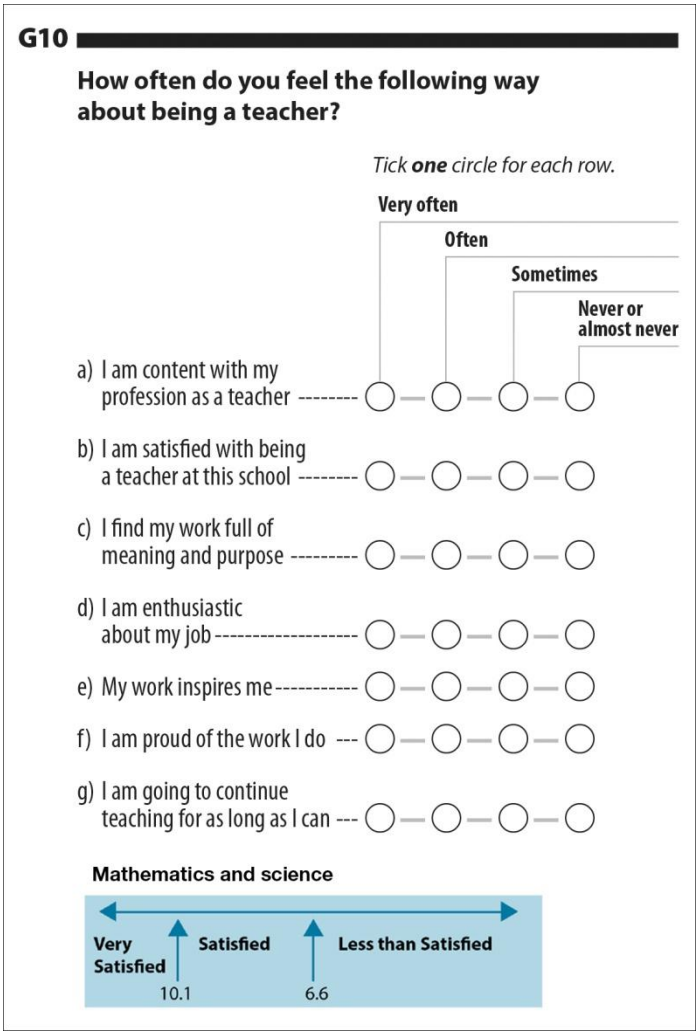
6.5 Teachers' reported job satisfaction

Teachers were asked to indicate the extent to which they were satisfied with their profession as a teacher. The statements and details of the scaling are shown in Figure 6.1 and the results for mathematics and science are shown in Table 6.8.

The international analysis uses responses to these statements to create the 'Teacher Job Satisfaction' scale. Teachers were categorised as being 'Very Satisfied', 'Satisfied' and 'Less than Satisfied'. As construction of the scale has changed since 2011, caution should be exercised when interpreting trends over time[33].

[33] In 2011, teachers responded to six statements about their career satisfaction and were categorised into three bands: 'Satisfied', 'Somewhat Satisfied' and 'Less than Satisfied'. In addition, a number of the statements have changed since 2011 (only statements a) and b) were used in 2011).

Figure 6.1 Teacher job satisfaction



Source: adapted from Exhibit 6.6 international mathematics report (Mullis *et al.*, 2016a) and Exhibit 6.6, international science report (Martin *et al.*, 2016a).

Table 6.8 Teacher job satisfaction

Mathematics

Reported by teachers

Students were scored according to how often their teachers responded positively to the seven statements on the *Teacher Job Satisfaction* scale. Students with **Very Satisfied** teachers had a score on the scale of at least 10.1, which corresponds to their teachers responding "very often" to four of the seven statements and responding "often" to the other three, on average. Students with **Less than Satisfied** teachers had a score no higher than 6.6, which corresponds to their teachers responding "sometimes" to four of the seven statements and "often" to the other three, on average. All other students had **Satisfied** teachers.

Country	Very Satisfied		Satisfied		Less than Satisfied		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	59 (5.0)	574 (4.3)	37 (4.7)	572 (6.4)	4 (2.0)	563 (23.8)	10.3 (0.21)
International Avg.	52 (0.5)	508 (0.6)	42 (0.5)	503 (0.8)	6 (0.2)	501 (2.0)	

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

Science

Reported by teachers

Students were scored according to how often their teachers responded positively to the seven statements on the *Teacher Job Satisfaction* scale. Students with **Very Satisfied** teachers had a score on the scale of at least 10.1, which corresponds to their teachers responding "very often" to four of the seven statements and responding "often" to the other three, on average. Students with **Less than Satisfied** teachers had a score no higher than 6.6, which corresponds to their teachers responding "sometimes" to four of the seven statements and "often" to the other three, on average. All other students had **Satisfied** teachers.

Country	Very Satisfied		Satisfied		Less than Satisfied		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	59 (4.9)	522 (3.3)	37 (4.7)	520 (4.6)	4 (2.1)	514 (21.2)	10.3 (0.21)
International Avg.	52 (0.5)	509 (0.7)	42 (0.5)	504 (0.8)	6 (0.3)	502 (2.4)	

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

Sources: Exhibit 6.6 international mathematics report (Mullis *et al.*, 2016a) and Exhibit 6.6, international science report (Martin *et al.*, 2016a).

In Northern Ireland, in both mathematics and science, 59 per cent of pupils participating in TIMSS 2015 had teachers who reported that they were 'Very Satisfied' with their job, and a further 37 per cent (in both subjects) had teachers who were 'Satisfied'. Teachers of only 4 per cent of pupils reported that they were 'Less Than Satisfied'. These are similar findings to those seen in 2011.

The percentage of pupils in Northern Ireland taught by teachers falling into the highest category of job satisfaction was higher than the international averages on this scale.

Among the comparator countries, the highest percentage of pupils who had 'Very Satisfied' teachers was in the Republic of Ireland (62 per cent). This compared with an international average of 52 per cent of pupils taught by 'Very Satisfied' teachers. Teacher job satisfaction among the remaining comparator countries was lower than in Northern Ireland. For example, the percentages of pupils in England taught by teachers who reported being 'Very Satisfied' with their jobs was 42 per cent for mathematics and 43 per cent for science.

As was the case in TIMSS 2011, teacher job satisfaction in some high performing Pacific Rim countries was considerably lower than in Northern Ireland. For example, the percentage of pupils in Singapore taught by teachers who reported being 'Very Satisfied' with their careers was 37 per cent for mathematics and 35 per cent for science. At the opposite end of the scale, the percentages of pupils taught by teachers who reported being 'Less than Satisfied' in their role in Singapore were 11 and 12 per cent (for mathematics and science respectively), compared with international averages of 6 per cent.

The international averages for mathematics and science show that, as levels of teacher satisfaction increase, so does achievement generally (although not in the highest achieving countries), but we do not know if this association is statistically significant across all three categories. The same is true in Northern Ireland, although the difference between scores is relatively small and unlikely to be statistically significant.

6.6 Conclusion

In terms of levels of qualification, principals and teachers were asked about the highest level of formal education they had completed and teachers were also asked about the focus of their formal education and training. In Northern Ireland, more than three-quarters of pupils participating in TIMSS 2015 attended schools where the principal has a postgraduate degree (for example a doctorate or master's). This is much higher than the international average. The majority of pupils, 83 per cent, were taught by a teacher with a first degree. However only 16 per cent of pupils were taught by teachers who have a postgraduate degree. This is approximately 10 per cent lower than the international averages (26 per cent for mathematics and 28 per cent for science).

For mathematics, just under two-thirds of pupils were taught by teachers whose main area of study was primary education without specialisation in mathematics. The percentage of pupils taught by a mathematics specialist was 18 per cent; an increase of 7 per cent since 2011. The picture for science was slightly different, where three-quarters of pupils were taught by non-subject specialists and only 12 per cent were taught by teachers who had a specialism in science. This is similar to 2011.

The survey explored what professional development activities teachers had participated in during the last two years. For mathematics, the level of participation in professional development activities in Northern Ireland was higher than on average internationally. The most common areas for teachers in Northern Ireland to participate in professional development were mathematics pedagogy / instruction and mathematics assessment. In contrast to mathematics, the levels of participation in professional development in science were relatively low. This was the case both in Northern Ireland and on average internationally. The most commonly attended areas of professional development in Northern Ireland were science pedagogy / instruction, improving critical thinking or inquiry skills, and integrating science with other subjects; 31 per cent of pupils were taught science by a teacher who had participated in these areas. Levels of participation in professional development activities on assessment were much lower for science than for mathematics, with only 7 per cent of pupils taught by teachers who had participated in a professional development activity on science assessment. This is also much lower than the international average of 25 per cent.

In terms of working with colleagues to improve teaching, teachers in Northern Ireland reported relatively frequent collaboration with their colleagues. For both mathematics and science, the most common collaborative practice reported by teachers was working with colleagues to implement the curriculum. Just over three-quarters of pupils were taught mathematics / science by a teacher who was involved in that aspect of teaching 'Very Often' or 'Often'. Visits to another classroom was the least common form of collaborative practice undertaken by teachers in Northern Ireland; just under a quarter of pupils were taught by a teacher who was involved in that sort of collaboration 'Very Often' or 'Often'.

In Northern Ireland, teachers reported high levels of job satisfaction. This was true of mathematics and science and reflects a similar level of job satisfaction to that seen in 2011. As was the case in 2011, in Northern Ireland, higher levels of career satisfaction did not appear to be associated with increased pupil achievement.

7 School resources

Chapter outline

This chapter summarises principal and teacher reports concerning the working conditions and resources available in their school for teaching mathematics and science in Year 6 (Y6, ages 9-10).

Outcomes for Northern Ireland are compared with the international averages and, in some cases, comparator countries.

Key findings

- In terms of teaching space and conditions, and teaching materials and supplies, teachers in Northern Ireland rated their working conditions relatively highly compared with international averages.
- The majority of pupils participating in TIMSS 2015 were taught mathematics and science by teachers who were classified as having 'Hardly Any Problems' with their working conditions; teachers of 30 per cent of pupils in both subjects reported 'Moderate Problems'.
- According to principals, there were no pupils in Northern Ireland attending schools in which teaching was 'Affected a Lot' by resource shortages. This was the same for both mathematics and science.
- For mathematics, 67 per cent of pupils were in schools in which teaching was reported to be 'Affected' by shortages in resources. This is similar to the international average. For science, the equivalent figure was 80 per cent which is higher than the international average.
- Schools in Northern Ireland had a lower average number of computers available than was the case in most of the subset of main comparator countries and the international average. However, the number of computers available in Northern Ireland's schools has increased on average since 2011.
- Fewer than 10 per cent of pupils were in schools where capacity to teach was affected 'A Lot' by a shortage or inadequacy of five technological resources. This included: 'Technically Competent Staff', 'Audio-visual Resources', Computer Technology for Teaching and Learning' and 'Computer Software / Applications for Science / Mathematics Teaching'. This is lower than the international average.
- In Northern Ireland, fewer pupils were affected by a lack of 'Computer Technology for Teaching and Learning' and by 'Audio-visual Resources of Delivery for Teaching' than was the case in any of the comparator countries.
- Northern Ireland had a higher percentage of pupils attending schools without a school library than the international average and most comparator countries. In Northern Ireland, school libraries seem to be less well equipped than is the case on average internationally.

Interpreting the data: percentages in tables

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

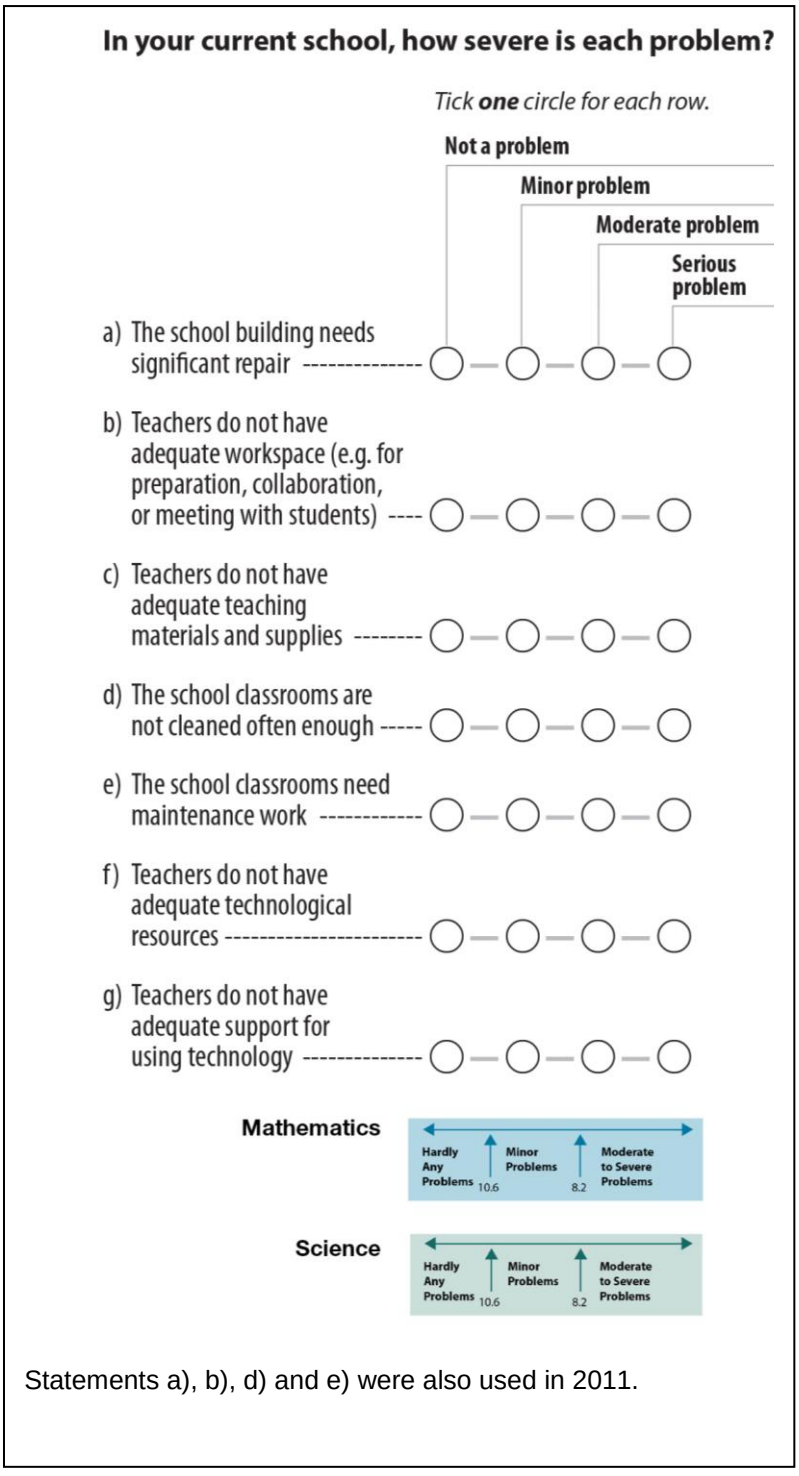
Year 6 (Y6) pupils were sampled by class. As a result, the Y6 Teacher Questionnaire would, in most cases, have been completed by the class teacher of the sampled class. However, in some cases, it might have been completed by different teachers who teach these pupils mathematics and / or science separately.

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 because the distribution of pupils within the sample of teachers may differ by subject.

7.1 School conditions and resources

Teachers were asked to rate the working conditions in their current school in terms of seven potential problem areas. Pupils were scored according to their teachers' responses concerning these areas on the 'Problems with School Conditions and Resources' scale, covering buildings, workspace, materials, classroom conditions and technology. Teachers were asked to rate the severity of each problem (see Figure 7.1) and their responses were analysed as a separate scale for each of mathematics and science. The data for each subject is shown in Table 7.1.

Figure 7.1 School conditions and resources



Statements a), b), d) and e) were also used in 2011.

Source: Adapted from the international version of the TIMSS 2015 Teacher Questionnaire.

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.

Table 7.1 School conditions and resources

Mathematics

Reported by teachers

Students were scored according to their teachers' responses concerning seven conditions and resources on the *Problems with School Conditions and Resources* scale. Students whose teachers reported **Hardly Any Problems** with their school conditions and resources had a score on the scale of at least 10.6, which corresponds to their teachers reporting "not a problem" for four of seven conditions and resources and "minor problem" for the other three, on average. Students whose teachers reported **Moderate to Severe Problems** had a score no higher than 8.2, which corresponds to their teachers reporting "moderate problem" for four of seven conditions and resources and "minor problem" for the other three, on average. All other students had teachers that reported **Minor Problems** with their school conditions and resources.

Country	Hardly Any Problems		Minor Problems		Moderate to Severe Problems		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	60 (4.2)	572 (3.5)	30 (3.3)	570 (7.5)	10 (3.2)	579 (9.1)	10.8 (0.19)
International Avg.	37 (0.5)	512 (0.8)	43 (0.5)	505 (0.7)	20 (0.4)	499 (1.1)	

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

Source: Exhibit 5.8, international mathematics report (Mullis *et al.*, 2016a).

Science

Reported by teachers

Students were scored according to their teachers' responses concerning seven conditions and resources on the *Problems with School Conditions and Resources* scale. Students whose teachers reported **Hardly Any Problems** with their school conditions and resources had a score on the scale of at least 10.6, which corresponds to their teachers reporting "not a problem" for four of seven conditions and resources and "minor problem" for the other three, on average. Students whose teachers reported **Moderate to Severe Problems** had a score no higher than 8.2, which corresponds to their teachers reporting "moderate problem" for four of seven conditions and resources and "minor problem" for the other three, on average. All other students had teachers that reported **Minor Problems** with their school conditions and resources.

Country	Hardly Any Problems		Minor Problems		Moderate to Severe Problems		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	60 (4.2)	572 (3.5)	30 (3.3)	570 (7.5)	10 (3.2)	579 (9.1)	10.8 (0.19)
International Avg.	37 (0.5)	512 (0.8)	43 (0.5)	505 (0.7)	20 (0.4)	499 (1.1)	

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

Source: Exhibit 5.8, international science report (Martin *et al.*, 2016a).

Teachers in Northern Ireland rated the conditions of their school and availability of resources highly. The percentages in each category are the same for each subject, with teachers of almost two-thirds of pupils reporting 'Hardly Any Problems'. This is higher than the international average.

Northern Ireland had the second highest percentage of pupils with teachers reporting 'Hardly Any Problems' in mathematics and the third highest in science across all countries. The percentage of pupils in Northern Ireland with teachers reporting 'Moderate to Severe Problems' or 'Minor Problems' was lower than the international average in both mathematics and science.

Internationally, there are apparent associations between the severity of problems in a school and achievement. That is, as the severity of problems increases achievement decreases. For both mathematics and science, pupils in schools where teachers report 'Moderate to Severe Problems' appear, on average, to have lower scores than those whose teachers report 'Minor Problems' or 'Hardly Any Problems'. This is not the case in Northern Ireland, where there is no association between teacher reports of the severity of challenges with school conditions and resources and pupil achievement. This was true for mathematics and science.

7.2 Views about limitations on teaching caused by resources

7.2.1 Shortage or inadequacy of resources

Principals were asked to rate the extent to which their teachers' capacity to teach was limited by a shortage of resources. Pupils were scored according to their principals' responses concerning the resources shown below (Figure 7.2). In each case, the scale contained the general resources and the relevant subject-specific resources. The question was analysed as two separate scales, one for each subject (mathematics and science). The data for each subject is shown in Table 7.2.

Figure 7.2 Teaching affected by resource shortages

How much is your school's capacity to provide teaching affected by a shortage or inadequacy of the following?

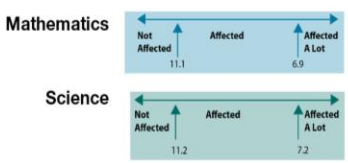
*Tick **one** circle for each row.*

	Not at all	A little	Some	A lot
A. General School Resources				
a) Teaching materials (e.g. textbooks)	○	○	○	○
b) Supplies (e.g. paper, pencils, materials)	○	○	○	○
c) School buildings and grounds	○	○	○	○
d) Heating/cooling and lighting systems	○	○	○	○
e) Teaching space (e.g. classrooms)	○	○	○	○
f) Technologically competent staff	○	○	○	○
g) Audio-visual resources for delivery of teaching (e.g. interactive white boards, digital projectors)	○	○	○	○
h) Computer technology for teaching and learning (e.g. computers or tablets for student use)	○	○	○	○
i) Resources for students with disabilities	○	○	○	○

Statements a) – f) from 2015 were also used in 2011.

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

	Not at all	A little	Some	A lot
B. Resources for Mathematics Teaching				
a) Teachers with a specialisation in mathematics	○	○	○	○
b) Computer software/ applications for mathematics teaching	○	○	○	○
c) Library resources relevant to mathematics teaching	○	○	○	○
d) Calculators for mathematics teaching	○	○	○	○
e) Concrete objects or materials to help pupils understand quantities or procedures	○	○	○	○
C. Resources for Science Teaching				
a) Teachers with a specialisation in science	○	○	○	○
b) Computer software/ applications for science teaching	○	○	○	○
c) Library resources relevant to science teaching	○	○	○	○
d) Science equipment and materials for experiments	○	○	○	○
e) A whole school science policy	○	○	○	○
f) Emphasis of science within the school	○	○	○	○
g) A dedicated science co-ordinator	○	○	○	○



Statements a – d from 2015 were also used in 2011 for both mathematics and science

Source: Adapted from the international version of the TIMSS 2015 School Questionnaire.

Table 7.2 Limitations on teaching caused by resourcing

Mathematics

Reported by principals

Students were scored according to their principals' responses concerning thirteen school and classroom resources on the *Mathematics Resource Shortages* scale. Students in schools where instruction was **Not Affected** by resource shortages had a score on the scale of at least 11.1, which corresponds to their principals reporting that shortages affected instruction "not at all" for seven of the thirteen resources and "a little" for the other six, on average. Students in schools where instruction was **Affected A Lot** had a score no higher than 6.9, which corresponds to their principals reporting that shortages affected instruction "a lot" for seven of the thirteen resources and "some" for the other six, on average. All other students attended schools where instruction was **Affected** by resource shortages.

Country	Not Affected		Affected		Affected A Lot		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 r	33 (4.8)	571 (7.3)	67 (4.8)	570 (4.4)	0 (0.0)	~ ~	10.7 (0.16)	r 0.1 (0.24)
International Avg.	27 (0.5)	519 (1.5)	69 (0.5)	502 (0.5)	4 (0.2)	466 (3.1)		

Significantly higher than 2011 ▲
Significantly lower than 2011 ▼

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 pupils.

Source: Exhibit 5.6, international mathematics report (Mullis *et al.*, 2016a).

Science

Reported by principals

Students were scored according to their principals' responses concerning twelve school and classroom resources on the *Science Resource Shortages* scale. Students in schools where instruction was **Not Affected** by resource shortages had a score on the scale of at least 11.2, which corresponds to their principals reporting that shortages affected instruction "not at all" for six of the twelve resources and "a little" for the other six, on average. Students in schools where instruction was **Affected A Lot** had a score no higher than 7.2, which corresponds to their principals reporting that shortages affected instruction "a lot" for six of the twelve resources and "some" for the other six, on average. All other students attended schools where instruction was **Affected** by resource shortages.

Country	Not Affected		Affected		Affected A Lot		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 r	20 (4.4)	526 (7.7)	80 (4.4)	517 (3.4)	0 (0.0)	~ ~	10.3 (0.14)	r -0.1 (0.23)
International Avg.	25 (0.5)	517 (1.7)	69 (0.5)	504 (0.6)	5 (0.2)	483 (3.1)		

Significantly higher than 2011 ▲
Significantly lower than 2011 ▼

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 pupils.

Source: Exhibit 5.6, international science report (Martin *et al.*, 2016a).

According to their principals, the majority of pupils in Northern Ireland participating in TIMSS 2015 were 'Affected' by resource shortages in both mathematics and science. This is similar to findings in 2011. However, the percentage of pupils, according to their principals, in Northern Ireland that were 'Affected' by shortages of science resources was much higher than for mathematics (80 per cent and 67 per cent respectively). In 2011 there was a similar difference between the subjects.

For mathematics, the percentage of pupils in Northern Ireland in the 'Not Affected' and 'Affected' categories was relatively close to the international averages. For science, on the other hand, whilst the percentage of pupils 'Not Affected' by resource shortages was also relatively close to the international average (although lower), the percentage of pupils in the

'Affected' category was higher. Northern Ireland had no pupils in the 'Affected A Lot' category for either subject, as did 11 of the other countries participating in TIMSS 2015.

Internationally, the pattern is for pupils in less well resourced schools to show lower attainment in each subject. This appears to be the pattern in Northern Ireland also, although the achievement scores in mathematics are almost identical for pupils in Northern Ireland in the 'Affected' and 'Not Affected' categories. Due to the sizes of the standard errors, however, this apparent trend is unlikely to be statistically significant at national level in Northern Ireland. This mirrors what was seen in 2011.

7.2.2 Availability of computers

Principals were asked about the availability of computers, including tablets, in their schools. Table 7.3 shows the average number of computers available for Y6 pupils. (Data is provided for Northern Ireland and the comparator countries for 2015 and 2011.)

The average number of computers available per school for use by Y6 pupils in Northern Ireland was slightly lower than the international average (30 and 35 respectively). Although there has been an increase in the average number of computers available in Northern Ireland since 2011, this is not as big an increase as that seen on average internationally. Of the comparator countries, Singapore had the highest number of computers for Y6 pupils (180). Poland and the Republic of Ireland had a lower average number of computers available to pupils compared with Northern Ireland: 25 and 18 respectively.

Table 7.3 Availability of computers

Country	Average number of computers available for Y6	
	2015	2011
Australia	45	33
England	47	43
Finland	31	17
Hong Kong SAR	74	64
Northern Ireland	30	24
Poland	25	11
Republic of Ireland	18	12
Singapore	180	123
International Avg.	**35**	**25**

Sources: 2015 School Context Data Almanac by Mathematics Achievement and 2015 School Context Data Almanac by Science Achievement question ACBG11, and 2011 School Background Data Almanac by Mathematics Achievement and School Background Data Almanac by Science Achievement question ACBG07.

7.2.3 Limitations on teaching caused by technological resources

As discussed in section 7.2.1, principals reported the extent to which their school's capacity to provide teaching was affected by shortages in or inadequacies of resources. Table 7.4

highlights the statements that focused on various technological resources. It shows the percentages of pupils in schools where principals reported that teaching was affected 'A Lot' by shortages of these technological resources. Among comparator countries and internationally, findings varied significantly. This may reflect the way in which different education systems benchmark the availability of resources and competence of staff.

Table 7.4 Limitations on teaching caused by technological resources

Country	Percentage of pupils whose principals reported teaching being affected 'A Lot' by shortages or inadequacies				
	Technologically competent staff	Audio-visual resources of delivery for teaching	Computer technology for teaching and learning	Computer software / applications for mathematics	Computer software / applications for science
	(%)	(%)	(%)	(%)	(%)
Australia	5	3	6	4	10
England	1	3	6	2	3
Finland	1	3	12	4	4
Hong Kong SAR	8	11	13	7	9
Northern Ireland	7	0	2	1	9
Poland	5	8	10	8	6
Republic of Ireland	4	4	20	10	21
Singapore	10	13	11	8	8
International Avg.	**11**	**12**	**14**	**10**	**12**

Sources: 2015 School Context Data Almanac by Mathematics / Science, questions ACBG14AF, ACBG14AG, ACBG14AH, ACBG14BB, ACBG14CB.

In Northern Ireland, 7 per cent of pupils were taught in schools which principals reported were affected 'A Lot' by shortages or inadequacies of 'Technologically Competent Staff', while none were affected by 'Audio-visual Resources of Delivery for Teaching', 2 per cent were affected by shortages or inadequacies of 'Computer Technology for Teaching and Learning' and 1 per cent were affected by shortages or inadequacies of 'Computer 'Computer Software / Applications for Mathematics'. A shortage or inadequacy of 'Computer Software / Applications for Science Teaching' had the highest percentage, affecting 9 per cent of pupils participating in TIMSS 2015, although this has decreased since 2011 when it was 15 per cent. Despite the percentage of pupils being affected 'A Lot' by a shortage or inadequacy of 'Technologically Competent Staff' and 'Computer Software Applications for Science' being slightly higher than for the other shortages or inadequacies, the percentages of pupils affected in all categories in Northern Ireland are lower than the international averages.

Across the comparator countries, Singapore and Hong Kong had higher percentages of pupils affected 'A Lot' by a shortage or inadequacy of 'Technologically Competent Staff' than Northern Ireland (10 per cent and 8 per cent respectively). For 'Audio-visual Resources of Delivery for Teaching' and 'Computer Technology for Teaching and Learning', Northern Ireland had the lowest percentage of pupils affected 'A Lot' by shortages or inadequacies than any comparator country.

Among the comparator countries, Singapore also had the highest percentage of principals reporting that shortages of 'Audio-visual Resources of Delivery for Teaching' (13 per cent) impacted on capacity to teach. In the Republic of Ireland, 20 per cent of pupils participating in TIMSS 2015 were taught in schools affected 'A Lot' by shortages or inadequacies of 'Computer Technology for Teaching and Learning', and 10 per cent were affected by shortages or inadequacies of 'Computer Software / Applications for Mathematics'. These are the highest percentages in these shortage areas across the comparator countries.

The Republic of Ireland and Australia had higher percentages of pupils affected 'A Lot' by shortages or inadequacies of 'Computer Software / Applications for Science', than Northern Ireland (21 per cent and 10 per cent respectively), and Hong Kong had the same percentage as Northern Ireland (9 per cent).

7.3 Access to school library

In Northern Ireland, 73 per cent of pupils participating in TIMSS 2015 attended schools with a library. This is similar to 2011 but is lower than the international average of 87 per cent (in both 2015 and 2011).

Table 7.5 Percentage of pupils attending a school with a library

Country	Percentage of pupils (%)
Australia	99
England	92
Finland	67
Hong Kong SAR	100
Northern Ireland	73
Poland	97
Republic of Ireland	53
Singapore	100
International Avg.	**87**

Sources: 2015 School Context Data Almanac Mathematics / Science, question ACBG13

Among comparator countries, Northern Ireland had the second lowest percentage of pupils with access to a school library. All pupils in Hong Kong and Singapore, 99 per cent of pupils in Australia, 97 per cent of pupils in Poland, 92 per cent of pupils in England and 76 per cent

of pupils in Finland attended a school with a library. Only the Republic of Ireland was lower, with 53 per cent of pupils participating in TIMSS 2015 attending a school with a library.

Where principals reported that there was a library in their school they were then asked to indicate:

- the number of books with different titles (print and digital) available in the library
- the number of magazines and other periodicals (print and digital) available in the library (Table 7.6).

Table 7.6 Availability of books, magazines and other periodicals in school libraries

	Percentage of pupils			
	Books with different titles		Magazines and other periodicals	
Country	More than 5000 printed	More than 250 digital	More than 10 print	More than 10 digital
	(%)	(%)	(%)	(%)
Australia	61	25	35	11
England	17	14	8	0
Finland	4	1	3	0
Hong Kong SAR	80	25	41	1
Northern Ireland	1	0	6	0
Poland	60	3	18	3
Republic of Ireland	9	1	3	0
Singapore	73	37	45	8
International Avg.	**36**	**14**	**24**	**5**

Sources: 2015 School Context Data Almanac by Mathematics / Science, questions ACBG13AA, ACBG13AB, ACBG13BA, ACBG13BB.

Principals in Northern Ireland reported that 1 per cent of pupils attended a school with a large school library (more than 5000 printed books). This was considerably lower than the international average (36 per cent) but similar to the 2011 findings. As was the case in 2011, Hong Kong and Singapore reported the highest percentages of pupils with access to school libraries with more than 5000 printed books (80 per cent and 73 per cent respectively).

In terms of digital books, Northern Ireland had no pupils in schools with more than 250 digital books in their library. Across the comparator countries the picture was varied, with Finland, the Republic of Ireland and Poland reporting very low numbers of pupils attending schools with libraries containing more than 250 digital books, while Singapore, Hong Kong and Australia, by contrast, reported the highest levels of access to school libraries equipped with more than 250 digital books (37 per cent, 25 per cent and 25 per cent of pupils respectively).

Northern Ireland had only 6 per cent of pupils at schools with more than 10 print magazines and other periodicals in the school library, and no pupils in schools with libraries equipped with more than 10 magazines and periodicals in digital form. This is lower than the international averages (24 and 5 per cent respectively). However, among the comparator countries, Northern Ireland is not alone in having no pupils attending schools with access to 10 or more digital magazines / periodicals. Of the comparator countries, the situation is the same in England, Finland and the Republic of Ireland. In fact, when compared with Northern Ireland, the Republic of Ireland and Finland had a lower percentage of pupils attending schools with 10 or more printed periodicals / magazines.

Once again it was Singapore, Hong Kong and Australia that had the best equipped school libraries. In Australia, 11 per cent of pupils participating in TIMSS 2015 attended schools with a library equipped with more than 10 digital magazines and other periodicals. This is higher than any of the other comparator countries and significantly higher than the international average.

7.4 Conclusion

Teachers were asked about a number of potential challenges relating to school conditions and resources that might impact on their teaching. These included the condition of their school buildings, workspace and classrooms. They were also asked about support around technology and technological resources. Responses indicated that, overall, the majority of pupils in Northern Ireland participating in TIMSS 2015 were taught by teachers who reported having 'Hardly Any Problems' with their working conditions, although a sizeable minority reported 'Minor Problems'. Although international results show that, as the severity of challenges increases, achievement decreases, this is not true in Northern Ireland, where there is no association between the reported severity of problems and achievement.

In Northern Ireland, the majority of pupils attended schools where the principal reported that teaching was 'Affected' by a shortage of resources. This was true for both mathematics and science, although results for science in Northern Ireland were higher than the international average. No principals reported pupils being 'Affected A Lot' by resource shortages. Findings were similar in 2011. The pattern in the international results is for pupils in less well resourced schools to show lower attainment in each subject; this pattern was also seen in Northern Ireland but is unlikely to be statistically significant..

On average, principals in Northern Ireland reported that their schools had 30 computers available for Y6 pupils. Although this is an increase from 2011, it remains lower than the international average and most of the comparator countries. In terms of the impact of shortages of or inadequacies in technological resources and support, more pupils were reported to be affected by a shortage or inadequacy of 'Technologically Competent Staff' and 'Computer Software / Applications for Science' in Northern Ireland than any other shortage or inadequacy. However, in all areas of shortage, Northern Ireland had a lower percentage of pupils affected than the international average.

In Northern Ireland a higher percentage of pupils attended schools without a school library than the international average and most comparator countries. In addition pupils participating in TIMSS 2015 in Northern Ireland were less likely to attend schools with a well-

resourced library, as in 2011. Pupils in Northern Ireland were not alone in attending schools with less well equipped libraries; this was also the case in the Republic of Ireland and Finland.

8 School learning environment

Chapter outline

This chapter presents findings from TIMSS 2015 relating to the school learning environment, as reported by teachers and principals. Sections relate to the emphasis placed on academic success and perceptions of safety, orderliness, discipline, bullying and the impact of disruptive and uninterested pupils.

Outcomes for Northern Ireland are compared with the international averages, and where relevant, with those of other countries.

Key findings

- In both mathematics and science, principals and teachers in Northern Ireland reported some of the highest levels of emphasis on academic success of any nation. Teachers reported higher levels of emphasis on academic success than principals.
- The vast majority of pupils in Northern Ireland attended schools which were categorised as 'Very Safe and Orderly' (teacher reports), with only one country having a higher percentage of pupils in this category. Similarly most pupils in Northern Ireland attended schools with 'Hardly Any', or 'Minor', problems with discipline (principal reports).
- On average, pupils in Northern Ireland participating in TIMSS 2015 reported experiencing bullying behaviours less frequently than those in most other participating countries.
- Teachers in Northern Ireland reported that their teaching was rarely limited by disruptive or uninterested pupils.
- Most aspects of the school learning environment in Northern Ireland remained stable between the 2011 and 2015 TIMSS cycles.

Interpreting the data: percentages in tables

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

Year 6 (Y6) pupils (ages 9-10) were sampled by class. As a result, the Y6 Teacher Questionnaire would, in most cases, 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 because the distribution of pupils within the sample of teachers may differ by subject.

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.

8.1 Schools' emphasis on academic success – views of teachers and principals

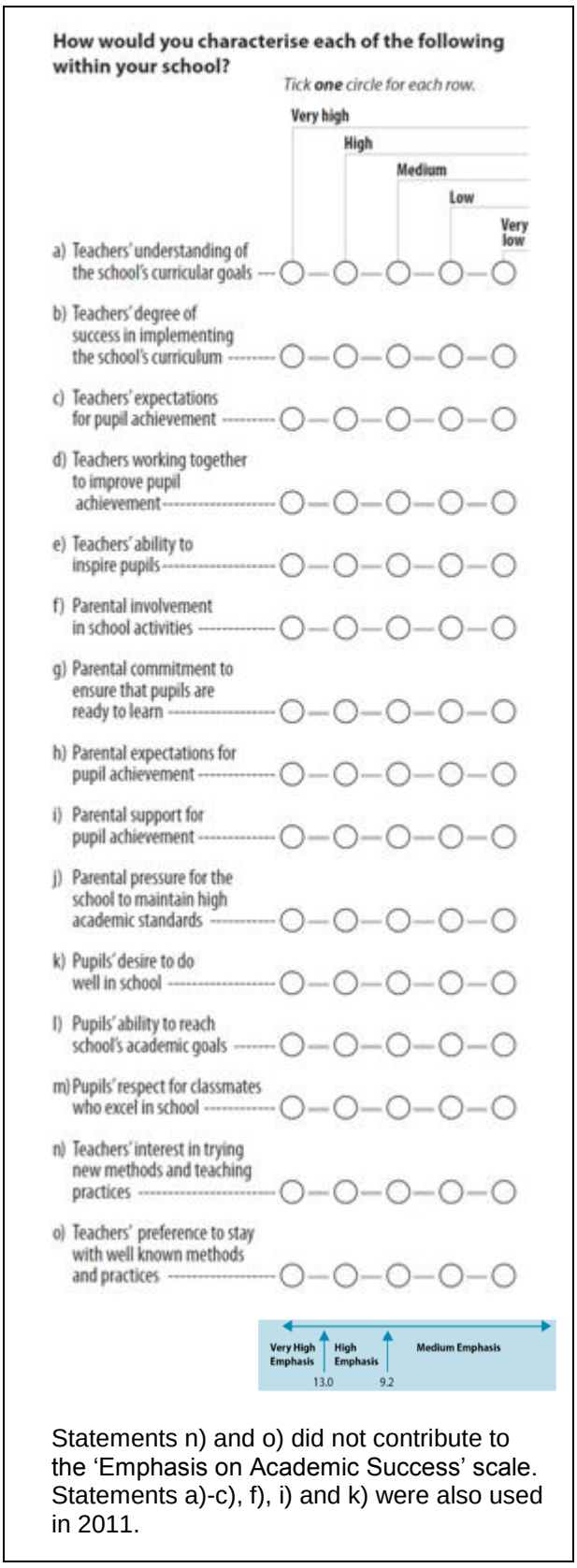
Principals and teachers were asked to rate the emphasis placed on academic success within their school by teachers, parents and pupils. Principals were asked a set of 13 questions, shown in Figure 8.1. Teachers answered a similar set of questions to principals, plus several additional questions; these are shown in Figure 8.2. Principals and teachers were also invited to rate levels of parental support and pupil motivation, as well as teachers' understanding of curricula goals and their expectations of pupils.

The questions were analysed as a separate scale for each subject (mathematics and science). The scale categories for each subject (for principals and teachers) are summarised below the teacher questions in Figure 8.2 and the data for each subject is shown in Table 8.1.

The data provided by principals and teachers for this scale comes from the School Questionnaire and the Teacher Questionnaire. The majority of the questions are not subject-specific. As a result, the overall proportions are broadly the same for mathematics and science[34]. Differences in achievement scores, however, are subject specific and have been reported separately where appropriate.

[34] Small differences in percentages may arise from patterns of non-response, or rounding.

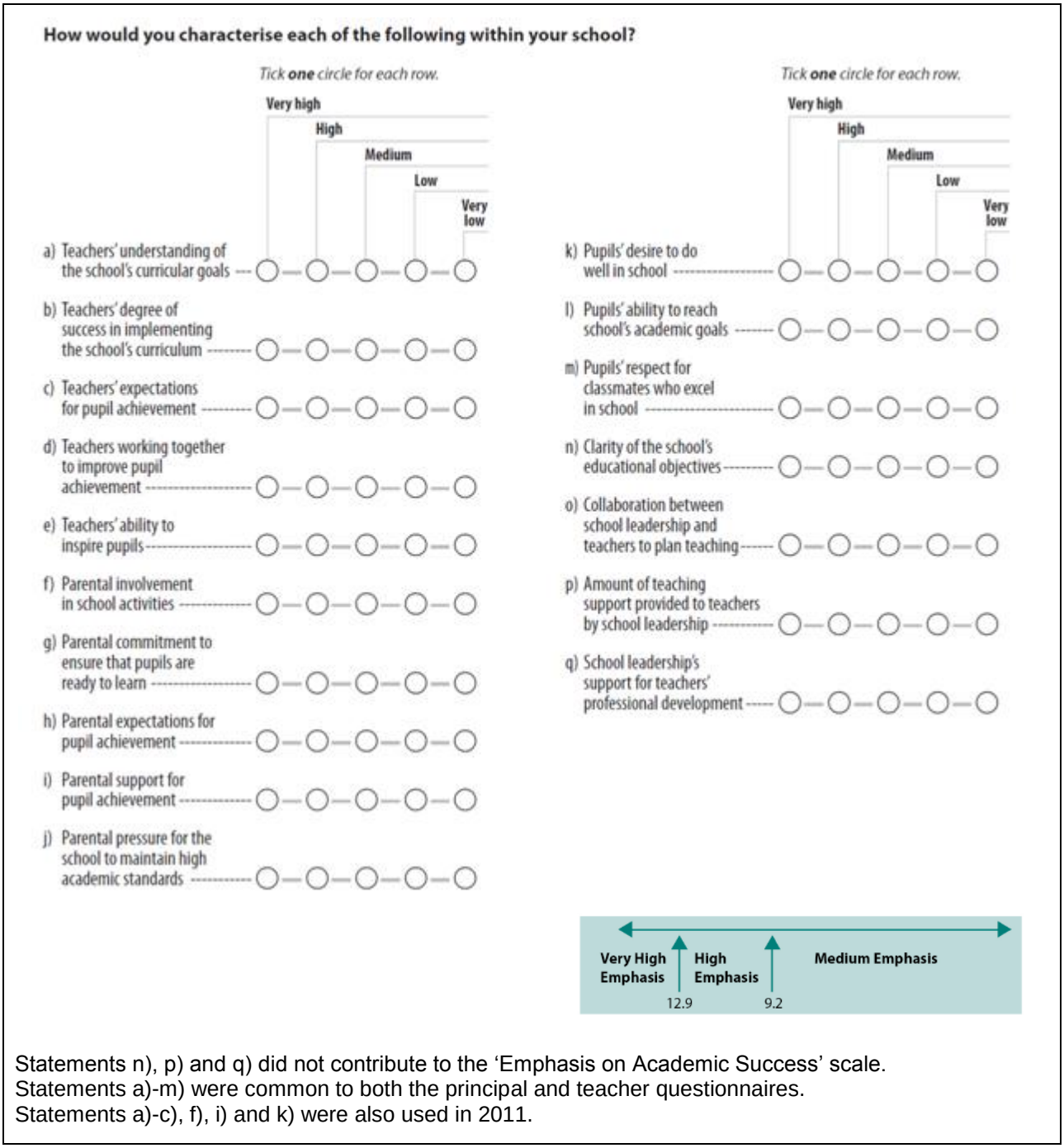
Figure 8.1 School's emphasis on academic success – questions for school principal



Statements n) and o) did not contribute to the 'Emphasis on Academic Success' scale. Statements a)-c), f), i) and k) were also used in 2011.

Source: Exhibit 6.2, International mathematics report (Mullis *et al.*, 2016a) and Exhibit 6.2 International science report (Martin *et al.*, 2016a).

Figure 8.2 School's emphasis on academic success – questions for teachers



Statements n), p) and q) did not contribute to the 'Emphasis on Academic Success' scale.
Statements a)-m) were common to both the principal and teacher questionnaires.
Statements a)-c), f), i) and k) were also used in 2011.

Source: Exhibit 6.4, International mathematics report (Mullis *et al.*, 2016a) and Exhibit 6.4 International science report (Martin *et al.*, 2016a).

Table 8.1 School emphasis on academic success

Mathematics

Reported by principals

Students were scored according to their principals' responses characterizing thirteen aspects on the *School Emphasis on Academic Success* scale. Students in schools where their principals reported a **Very High Emphasis** on academic success had a score on the scale of at least 13.0, which corresponds to their principals characterizing seven of the thirteen aspects as "very high" and the other six as "high," on average. Students in schools with a **Medium Emphasis** on academic success had a score no higher than 9.2, which corresponds to their principals characterizing seven of the thirteen aspects as "medium" and the other six as "high," on average. All other students attended schools with a **High Emphasis** on academic success.

Country	Very High Emphasis		High Emphasis		Medium Emphasis		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	15 (3.9)	589 (8.6)	76 (4.6)	569 (4.2)	9 (2.7)	548 (9.8)	11.4 (0.19)
International Avg.	7 (0.3)	527 (2.4)	54 (0.5)	512 (0.6)	39 (0.5)	490 (0.8)	

This TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale points corresponded to the standard deviation of the distribution.

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

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

Mathematics

Reported by teachers

Students were scored according to their teachers' responses characterizing fourteen aspects on the *School Emphasis on Academic Success* scale. Students in schools where their teachers reported a **Very High Emphasis** on academic success had a score on the scale of at least 12.9, which corresponds to their teachers characterizing seven of the fourteen aspects as "very high" and the other seven as "high," on average. Students in schools with a **Medium Emphasis** on academic success had a score no higher than 9.2, which corresponds to their teachers characterizing seven of the fourteen aspects as "medium" and the other seven as "high," on average. All other students attended schools with a **High Emphasis** on academic success.

Country	Very High Emphasis		High Emphasis		Medium Emphasis		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	22 (3.6)	585 (7.3)	67 (4.4)	574 (4.2)	11 (3.1)	539 (6.6)	11.8 (0.20)
International Avg.	7 (0.3)	515 (2.2)	56 (0.5)	513 (0.6)	36 (0.5)	488 (0.8)	

This TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale points corresponded to the standard deviation of the distribution.

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

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

Sources: Exhibits 6.2 and 6.4 International mathematics report (Mullis *et al.*, 2016a).

Table 8.1 School emphasis on academic success - continued

Science

Reported by principals

Students were scored according to their principals' responses characterizing thirteen aspects on the *School Emphasis on Academic Success* scale. Students in schools where their principals reported a **Very High Emphasis** on academic success had a score on the scale of at least 13.0, which corresponds to their principals characterizing seven of the thirteen aspects as "very high" and the other six as "high," on average. Students in schools with a **Medium Emphasis** on academic success had a score no higher than 9.2, which corresponds to their principals characterizing seven of the thirteen aspects as "medium" and the other six as "high," on average. All other students attended schools with a **High Emphasis** on academic success.

Country	Very High Emphasis		High Emphasis		Medium Emphasis		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	15 (3.9)	529 (7.5)	76 (4.6)	519 (3.3)	9 (2.7)	503 (7.8)	11.4 (0.19)
International Avg.	7 (0.3)	525 (2.2)	55 (0.6)	514 (0.6)	38 (0.5)	491 (0.9)	

This TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale points corresponded to the standard deviation of the distribution.

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

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

Science

Reported by teachers

Students were scored according to their teachers' responses characterizing fourteen aspects on the *School Emphasis on Academic Success* scale. Students in schools where their teachers reported a **Very High Emphasis** on academic success had a score on the scale of at least 12.9, which corresponds to their teachers characterizing seven of the fourteen aspects as "very high" and the other seven as "high," on average. Students in schools with a **Medium Emphasis** on academic success had a score no higher than 9.2, which corresponds to their teachers characterizing seven of the fourteen aspects as "medium" and the other seven as "high," on average. All other students attended schools with a **High Emphasis** on academic success.

Country	Very High Emphasis		High Emphasis		Medium Emphasis		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	22 (3.6)	529 (5.3)	66 (4.4)	522 (3.4)	11 (3.1)	500 (5.9)	11.8 (0.20)
International Avg.	8 (0.3)	522 (2.4)	56 (0.5)	514 (0.6)	36 (0.5)	491 (0.9)	

This TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale points corresponded to the standard deviation of the distribution.

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

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

Sources: Exhibits 6.2 and 6.4 International science report (Martin *et al.*, 2016a).

In Northern Ireland, across both mathematics and science, principals of 91 per cent of pupils participating in TIMSS 2015 reported that their schools placed a 'High' or 'Very High' emphasis on academic success. This is similar to the 2011 results, which showed principals of over 90 per cent of pupils reporting that their school had either a 'High' or 'Very High' emphasis on academic success. However, compared with 2011 the percentage of pupils in the highest category has decreased, from 33 per cent in 2011 to 15 per cent in 2015. Caution should though be exercised when comparing 2011 and 2015. This is because the number of questions contributing to the scale has increased from eight to 13, and only six questions are common to both the 2011 and 2015 scales.

Teacher reports broadly reflected those of principals. Just under 90 per cent of pupils across both mathematics and science were in schools where their teachers reported a 'High' or 'Very High' emphasis on academic success. As with principals, the most noticeable change

between 2011 and 2015 was a decrease in the percentage of pupils in schools in which teachers reported a 'Very High Emphasis' on academic success. This fell from 31 per cent in 2011 to 22 per cent in 2015.

In both mathematics and science, Northern Ireland was one of the nations participating in TIMSS 2015 with the highest school emphasis on academic success. Only six countries had a higher proportion of pupils whose principals reported that their schools placed a 'Very High Emphasis' on academic success. These countries included the high performer Korea (26 per cent) and the Republic of Ireland (19 per cent). By contrast, in the sub-set of main comparator countries considered for this report, Poland and Finland had some of the lowest figures internationally, with only 1 per cent of pupils in schools where principals reported placing a 'Very High Emphasis' on academic success.

Teachers in Northern Ireland were more likely to report that their school placed a 'Very High Emphasis' on academic success than principals; 22 per cent of pupils in Northern Ireland were taught in schools where teachers reported that their school placed a 'Very High Emphasis' on academic success in mathematics and science. Korea was the only country to have a higher percentage of pupils in this category (29 per cent). Among the main comparator countries Poland, Singapore, Hong Kong and Finland all had less than 5 per cent of pupils in schools where teachers reported placing a 'Very High Emphasis' on success.

Principals had an average scale score of 11.4 and teachers 11.8. This was the case for mathematics and science. (Details of how the scale scores were calculated is provided in Table 8.1). For mathematics, Northern Ireland had the highest scale score for teachers of any participating country and the fourth highest scale score for principals. For science, the results were similarly high, with Northern Ireland having the joint highest average scale score for teachers and the fourth highest for principals.

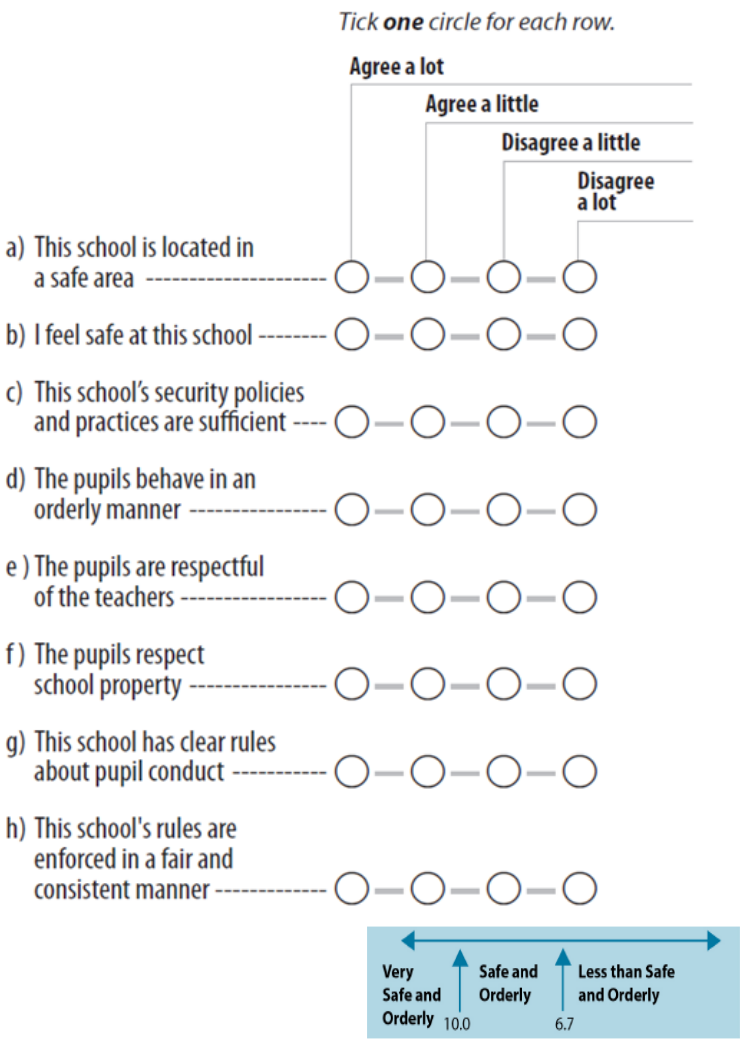
On average, across all countries internationally, pupil attainment in both mathematics and science tended to be higher where teachers and principals reported a higher emphasis on academic success. This was also the case in Northern Ireland; however, the association between emphasis on academic success and achievement is unlikely to be statistically significant for mathematics or science.[35]

8.2 The extent to which schools are 'safe and orderly'

Teachers were asked about their perceptions of safety and the behaviour of pupils in their school. Based on their responses, pupils were categorised as attending schools which were either 'Very Safe and Orderly'; 'Safe and Orderly'; or 'Less than Safe and Orderly' (see Figure 8.3). The results for both mathematics and science are shown in Table 8.2.

[35] Based on low percentages in some categories and/or the size of standard errors.

Figure 8.3 Safe and orderly schools



Statements a)-e) were also used in the 2011 survey.

Source: adapted from Exhibit 7.3, International mathematics report (Mullis *et al.*, 2016a) and Exhibit 7.3, International science report (Martin *et al.*, 2016a).

Table 8.2 Safe and orderly schools

Mathematics

Reported by teachers

Students were scored according to their teachers' degree of agreement with eight statements on the *Safe and Orderly School* scale. Students in **Very Safe and Orderly** schools had a score on the scale of at least 10.0, which corresponds to their teachers "agreeing a lot" with four of the eight qualities of a safe and orderly school and "agreeing a little" with the other four, on average. Students in **Less than Safe and Orderly** schools had a score no higher than 6.7, which corresponds to their teachers "disagreeing a little" with four of the eight qualities and "agreeing a little" with the other four, on average. All other students attended **Safe and Orderly** schools.

Country	Very Safe and Orderly		Safe and Orderly		Less than Safe and Orderly		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 r	85 (3.1)	576 (3.1)	15 (3.1)	554 (12.1)	0 (0.0)	~ ~	12.0 (0.16)	r 0.5 (0.21)
International Avg.	56 (0.5)	511 (0.6)	40 (0.5)	497 (0.8)	4 (0.2)	464 (2.9)		

This TIMSS questionnaire scale was established in 2011 based on the combined response distribution of all countries that participated in TIMSS 2011. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale score points corresponded to the standard deviation of the distribution.

( ) 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 pupils.

Science

Reported by teachers

Students were scored according to their teachers' degree of agreement with eight statements on the *Safe and Orderly School* scale. Students in **Very Safe and Orderly** schools had a score on the scale of at least 10.0, which corresponds to their teachers "agreeing a lot" with four of the eight qualities of a safe and orderly school and "agreeing a little" with the other four, on average. Students in **Less than Safe and Orderly** schools had a score no higher than 6.7, which corresponds to their teachers "disagreeing a little" with four of the eight qualities and "agreeing a little" with the other four, on average. All other students attended **Safe and Orderly** schools.

Country	Very Safe and Orderly		Safe and Orderly		Less than Safe and Orderly		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 r	85 (3.1)	523 (2.4)	15 (3.1)	506 (7.3)	0 (0.0)	~ ~	12.0 (0.16)	r 0.5 (0.21)
International Avg.	57 (0.5)	513 (0.6)	39 (0.5)	498 (0.8)	4 (0.2)	469 (2.8)		

This TIMSS questionnaire scale was established in 2011 based on the combined response distribution of all countries that participated in TIMSS 2011. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale score points corresponded to the standard deviation of the distribution.

( ) 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 pupils.

Sources: Exhibit 7.3, International mathematics report (Mullis *et* al., 2016a) and Exhibit 7.3, International science report (Martin *et al.*, 2016a).

In both mathematics and science, the vast majority of pupils in Northern Ireland participating in TIMSS 2015 (85 per cent) had teachers who reported that their schools were 'Very Safe and Orderly'. Among all participating countries, only teachers in Indonesia reported a higher percentage of pupils in 'Very Safe and Orderly' schools (87 per cent). This mirrors the findings from 2011. The average scale score for Northern Ireland was 12 for both mathematics and science. This was the second highest score among participating countries; again, Indonesia was the only country with a marginally higher average scale score (12.1 for both subjects).

For mathematics, across the comparator countries, there was variation in terms of the percentage of pupils in each of the three categories of this scale. England, Australia and the

Republic of Ireland had 75 per cent or more of pupils in the 'Very Safe and Orderly' category. Poland by contrast had 50 per cent of pupils in this category and Finland only 37 per cent. As was the case for Northern Ireland, all the comparator countries had a very small proportion of pupils (3 per cent or less) in schools categorised as being 'Less than Safe and Orderly'.

For science, the Republic of Ireland, Australia and England had over 70 per cent of pupils in the 'Very Safe and Orderly' category. Poland, Singapore and Hong Kong had between 60 and 70 per cent of pupils in 'Very Safe and Orderly' schools, and Finland, again, had 37 per cent. All seven comparator countries had fewer than five per cent of pupils in 'Less than Safe and Orderly' schools.

In 2011, among all countries participating in TIMSS, Northern Ireland had the largest percentage of pupils in the highest category for school safety and orderliness; this was the case for both subjects. The results for Northern Ireland for both mathematics and science remained stable between 2011 and 2015, with the percentage of pupils in the highest category for safety and orderliness remaining the same. However, since 2011, the number of questions on school safety and orderliness has changed[36].

Internationally, pupils in schools that teachers reported as being 'Very Safe and Orderly', on average, scored more highly than those in schools that teachers reported were 'Safe and Orderly', which in turn scored more highly than those deemed 'Less than Safe and Orderly'. This suggests an association between safety and orderliness and attainment[37], but this relationship was not seen in all participating countries and the direction of causality cannot be inferred from the data.

In Northern Ireland, there did appear to be an association between attending a school that was judged to be 'Very Safe and Orderly' and higher average achievement in both mathematics and science, as can be seen in Table 8.2. The standard error statistics suggest, however, that these differences are unlikely to be statistically significant. The association between attending schools which are 'Very Safe and Orderly' and higher average achievement was consistent across all seven comparator countries.

The full international tables follow, for reference, showing data for all countries (Tables 8.3 and 8.4).

[36] Only five questions were used in 2011 to calculate this scale, as opposed to eight in 2015. The three categories in 2011 were also different to 2015. In 2011, schools were categorised as being either 'Safe and Orderly', 'Somewhat Safe and Orderly' or 'Not Safe and Orderly'.
[37] Tests of statistical significance were not carried out in this international analysis.

Table 8.3 International tables for safe and orderly schools (mathematics)

Students were scored according to their teachers' degree of agreement with eight statements on the *Safe and Orderly School* scale. Students in **Very Safe and Orderly** schools had a score on the scale of at least 10.0, which corresponds to their teachers "agreeing a lot" with four of the eight qualities of a safe and orderly school and "agreeing a little" with the other four, on average. Students in **Less than Safe and Orderly** schools had a score no higher than 6.7, which corresponds to their teachers "disagreeing a little" with four of the eight qualities and "agreeing a little" with the other four, on average. All other students attended **Safe and Orderly** schools.

Country	Very Safe and Orderly		Safe and Orderly		Less than Safe and Orderly		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		
Indonesia	89 (2.1)	399 (3.7)	11 (2.1)	390 (12.3)	0 (0.1)	~ ~	12.1 (0.11)	◊ ◊
Northern Ireland r	85 (3.1)	576 (3.1)	15 (3.1)	554 (12.1)	0 (0.0)	~ ~	12.0 (0.16)	r 0.5 (0.21)
Ireland, Rep. of	83 (2.7)	551 (2.2)	14 (2.7)	536 (5.6)	2 (1.3)	~ ~	11.7 (0.15)	0.4 (0.21)
Qatar	77 (3.2)	444 (4.3)	21 (3.2)	432 (9.0)	2 (1.2)	~ ~	11.3 (0.15)	0.9 (0.19) ▲
Spain	76 (2.6)	512 (2.6)	21 (2.6)	489 (5.0)	3 (1.0)	442 (19.5)	11.1 (0.11)	1.4 (0.20) ▲
England	76 (3.7)	550 (4.0)	24 (3.7)	536 (6.2)	0 (0.4)	~ ~	11.3 (0.17)	0.6 (0.25) ▲
Kazakhstan	75 (3.7)	545 (5.6)	25 (3.7)	544 (8.2)	0 (0.0)	~ ~	11.5 (0.16)	0.7 (0.22) ▲
Australia	75 (2.8)	529 (4.1)	23 (2.9)	490 (5.8)	2 (0.8)	~ ~	11.4 (0.13)	r 0.3 (0.21)
Norway (5)	72 (3.0)	553 (3.0)	24 (2.9)	540 (3.6)	4 (1.4)	554 (20.1)	10.8 (0.14)	◊ ◊
New Zealand	71 (2.5)	504 (2.6)	26 (2.2)	461 (5.0)	3 (0.8)	446 (12.7)	11.0 (0.12)	0.0 (0.15)
Iran, Islamic Rep. of	70 (2.5)	432 (4.1)	27 (2.5)	436 (6.8)	3 (1.1)	379 (23.5)	10.7 (0.12)	0.4 (0.19)
Bulgaria	69 (3.5)	533 (5.3)	29 (3.7)	504 (8.9)	2 (1.8)	~ ~	10.4 (0.13)	◊ ◊
Portugal	65 (3.4)	547 (3.1)	32 (3.5)	534 (4.4)	3 (1.1)	503 (24.5)	10.6 (0.13)	1.0 (0.23) ▲
Oman	64 (2.9)	430 (3.2)	33 (3.0)	418 (5.2)	3 (1.1)	421 (9.5)	10.5 (0.12)	0.6 (0.15) ▲
Hong Kong SAR	64 (4.5)	616 (3.4)	34 (4.5)	612 (6.5)	2 (1.3)	~ ~	10.6 (0.17)	0.4 (0.24)
Singapore	63 (2.6)	619 (4.5)	35 (2.6)	616 (6.5)	2 (0.6)	~ ~	10.7 (0.11)	0.4 (0.15) ▲
Georgia	62 (3.8)	468 (5.3)	37 (3.9)	456 (6.3)	1 (0.6)	~ ~	10.4 (0.14)	-0.9 (0.18) ▼
United Arab Emirates	62 (1.8)	473 (3.5)	35 (1.8)	420 (4.6)	3 (0.8)	409 (23.1)	10.6 (0.08)	-0.2 (0.11)
Cyprus	60 (3.8)	530 (3.1)	36 (3.7)	513 (4.1)	4 (1.3)	514 (7.7)	10.5 (0.17)	◊ ◊
Netherlands r	60 (3.7)	534 (2.2)	39 (3.8)	523 (2.7)	1 (1.1)	~ ~	10.3 (0.16)	r 0.1 (0.24)
Saudi Arabia	59 (3.0)	397 (5.5)	34 (3.2)	361 (6.9)	7 (2.0)	379 (19.9)	10.1 (0.13)	-0.3 (0.21)
Lithuania	57 (4.3)	535 (3.7)	42 (4.2)	536 (4.5)	1 (0.8)	~ ~	10.3 (0.13)	0.6 (0.18) ▲
Bahrain	56 (2.5)	464 (2.4)	37 (2.5)	442 (2.8)	8 (0.9)	427 (5.6)	10.2 (0.13)	-0.1 (0.22)
Canada	55 (2.2)	512 (2.8)	42 (2.3)	511 (4.8)	3 (0.8)	484 (14.1)	10.4 (0.09)	◊ ◊
Kuwait	55 (3.5)	355 (5.3)	41 (3.4)	347 (9.0)	3 (1.0)	360 (36.1)	10.1 (0.15)	◊ ◊
United States	55 (2.5)	552 (3.0)	38 (2.3)	526 (4.4)	7 (1.4)	500 (11.1)	10.3 (0.12)	-0.2 (0.15)
Russian Federation	55 (3.8)	566 (4.6)	43 (3.9)	562 (6.5)	2 (0.9)	~ ~	10.1 (0.12)	0.2 (0.21)
Czech Republic	54 (3.6)	532 (3.0)	45 (3.5)	524 (3.7)	2 (0.8)	~ ~	9.8 (0.12)	0.3 (0.17)
Italy	53 (3.3)	508 (4.0)	44 (3.3)	507 (3.7)	3 (1.5)	482 (16.0)	10.0 (0.14)	1.4 (0.19) ▲
Slovak Republic	53 (3.3)	504 (3.3)	44 (3.3)	494 (4.0)	3 (1.0)	453 (19.4)	9.8 (0.11)	0.4 (0.14) ▲
Serbia	52 (3.5)	521 (4.0)	41 (3.6)	513 (6.4)	7 (1.6)	522 (9.6)	10.1 (0.14)	0.7 (0.21) ▲
Jordan	52 (3.9)	397 (4.8)	39 (3.9)	385 (5.9)	9 (2.1)	353 (10.8)	10.0 (0.16)	◊ ◊
Poland	50 (3.8)	536 (3.0)	48 (3.6)	534 (3.1)	2 (0.9)	~ ~	9.9 (0.12)	◊ ◊
Turkey	49 (3.3)	497 (5.6)	44 (3.3)	472 (4.7)	7 (1.6)	454 (15.6)	9.7 (0.14)	0.8 (0.23) ▲
South Africa (5)	49 (3.8)	385 (7.3)	41 (3.7)	366 (7.3)	10 (2.2)	373 (10.8)	9.7 (0.15)	◊ ◊
Croatia	48 (3.5)	501 (2.4)	50 (3.5)	503 (2.8)	2 (1.0)	~ ~	9.9 (0.13)	-0.9 (0.18) ▼
Chile	47 (4.2)	475 (4.5)	41 (4.4)	451 (4.9)	12 (2.6)	438 (6.8)	9.6 (0.20)	0.4 (0.27)
Germany	46 (3.2)	529 (3.1)	50 (3.1)	516 (3.7)	5 (1.5)	496 (11.4)	9.7 (0.11)	-0.1 (0.17)
Hungary	46 (3.9)	539 (4.9)	48 (3.9)	524 (5.9)	6 (2.2)	480 (22.4)	9.6 (0.15)	-0.2 (0.20)
Korea, Rep. of	44 (3.7)	615 (3.8)	54 (3.6)	603 (2.8)	2 (1.2)	~ ~	10.0 (0.17)	1.3 (0.25) ▲
Belgium (Flemish)	43 (3.5)	552 (3.6)	52 (3.6)	542 (3.3)	5 (1.6)	530 (9.8)	9.6 (0.11)	-0.1 (0.16)
Morocco	43 (2.9)	388 (6.0)	47 (3.1)	372 (5.5)	11 (1.8)	352 (9.8)	9.6 (0.13)	0.8 (0.22) ▲
Denmark	41 (3.6)	547 (4.9)	53 (3.8)	533 (3.9)	6 (1.8)	525 (10.7)	9.5 (0.15)	-1.1 (0.19) ▼
France	40 (3.6)	501 (4.2)	54 (3.8)	483 (3.5)	6 (1.6)	444 (10.7)	9.4 (0.13)	◊ ◊
Sweden	37 (4.3)	533 (3.9)	57 (4.4)	515 (3.5)	6 (1.9)	467 (17.4)	9.6 (0.15)	r -0.1 (0.22)
Finland	37 (3.1)	540 (2.5)	60 (3.1)	534 (2.4)	3 (1.0)	509 (15.3)	9.5 (0.11)	0.2 (0.17)
Chinese Taipei	35 (3.6)	597 (3.0)	61 (3.9)	596 (2.6)	4 (1.5)	605 (13.9)	9.4 (0.14)	0.4 (0.21)
Slovenia	29 (3.2)	522 (3.2)	64 (3.4)	521 (2.5)	7 (1.6)	510 (5.7)	9.0 (0.10)	0.1 (0.15)
Japan	7 (1.8)	606 (6.2)	83 (2.5)	593 (2.1)	9 (2.2)	577 (4.7)	8.2 (0.08)	0.3 (0.12)
International Avg.	56 (0.5)	511 (0.6)	40 (0.5)	497 (0.8)	4 (0.2)	464 (2.9)		

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A diamond (◊) indicates the country did not participate in the 2011 assessment.
A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the pupils. An "x" indicates data are available for less than 50% of pupils.

▲ Significantly higher than 2011
▼ Significantly lower than 2011

Source: Exhibit 7.3, International mathematics report (Mullis *et al.*, 2016a).

Table 8.4 International tables for safe and orderly schools (science)

Students were scored according to their teachers' degree of agreement with eight statements on the *Safe and Orderly School* scale. Students in **Very Safe and Orderly** schools had a score on the scale of at least 10.0, which corresponds to their teachers "agreeing a lot" with four of the eight qualities of a safe and orderly school and "agreeing a little" with the other four, on average. Students in **Less than Safe and Orderly** schools had a score no higher than 6.7, which corresponds to their teachers "disagreeing a little" with four of the eight qualities and "agreeing a little" with the other four, on average. All other students attended **Safe and Orderly** schools.

Country	Very Safe and Orderly		Safe and Orderly		Less than Safe and Orderly		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		
Indonesia	87 (2.3)	400 (5.3)	12 (2.2)	376 (13.0)	1 (0.5)	~ ~	12.1 (0.12)	◊ ◊
Northern Ireland r	85 (3.1)	523 (2.4)	15 (3.1)	506 (7.3)	0 (0.0)	~ ~	12.0 (0.16)	r 0.5 (0.21)
Ireland, Rep. of	83 (2.7)	534 (2.5)	14 (2.7)	511 (6.1)	2 (1.3)	~ ~	11.7 (0.15)	0.4 (0.21)
Qatar	79 (3.1)	444 (4.6)	19 (3.0)	410 (10.7)	1 (0.8)	~ ~	11.4 (0.12)	1.0 (0.24) ▲
Australia	77 (2.7)	533 (3.6)	21 (2.7)	502 (5.6)	2 (0.6)	~ ~	11.4 (0.15)	r 0.4 (0.22)
Kazakhstan	75 (3.7)	550 (5.5)	25 (3.7)	547 (8.2)	0 (0.0)	~ ~	11.5 (0.16)	0.7 (0.22) ▲
Spain	74 (2.7)	525 (2.7)	23 (2.7)	505 (4.6)	3 (1.2)	456 (15.1)	11.1 (0.11)	1.3 (0.20) ▲
England	73 (3.5)	541 (3.3)	26 (3.4)	524 (5.4)	1 (0.6)	~ ~	11.2 (0.17)	0.4 (0.23)
Norway (5)	72 (2.9)	543 (2.8)	25 (2.8)	528 (3.8)	3 (0.9)	538 (11.0)	11.0 (0.15)	◊ ◊
New Zealand	71 (2.6)	517 (3.1)	26 (2.3)	480 (5.1)	3 (0.8)	469 (13.2)	11.0 (0.12)	0.0 (0.16)
Iran, Islamic Rep. of	70 (2.5)	421 (5.0)	27 (2.5)	428 (7.5)	3 (1.1)	363 (21.2)	10.7 (0.12)	0.4 (0.19)
Bulgaria	68 (3.7)	548 (6.0)	30 (3.9)	509 (9.5)	2 (1.8)	~ ~	10.4 (0.14)	◊ ◊
Poland	66 (3.7)	549 (2.8)	33 (3.8)	543 (4.3)	0 (0.4)	~ ~	10.2 (0.11)	◊ ◊
Georgia	66 (3.8)	455 (5.2)	33 (3.9)	445 (5.7)	1 (0.6)	~ ~	10.5 (0.15)	-0.8 (0.19) ▼
Portugal	65 (3.4)	513 (2.6)	32 (3.5)	502 (3.5)	3 (1.1)	478 (15.5)	10.6 (0.13)	1.0 (0.23) ▲
Singapore	64 (2.4)	599 (4.8)	32 (2.3)	576 (6.1)	4 (0.9)	570 (15.4)	10.7 (0.10)	0.4 (0.14) ▲
Cyprus	62 (4.3)	484 (3.2)	33 (4.2)	478 (4.4)	5 (2.0)	468 (14.7)	10.4 (0.18)	◊ ◊
Hong Kong SAR	61 (4.6)	562 (4.7)	37 (4.8)	551 (6.7)	2 (1.3)	~ ~	10.7 (0.17)	0.8 (0.24) ▲
Bahrain	60 (1.6)	469 (3.2)	34 (1.6)	444 (4.1)	5 (0.2)	451 (3.2)	10.5 (0.05)	0.4 (0.20)
United Arab Emirates	60 (1.8)	474 (4.2)	36 (1.8)	423 (5.4)	4 (0.7)	386 (19.0)	10.6 (0.08)	-0.2 (0.11)
Netherlands r	60 (3.7)	524 (3.3)	39 (3.8)	508 (4.0)	1 (1.1)	~ ~	10.3 (0.16)	r 0.1 (0.24)
Lithuania	57 (4.2)	527 (3.6)	41 (4.2)	530 (4.5)	2 (0.9)	~ ~	10.3 (0.14)	0.6 (0.18) ▲
United States	57 (2.6)	560 (2.7)	36 (2.5)	531 (4.1)	8 (1.5)	510 (9.9)	10.3 (0.13)	r -0.2 (0.16)
Saudi Arabia	56 (3.4)	404 (6.8)	37 (3.6)	377 (8.6)	7 (1.8)	351 (17.8)	10.2 (0.13)	0.3 (0.22)
Canada	56 (2.4)	528 (3.1)	41 (2.5)	523 (4.4)	3 (0.8)	496 (12.4)	10.4 (0.10)	◊ ◊
Oman	55 (2.9)	436 (4.9)	41 (2.9)	424 (4.7)	4 (1.3)	431 (10.8)	10.3 (0.12)	0.4 (0.15) ▲
Russian Federation	54 (4.0)	568 (4.3)	44 (4.0)	567 (6.0)	2 (0.9)	~ ~	10.1 (0.13)	0.2 (0.21)
Italy	53 (3.6)	515 (3.6)	43 (3.5)	520 (4.2)	4 (1.6)	488 (10.1)	10.0 (0.15)	1.5 (0.18) ▲
Serbia	52 (3.5)	528 (3.8)	41 (3.6)	520 (6.8)	7 (1.6)	526 (7.8)	10.1 (0.14)	0.7 (0.21) ▲
Slovak Republic	51 (3.3)	530 (3.6)	45 (3.3)	513 (4.5)	3 (1.0)	471 (22.6)	9.8 (0.12)	0.4 (0.15) ▲
Czech Republic	51 (3.3)	538 (3.0)	47 (3.3)	531 (3.2)	2 (0.8)	~ ~	9.8 (0.12)	0.4 (0.17)
Kuwait	51 (3.2)	345 (10.4)	41 (3.6)	333 (7.4)	7 (1.8)	326 (24.0)	10.0 (0.15)	◊ ◊
Hungary	51 (3.8)	553 (4.4)	43 (3.6)	534 (5.4)	6 (2.2)	508 (14.4)	9.7 (0.15)	0.0 (0.20)
Germany	50 (3.4)	537 (3.7)	46 (3.3)	520 (3.9)	3 (1.3)	490 (16.4)	9.8 (0.12)	0.2 (0.17)
Turkey	49 (3.3)	497 (5.3)	44 (3.3)	473 (4.7)	7 (1.6)	454 (14.5)	9.7 (0.14)	0.8 (0.23) ▲
Croatia	48 (3.5)	532 (2.5)	50 (3.5)	534 (3.0)	2 (1.0)	~ ~	9.9 (0.13)	-0.9 (0.18) ▼
Morocco	47 (2.4)	370 (6.5)	39 (2.5)	341 (7.6)	14 (2.2)	327 (12.7)	9.7 (0.13)	0.8 (0.19) ▲
Korea, Rep. of	46 (4.2)	595 (3.1)	52 (4.2)	585 (2.5)	2 (1.2)	~ ~	10.1 (0.17)	1.4 (0.25) ▲
Chinese Taipei	44 (4.1)	554 (3.0)	49 (4.2)	556 (2.6)	7 (2.1)	558 (7.7)	9.7 (0.15)	0.3 (0.22)
Belgium (Flemish)	43 (3.5)	518 (4.0)	52 (3.6)	508 (3.4)	5 (1.6)	492 (11.0)	9.6 (0.11)	-0.1 (0.16)
Chile	43 (4.2)	499 (4.5)	44 (4.6)	469 (5.3)	13 (2.5)	447 (6.4)	9.4 (0.17)	0.2 (0.25)
France	43 (3.6)	501 (3.5)	52 (3.8)	481 (3.6)	5 (1.5)	448 (12.5)	9.5 (0.13)	◊ ◊
Denmark	41 (3.9)	537 (3.4)	53 (4.1)	521 (3.8)	6 (1.7)	500 (8.5)	9.5 (0.15)	-0.8 (0.19) ▼
Sweden	39 (4.5)	558 (4.5)	57 (4.4)	532 (3.9)	4 (1.5)	485 (32.7)	9.5 (0.16)	r 0.0 (0.23)
Finland	37 (3.4)	558 (2.7)	60 (3.4)	553 (2.7)	3 (1.0)	511 (20.9)	9.6 (0.11)	0.2 (0.17)
Slovenia	29 (3.2)	547 (3.7)	64 (3.4)	543 (3.3)	7 (1.6)	533 (6.4)	9.0 (0.10)	0.1 (0.15)
Japan	9 (2.5)	575 (6.0)	81 (3.2)	570 (1.9)	10 (2.0)	554 (4.4)	8.2 (0.08)	0.4 (0.13) ▲
International Avg.	57 (0.5)	513 (0.6)	39 (0.5)	498 (0.8)	4 (0.2)	469 (2.8)		

▲ Significantly higher than 2011
▼ Significantly lower than 2011

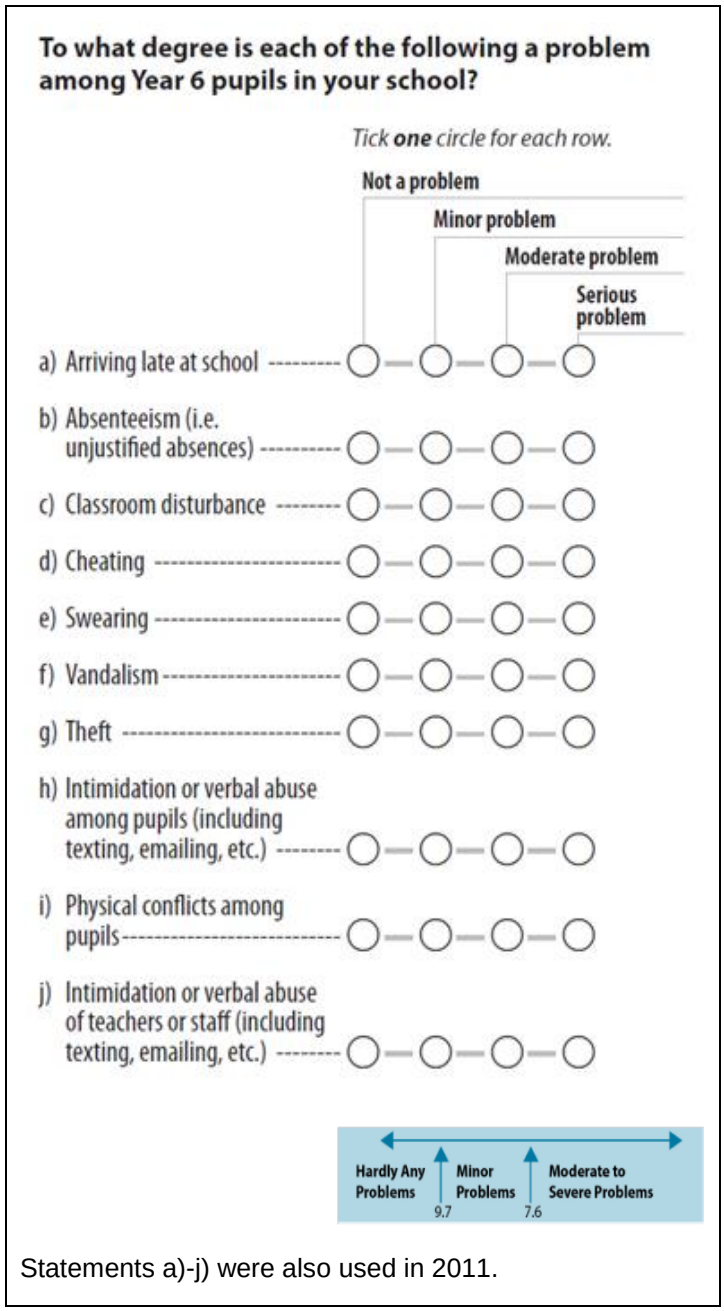
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A diamond (◊) indicates the country did not participate in the 2011 assessment.
A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the pupils. An "x" indicates data are available for less than 50% of pupils.

Source: Exhibit 7.3, International science report (Martin *et al.*, 2016a).

8.3 Principals' views of school discipline problems

Principals were asked about the degree to which a number of discipline issues were a problem in their school. Based on their responses, pupils were categorised as attending schools with 'Hardly Any Problems', 'Minor Problems' or 'Moderate to Severe Problems' (see Figure 8.4). The results for both subjects are shown in Table 8.5.

Figure 8.4 School discipline problems



Statements a)-j) were also used in 2011.

Exhibit 7.1, International mathematics report (Mullis *et al.*, 2016a), and Exhibit 7.1, International science report (Martin *et al.*, 2016a).

Table 8.5 School discipline problems

Mathematics

Reported by principals

Students were scored according to their principals' responses concerning ten potential school problems on the *School Discipline Problems* scale. Students in schools with **Hardly Any Problems** had a score on the scale of at least 9.7, which corresponds to their principals reporting "not a problem" for five of the ten issues and "minor problem" for the other five, on average. Students in schools with **Moderate to Severe Problems** had a score no higher than 7.6, which corresponds to their principals reporting "moderate problem" for five of the ten issues and "minor problem" for the other five, on average. All other students attended schools with **Minor Problems**.

Country		Hardly Any Problems		Minor Problems		Moderate to Severe Problems		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	r	78 (4.0)	575 (3.6)	22 (4.0)	552 (8.8)	0 (0.0)	~ ~	10.8 (0.13)	r -0.2 (0.19)
International Avg.		60 (0.5)	512 (0.7)	31 (0.5)	497 (0.9)	10 (0.3)	468 (2.3)		

( ) 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 pupils.

Science

Reported by principals

Students were scored according to their principals' responses concerning ten potential school problems on the *School Discipline Problems* scale. Students in schools with **Hardly Any Problems** had a score on the scale of at least 9.7, which corresponds to their principals reporting "not a problem" for five of the ten issues and "minor problem" for the other five, on average. Students in schools with **Moderate to Severe Problems** had a score no higher than 7.6, which corresponds to their principals reporting "moderate problem" for five of the ten issues and "minor problem" for the other five, on average. All other students attended schools with **Minor Problems**.

Country		Hardly Any Problems		Minor Problems		Moderate to Severe Problems		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	r	78 (4.0)	522 (2.8)	22 (4.0)	508 (7.7)	0 (0.0)	~ ~	10.8 (0.13)	r -0.2 (0.19)
International Avg.		61 (0.5)	513 (0.7)	30 (0.5)	498 (1.0)	9 (0.3)	471 (2.5)		

( ) 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 pupils.

Sources: Exhibit 7.1, International mathematics report (Mullis *et* al., 2016a), and Exhibit 7.1, International science report (Martin *et al.*, 2016a).

The vast majority of pupils in Northern Ireland (78 per cent) had principals who reported 'Hardly Any Problems' with discipline or safety in their schools. Across all countries participating in TIMSS 2015, only four - the Republic of Ireland, the Netherlands, the high performer Korea and Lithuania reported fewer problems than Northern Ireland, with England having the same percentage of pupils in this category. The remaining 22 per cent of pupils in Northern Ireland were in schools where principals reported 'Minor Problems'.

In Northern Ireland, there was a change between 2011[38] and 2015 in the results for school discipline and safety. There was a drop of 7 per cent between 2011 and 2015 in the

[38] The same ten statements were used to calculate the scale in 2011 and 2015. However, the categories in 2011 were slightly different. Schools were classed as having *Hardly Any Problems*, *Minor Problems* or *Moderate Problems*.

proportion of pupils in schools where principals reported ‘Hardly Any Problems’. The average scale score also decreased from 11.0 in 2011 to 10.8 in 2015, although this was not statistically significant.

On average internationally, pupils in schools with lower problem ratings for school discipline scored higher in TIMSS 2015 than those in schools with more reported problems. Northern Ireland followed this pattern: pupils in schools judged to have ‘Hardly Any Problems’ had higher average scores than those in schools judged to have ‘Minor Problems’. However, the standard error statistics for Northern Ireland on this scale suggest that the apparent differences in both subjects (shown in Table 8.5) are unlikely to be statistically significant. In addition, across countries, rankings in ratings for discipline problems did not necessarily relate directly to overall rankings of average pupil achievement.

The full international tables follow, for reference, showing data for all countries (Tables 8.6 and 8.7).

Table 8.6 School discipline problems mathematics

Reported by principals

Students were scored according to their principals' responses concerning ten potential school problems on the *School Discipline Problems* scale. Students in schools with **Hardly Any Problems** had a score on the scale of at least 9.7, which corresponds to their principals reporting "not a problem" for five of the ten issues and "minor problem" for the other five, on average. Students in schools with **Moderate to Severe Problems** had a score no higher than 7.6, which corresponds to their principals reporting "moderate problem" for five of the ten issues and "minor problem" for the other five, on average. All other students attended schools with **Minor Problems**.

Country	Hardly Any Problems		Minor Problems		Moderate to Severe Problems		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		
Ireland, Rep. of	84 (3.3)	552 (2.6)	14 (3.1)	531 (7.3)	2 (1.2)	~ ~	10.9 (0.11)	-0.2 (0.17)
Netherlands s	83 (4.1)	536 (2.2)	17 (4.1)	529 (3.8)	0 (0.0)	~ ~	11.1 (0.13)	s -0.2 (0.20)
Korea, Rep. of	81 (3.4)	608 (2.5)	14 (3.0)	613 (5.1)	5 (1.8)	591 (9.4)	11.3 (0.16)	0.4 (0.22)
Lithuania	79 (3.4)	536 (2.7)	20 (3.4)	532 (9.4)	1 (1.0)	~ ~	10.6 (0.10)	0.1 (0.16)
England	78 (3.7)	553 (3.6)	21 (3.6)	524 (6.7)	1 (0.8)	~ ~	10.9 (0.11)	0.3 (0.16)
Northern Ireland r	78 (4.0)	575 (3.6)	22 (4.0)	552 (8.8)	0 (0.0)	~ ~	10.8 (0.13)	r -0.2 (0.19)
Croatia	76 (4.1)	503 (2.1)	24 (4.1)	501 (4.5)	0 (0.0)	~ ~	10.7 (0.14)	0.3 (0.18)
Japan	74 (3.2)	595 (2.1)	20 (3.0)	589 (4.2)	6 (2.0)	589 (7.8)	10.4 (0.14)	-0.1 (0.18)
Norway (5)	74 (4.3)	553 (3.0)	25 (4.2)	537 (4.9)	1 (0.8)	~ ~	10.7 (0.13)	◊ ◊
Bulgaria	72 (4.2)	535 (4.6)	20 (3.8)	491 (10.0)	8 (2.9)	514 (33.2)	10.4 (0.18)	◊ ◊
Singapore	72 (0.0)	620 (4.9)	28 (0.0)	615 (8.0)	0 (0.0)	~ ~	10.7 (0.00)	0.0 (0.00)
Kazakhstan	71 (3.9)	544 (5.5)	13 (2.7)	559 (14.8)	15 (2.8)	536 (9.7)	10.3 (0.21)	-0.9 (0.24) ▼
New Zealand	71 (2.8)	506 (3.2)	28 (2.9)	462 (6.4)	1 (0.8)	~ ~	10.5 (0.08)	-0.1 (0.15)
Hong Kong SAR	71 (4.6)	617 (4.0)	29 (4.6)	610 (7.7)	0 (0.0)	~ ~	10.5 (0.13)	-0.8 (0.17) ▼
Georgia	70 (3.9)	468 (4.3)	22 (3.5)	441 (7.7)	8 (2.6)	491 (24.2)	10.4 (0.19)	-0.3 (0.24)
Spain	70 (3.4)	512 (2.9)	22 (3.0)	489 (5.8)	8 (1.5)	489 (9.3)	10.3 (0.13)	-0.5 (0.21)
Chinese Taipei	70 (4.1)	600 (2.2)	28 (3.8)	591 (4.2)	3 (1.6)	573 (16.4)	10.6 (0.14)	-0.7 (0.20) ▼
United States	69 (3.3)	549 (3.3)	29 (3.3)	521 (5.0)	3 (0.9)	475 (10.2)	10.3 (0.10)	0.0 (0.14)
Finland	68 (3.8)	538 (2.5)	31 (3.7)	529 (3.0)	1 (1.0)	~ ~	10.3 (0.11)	0.1 (0.16)
Belgium (Flemish)	68 (3.6)	553 (2.3)	31 (3.8)	535 (5.7)	1 (1.1)	~ ~	10.5 (0.12)	0.1 (0.18)
Russian Federation	67 (3.9)	566 (4.6)	32 (3.9)	560 (6.4)	0 (0.4)	~ ~	10.2 (0.09)	0.0 (0.13)
Canada	66 (3.1)	518 (2.6)	31 (2.9)	497 (4.6)	2 (1.0)	~ ~	10.2 (0.10)	◊ ◊
Czech Republic	65 (3.6)	529 (2.9)	31 (3.5)	528 (4.3)	4 (1.8)	506 (18.7)	10.1 (0.10)	0.0 (0.15)
Iran, Islamic Rep. of	65 (3.5)	436 (5.0)	26 (3.3)	438 (6.3)	9 (2.4)	383 (17.6)	10.0 (0.13)	-0.7 (0.17) ▼
Australia	64 (3.4)	530 (3.5)	30 (3.4)	506 (5.4)	6 (3.1)	446 (5.9)	10.2 (0.12)	-0.2 (0.17)
Qatar	63 (3.0)	444 (5.0)	26 (2.8)	428 (8.1)	11 (1.8)	434 (9.7)	10.0 (0.12)	0.0 (0.19)
Slovak Republic	63 (3.6)	510 (3.2)	32 (3.4)	484 (5.1)	5 (1.7)	444 (18.9)	10.0 (0.10)	0.1 (0.16)
United Arab Emirates	61 (2.4)	467 (3.5)	31 (2.5)	426 (4.9)	8 (1.2)	396 (9.6)	10.1 (0.07)	0.2 (0.13)
Italy	60 (4.5)	508 (3.7)	25 (3.7)	504 (5.4)	15 (3.0)	509 (7.9)	9.6 (0.16)	0.1 (0.22)
Bahrain	59 (0.2)	456 (1.8)	26 (0.2)	446 (2.6)	14 (0.1)	427 (7.3)	9.7 (0.01)	-0.4 (0.31)
France	58 (4.6)	497 (4.1)	33 (4.3)	480 (4.5)	9 (2.7)	454 (12.1)	9.9 (0.15)	◊ ◊
Serbia	56 (4.3)	519 (5.0)	35 (3.8)	521 (4.8)	9 (2.0)	499 (13.2)	9.8 (0.15)	0.1 (0.23)
Hungary	55 (3.7)	541 (4.5)	37 (3.6)	524 (5.3)	8 (1.7)	471 (20.7)	9.8 (0.11)	0.1 (0.17)
Denmark r	53 (4.3)	548 (3.8)	45 (4.4)	533 (4.5)	1 (1.0)	~ ~	9.9 (0.11)	r -0.2 (0.14)
Slovenia	52 (4.3)	521 (2.5)	45 (4.5)	520 (3.2)	3 (1.3)	540 (5.2)	9.8 (0.13)	-0.2 (0.18)
Poland	52 (3.6)	534 (2.7)	45 (3.8)	537 (3.6)	3 (1.4)	528 (16.0)	9.8 (0.09)	◊ ◊
Cyprus	50 (4.8)	530 (3.6)	42 (4.5)	517 (4.6)	8 (2.6)	514 (6.7)	9.7 (0.17)	◊ ◊
Sweden	49 (4.1)	531 (3.5)	40 (4.0)	514 (3.6)	10 (2.6)	481 (13.8)	9.4 (0.11)	-0.3 (0.17)
Saudi Arabia	49 (3.9)	388 (5.2)	26 (3.1)	377 (9.1)	25 (3.4)	382 (10.4)	9.2 (0.19)	0.1 (0.26)
Chile	46 (4.0)	470 (4.1)	47 (4.3)	452 (5.5)	6 (2.2)	437 (15.5)	9.6 (0.11)	0.4 (0.18)
Turkey	44 (3.5)	506 (4.8)	29 (3.2)	464 (7.9)	26 (2.9)	465 (7.5)	8.8 (0.15)	-0.2 (0.21)
Portugal	43 (4.5)	546 (3.6)	46 (4.7)	538 (4.2)	11 (2.6)	541 (7.1)	9.4 (0.15)	-0.9 (0.23) ▼
Germany	39 (3.8)	531 (3.3)	50 (3.7)	517 (2.7)	10 (2.4)	501 (10.6)	9.2 (0.10)	-0.3 (0.13)
Jordan	36 (4.0)	411 (6.0)	40 (3.9)	375 (6.7)	24 (3.2)	376 (9.0)	9.0 (0.17)	◊ ◊
Oman	34 (3.4)	426 (6.0)	36 (3.0)	419 (4.8)	29 (2.8)	434 (4.8)	8.6 (0.15)	0.2 (0.21)
Kuwait	25 (3.9)	373 (8.3)	40 (4.4)	344 (7.0)	35 (3.5)	342 (10.3)	8.3 (0.19)	◊ ◊
South Africa (5)	23 (3.1)	406 (13.6)	56 (3.5)	369 (5.4)	22 (3.1)	365 (8.3)	8.7 (0.11)	◊ ◊
Morocco	21 (3.0)	394 (8.7)	30 (3.0)	367 (6.8)	49 (3.2)	377 (4.4)	7.7 (0.16)	0.5 (0.21)
Indonesia	18 (2.9)	407 (9.9)	28 (3.3)	408 (6.6)	54 (3.6)	389 (5.9)	7.4 (0.16)	◊ ◊
International Avg.	60 (0.5)	512 (0.7)	31 (0.5)	497 (0.9)	10 (0.3)	468 (2.3)		

Significantly higher than 2011 ▲
Significantly lower than 2011 ▼

This TIMSS questionnaire scale was established in 2011 based on the combined response distribution of all countries that participated in TIMSS 2011. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale score points corresponded to the standard deviation of the distribution.

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

A diamond (◊) indicates the country did not participate in the 2011 assessment.

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

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

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

Source: Exhibit 7.1, International mathematics report (Mullis *et al.*, 2016a).

Table 8.7 School discipline problems science

Reported by principals

Students were scored according to their principals' responses concerning ten potential school problems on the *School Discipline Problems* scale. Students in schools with **Hardly Any Problems** had a score on the scale of at least 9.7, which corresponds to their principals reporting "not a problem" for five of the ten issues and "minor problem" for the other five, on average. Students in schools with **Moderate to Severe Problems** had a score no higher than 7.6, which corresponds to their principals reporting "moderate problem" for five of the ten issues and "minor problem" for the other five, on average. All other students attended schools with **Minor Problems**.

Country	Hardly Any Problems		Minor Problems		Moderate to Severe Problems		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		
Ireland, Rep. of	84 (3.3)	532 (2.8)	14 (3.1)	516 (7.4)	2 (1.2)	~ ~	10.9 (0.11)	-0.2 (0.17)
Netherlands s	83 (4.1)	526 (3.4)	17 (4.1)	514 (5.7)	0 (0.0)	~ ~	11.1 (0.13)	s -0.2 (0.20)
Korea, Rep. of	81 (3.4)	590 (2.2)	14 (3.0)	593 (4.6)	5 (1.8)	574 (7.0)	11.3 (0.16)	0.4 (0.22)
Lithuania	79 (3.4)	528 (2.8)	20 (3.4)	524 (8.8)	1 (1.0)	~ ~	10.6 (0.10)	0.1 (0.16)
England	78 (3.7)	542 (3.1)	21 (3.6)	517 (6.8)	1 (0.8)	~ ~	10.9 (0.11)	0.3 (0.16)
Northern Ireland r	78 (4.0)	522 (2.8)	22 (4.0)	508 (7.7)	0 (0.0)	~ ~	10.8 (0.13)	r -0.2 (0.19)
Croatia	76 (4.1)	533 (2.5)	24 (4.1)	533 (4.2)	0 (0.0)	~ ~	10.7 (0.14)	0.3 (0.18)
Japan	74 (3.2)	571 (1.9)	20 (3.0)	566 (3.7)	6 (2.0)	563 (6.5)	10.4 (0.14)	-0.1 (0.18)
Norway (5)	74 (4.3)	540 (3.0)	25 (4.2)	528 (5.2)	1 (0.8)	~ ~	10.7 (0.13)	◊ ◊
Bulgaria	72 (4.2)	550 (5.2)	20 (3.8)	496 (12.2)	8 (2.9)	506 (36.2)	10.4 (0.18)	◊ ◊
Singapore	72 (0.0)	592 (4.6)	28 (0.0)	588 (7.7)	0 (0.0)	~ ~	10.7 (0.00)	0.0 (0.00)
Kazakhstan	71 (3.9)	552 (5.6)	13 (2.7)	560 (15.3)	15 (2.8)	535 (10.3)	10.3 (0.21)	-0.9 (0.24) ▼
New Zealand	71 (2.8)	520 (3.4)	28 (2.9)	478 (6.3)	1 (0.8)	~ ~	10.5 (0.08)	-0.1 (0.15)
Hong Kong SAR	71 (4.6)	559 (4.3)	29 (4.6)	552 (8.3)	0 (0.0)	~ ~	10.5 (0.13)	-0.8 (0.17) ▼
Georgia	70 (3.9)	455 (4.2)	22 (3.5)	432 (8.1)	8 (2.6)	481 (26.8)	10.4 (0.19)	-0.3 (0.24)
Spain	70 (3.4)	525 (2.8)	22 (3.0)	501 (5.1)	8 (1.5)	507 (9.5)	10.3 (0.13)	-0.5 (0.21)
Chinese Taipei	70 (4.1)	559 (2.1)	28 (3.8)	549 (4.0)	3 (1.6)	531 (12.5)	10.6 (0.14)	-0.7 (0.20) ▼
United States	69 (3.3)	556 (3.0)	29 (3.3)	528 (5.5)	3 (0.9)	480 (11.8)	10.3 (0.10)	0.0 (0.14)
Finland	68 (3.8)	556 (2.8)	31 (3.7)	548 (3.3)	1 (1.0)	~ ~	10.3 (0.11)	0.1 (0.16)
Belgium (Flemish)	68 (3.6)	520 (2.6)	31 (3.8)	499 (6.0)	1 (1.1)	~ ~	10.5 (0.12)	0.1 (0.18)
Russian Federation	67 (3.9)	570 (4.0)	32 (3.9)	561 (5.6)	0 (0.4)	~ ~	10.2 (0.09)	0.0 (0.13)
Canada	66 (3.1)	531 (2.8)	31 (2.9)	514 (4.2)	2 (1.0)	~ ~	10.2 (0.10)	◊ ◊
Czech Republic	65 (3.6)	536 (2.6)	31 (3.5)	534 (4.4)	4 (1.8)	514 (20.0)	10.1 (0.10)	0.0 (0.15)
Iran, Islamic Rep. of	65 (3.5)	427 (5.6)	26 (3.3)	428 (7.8)	9 (2.4)	365 (21.0)	10.0 (0.13)	-0.7 (0.17) ▼
Australia	64 (3.4)	534 (2.9)	30 (3.4)	516 (4.7)	6 (3.1)	462 (6.3)	10.2 (0.12)	-0.2 (0.17)
Qatar	63 (3.0)	444 (5.5)	26 (2.8)	417 (9.1)	11 (1.8)	433 (12.1)	10.0 (0.12)	0.0 (0.19)
Slovak Republic	63 (3.6)	535 (3.4)	32 (3.4)	503 (5.7)	5 (1.7)	459 (19.0)	10.0 (0.10)	0.1 (0.16)
United Arab Emirates	61 (2.4)	470 (4.1)	31 (2.5)	422 (6.0)	8 (1.2)	385 (11.2)	10.1 (0.07)	0.2 (0.13)
Italy	60 (4.5)	518 (3.6)	25 (3.7)	513 (4.9)	15 (3.0)	517 (8.2)	9.6 (0.16)	0.1 (0.22)
Bahrain	59 (0.2)	469 (3.3)	26 (0.2)	450 (4.2)	14 (0.1)	423 (7.6)	9.7 (0.01)	-0.4 (0.31)
France	58 (4.6)	496 (3.7)	33 (4.3)	479 (4.3)	9 (2.7)	454 (12.8)	9.9 (0.15)	◊ ◊
Serbia	56 (4.3)	524 (5.2)	35 (3.8)	528 (4.4)	9 (2.0)	513 (13.5)	9.8 (0.15)	0.1 (0.23)
Hungary	55 (3.7)	553 (4.4)	37 (3.6)	537 (5.4)	8 (1.7)	484 (20.8)	9.8 (0.11)	0.1 (0.17)
Denmark r	53 (4.3)	536 (3.3)	45 (4.4)	522 (3.7)	1 (1.0)	~ ~	9.9 (0.11)	r -0.2 (0.14)
Slovenia	52 (4.3)	544 (3.4)	45 (4.5)	542 (3.5)	3 (1.3)	559 (4.1)	9.8 (0.13)	-0.2 (0.18)
Poland	52 (3.6)	546 (3.0)	45 (3.8)	549 (3.6)	3 (1.4)	543 (14.1)	9.8 (0.09)	◊ ◊
Cyprus	50 (4.8)	488 (3.4)	42 (4.5)	475 (4.4)	8 (2.6)	471 (8.4)	9.7 (0.17)	◊ ◊
Sweden	49 (4.1)	554 (4.1)	40 (4.0)	536 (4.5)	10 (2.6)	492 (16.8)	9.4 (0.11)	-0.3 (0.17)
Saudi Arabia	49 (3.9)	397 (6.5)	26 (3.1)	380 (11.0)	25 (3.4)	387 (12.8)	9.2 (0.19)	0.1 (0.26)
Chile	46 (4.0)	489 (4.1)	47 (4.3)	471 (5.6)	6 (2.2)	455 (17.0)	9.6 (0.11)	0.4 (0.18)
Turkey	44 (3.5)	505 (4.6)	29 (3.2)	464 (7.5)	26 (2.9)	468 (7.0)	8.8 (0.15)	-0.2 (0.21)
Portugal	43 (4.5)	511 (2.8)	46 (4.7)	507 (3.4)	11 (2.6)	507 (5.3)	9.4 (0.15)	-0.9 (0.23) ▼
Germany	39 (3.8)	541 (3.7)	50 (3.7)	522 (3.2)	10 (2.4)	506 (10.8)	9.2 (0.10)	-0.3 (0.13)
Oman	34 (3.4)	431 (7.4)	36 (3.0)	426 (5.8)	29 (2.8)	439 (6.0)	8.6 (0.15)	0.2 (0.21)
Kuwait	25 (3.9)	368 (10.6)	40 (4.4)	324 (10.0)	35 (3.5)	326 (12.3)	8.3 (0.19)	◊ ◊
Morocco	21 (3.0)	378 (12.5)	30 (3.0)	342 (7.8)	49 (3.2)	348 (5.9)	7.7 (0.16)	0.5 (0.21)
Indonesia	18 (2.9)	407 (11.7)	28 (3.3)	411 (8.9)	54 (3.6)	386 (7.0)	7.4 (0.16)	◊ ◊
International Avg.	61 (0.5)	513 (0.7)	30 (0.5)	498 (1.0)	9 (0.3)	471 (2.5)		

Significantly higher than 2011 ▲
Significantly lower than 2011 ▼

This TIMSS questionnaire scale was established in 2011 based on the combined response distribution of all countries that participated in TIMSS 2011. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale score points corresponded to the standard deviation of the distribution.

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

A diamond (◊) indicates the country did not participate in the 2011 assessment.

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

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

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

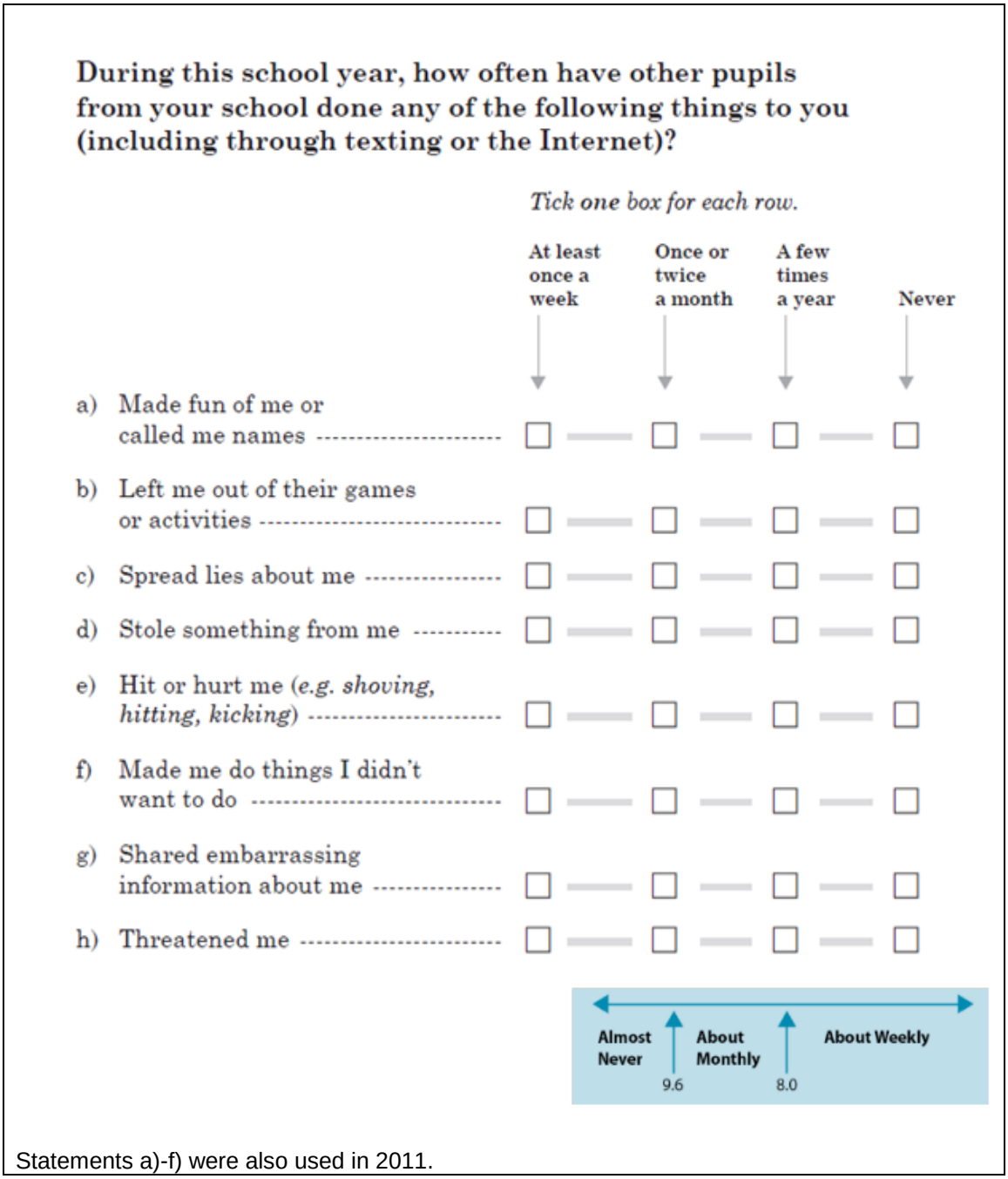
Source: Exhibit 7.1, International science report (Martin *et al.*, 2016a)

8.4 Pupil reports of bullying in school

Pupils were asked about the extent to which they had experienced a range of behaviours which were considered to demonstrate bullying at school. The questions they were asked and details of the scaling are shown in Figure 8.5 and the results for each subject are shown in Table 8.8.

Based on their responses, pupils were categorised as being in one of three bands, which described the frequency with which they had experienced the eight bullying behaviours in their school during the last year: 'Almost Never', 'About Monthly' and 'About Weekly'. The number of statements included in the question on pupil bullying increased from six in the 2011 survey to eight in 2015. The additional statements in 2015 asked pupils about their experience of threatening behaviour and their experience of having embarrassing information shared about them, for example through social media.

Figure 8.5 Pupils bullied at school



Statements a)-f) were also used in 2011.

Source: Exhibit 7.5, International mathematics report (Mullis *et al.*, 2016a), and Exhibit 7.5, International science report (Martin *et al.*, 2016a).

Table 8.8 Pupils bullied

Mathematics

Reported by pupils

Students were scored according to their responses to how often they experienced eight bullying behaviors on the *Student Bullying* scale. Students bullied **Almost Never** had a score on the scale of at least 9.6, which corresponds to "never" experiencing four of the eight bullying behaviors and experiencing each of the other four behaviors "a few times a year," on average. Students bullied **About Weekly** had a score no higher than 8.0, which corresponds to their experiencing each of four of the eight behaviors "once or twice a month" and each of the other four "a few times a year," on average. All other students were bullied **About Monthly**.

Country	Almost Never		About Monthly		About Weekly		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland	64 (1.5)	578 (3.0)	27 (1.1)	568 (4.4)	10 (0.7)	529 (7.2)	10.3 (0.06)
International Avg.	56 (0.2)	514 (0.5)	29 (0.1)	505 (0.5)	16 (0.1)	478 (0.8)	

This TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale score points corresponded to the standard deviation of the distribution.

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

Science

Reported by pupils

Students were scored according to their responses to how often they experienced eight bullying behaviors on the *Student Bullying* scale. Students bullied **Almost Never** had a score on the scale of at least 9.6, which corresponds to "never" experiencing four of the eight bullying behaviors and experiencing each of the other four behaviors "a few times a year," on average. Students bullied **About Weekly** had a score no higher than 8.0, which corresponds to their experiencing each of four of the eight behaviors "once or twice a month" and each of the other four "a few times a year," on average. All other students were bullied **About Monthly**.

Country	Almost Never		About Monthly		About Weekly		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland	64 (1.5)	524 (2.7)	27 (1.1)	520 (3.6)	10 (0.7)	496 (5.3)	10.3 (0.06)
International Avg.	57 (0.2)	515 (0.5)	28 (0.1)	506 (0.6)	15 (0.1)	481 (0.9)	

This TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale score points corresponded to the standard deviation of the distribution.

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

Sources: Exhibit 7.5 International mathematics report (Mullis *et al.*, 2016a) and Exhibit 7.5, international science report (Martin *et al.*, 2016a).

Pupils in Northern Ireland participating in TIMSS 2015 reported that, on average, they experienced bullying behaviours less frequently than those in most other participating countries. The average scale score for Northern Ireland on this scale was 10.3, placing pupils in the 'Almost Never' bullied category overall. Sixty-four per cent of pupils reported that they were 'Almost Never' bullied, while responses from 27 per cent of pupils were categorised as experiencing bullying' About Monthly' and 10 per cent as 'About Weekly'. These figures compare favourably with the international averages of 56 per cent (mathematics) and 57 per cent (science) for 'Almost Never'; 29 per cent (mathematics) and 28 per cent (science) for 'About Monthly'; and 16 per cent (mathematics) and 15 per cent (science) for 'About Weekly'.

In 2011, reported frequency of bullying in Northern Ireland was broadly similar to that reported by pupils in 2015, although there was a small reduction in the percentage of pupils

reporting an 'About Weekly' experience of bullying between 2011 and 2015 of 4 per cent. Additionally, there was an increase between 2011 and 2015 in the percentage of pupils in the 'Almost Never' category of 7 per cent.

Among comparator countries, the Republic of Ireland, Finland and Poland were ranked higher on this scale. These three countries also reported experiencing the lowest levels of bullying behaviour, while the highest levels of bullying among comparator countries were reported in Singapore and Australia. Internationally, average pupil attainment in both mathematics and science tended to be higher where less bullying was reported (but causality cannot be inferred). Pupils in Northern Ireland appeared to conform to this general pattern. The standard errors shown in Table 8.8 suggest that, in Northern Ireland, for both subjects, the differences in average achievement between pupils who are 'Almost Never' bullied and those who experience 'About Monthly' bullying behaviours are unlikely to be statistically significant. However, the differences in average achievement in both mathematics and science between pupils with 'About Weekly' and 'About Monthly' experience of bullying behaviours may be statistically significant[39].

8.5 The extent to which their teaching is limited by disruptive or uninterested pupils

Teachers were asked to indicate the extent to which they felt that their teaching was limited by disruptive or uninterested pupils. The results for mathematics and science are shown in Table 8.9. Teachers' responses led to them being categorised as having their teaching limited' Not At All', 'Some' or 'A Lot' by these factors.

Table 8.9 Teaching limited by disruptive or uninterested pupils

Mathematics teaching limited by disruptive pupils

Country	Not at All		Some		A lot	
	% of Pupils	Average Achievement	% of Pupils	Average Achievement	% of Pupils	Average Achievement
Northern Ireland r	44	582	47	568	9	553
International Avg.	27	521	54	509	19	493

[39] Tests of statistical significance were not carried out in this international analysis.

Mathematics teaching limited by uninterested pupils

Country	Not at All		Some		A lot	
	% of Pupils	Average Achievement	% of Pupils	Average Achievement	% of Pupils	Average Achievement
Northern Ireland r	26	597	68	565	6	550
International Avg.	23	524	62	509	15	490

Science teaching limited by disruptive pupils

Country	Not at All		Some		A lot	
	% of Pupils	Average Achievement	% of Pupils	Average Achievement	% of Pupils	Average Achievement
Northern Ireland r	44	529	47	516	9	505
International Avg.	27	517	54	506	19	492

Science teaching limited by uninterested pupils

Country	Not at All		Some		A lot	
	% of Pupils	Average Achievement	% of Pupils	Average Achievement	% of Pupils	Average Achievement
Northern Ireland r	26	538	67	516	6	502
International Avg.	24	521	61	505	15	488

Sources: Mathematics Teacher Context Data Almanac by Mathematics Achievement questions ATBG15D and ATBG15E and Science Teacher Context Data Almanac by Science Achievement questions ATBG15D and ATBG15E

The vast majority of pupils in Northern Ireland (over 90 per cent) across both subjects had teachers who felt that their teaching was limited ‘Some’ or ‘Not At All’ by disruptive or uninterested pupils.

In both mathematics and science, 9 per cent of pupils had teachers who reported that their teaching was limited ‘A Lot’ by disruptive pupils, and 6 per cent of pupils had teachers who reported that their lessons were limited ‘A Lot’ by pupils who were uninterested. These figures compare favourably with the respective international averages of 19 per cent and 15 per cent.

Among the comparator countries, for both mathematics and science, teachers in Northern Ireland had the highest percentage of pupils (44 per cent) in schools where teachers were ‘Not at All’ limited by disruptive students. In terms of teaching being limited by uninterested pupils, teachers in Northern Ireland fared less well. Among comparator countries, the Republic of Ireland, Finland and Hong Kong had a smaller percentage of pupils being taught by teachers whose teaching was disrupted ‘A Lot’ by uninterested pupils. England had a

similar proportion to Northern Ireland (6 per cent), with Singapore, Australia and Poland reporting higher levels.

Internationally, pupil attainment tended to be lower where teachers reported high levels of limitation caused by disruptive or uninterested pupils,[40] but the direction of causality cannot be inferred from the data.

In Northern Ireland, for both subjects, there was an apparent difference between the average achievement scores of those pupils whose teachers are limited' Not at All', 'Some' or 'A Lot' by either disruptive pupils or uninterested pupils. However, from the data available it is not possible to determine whether these apparent differences in achievement are statistically significant.

In the 2011 TIMSS survey the questions on the extent to which teachers were limited by disruptive or uninterested pupils only had two reporting categories 'Some or Not at All' and 'A Lot'. In 2011, 4 per cent of pupils in mathematics and 5 per cent of pupils in science were taught by teachers reporting that their teaching was limited 'A Lot' by disruptive pupils. These figures were different in 2015, with a five percentage point increase in the proportion of pupils in this category for mathematics and a four percentage point increase for science. There was a similar change in both subjects for disruption caused by uninterested pupils. For both subjects in 2011, only 2 per cent of pupils were in classes where teachers reported 'A Lot' of disruption by uninterested pupils. This increased to 6 per cent in 2015, but caution needs to be exercised in comparing the results for 2011 and 2015 as the reporting categories have changed between surveys.

8.6 Conclusion

Most aspects of the school learning environment in Northern Ireland have remained stable between the 2011 and 2015 TIMSS cycles. In both mathematics and science, principals and teachers in Northern Ireland reported some of the highest levels of emphasis on academic success of any nation. For example, over 90 per cent of pupils were taught in schools where principals reported placing a 'High' or 'Very High' emphasis on academic success. Teachers reported even higher levels of emphasis on academic success than principals. Only Korea had a higher percentage of pupils in schools which placed a 'Very High Emphasis' on academic success, as reported by teachers.

In Northern Ireland, in both mathematics and science, the majority of pupils (over 80 per cent) had teachers who reported that their schools were 'Very Safe and Orderly'. Among all countries participating in TIMSS 2015, only teachers in Indonesia reported a higher percentage of pupils in this category. Similarly, almost all pupils in Northern Ireland attended schools in which principals reported 'Hardly Any', or 'Minor', problems with discipline.

On average, pupils in Northern Ireland reported experiencing bullying behaviours less frequently than those in most other participating countries. Sixty-four per cent of pupils reported that they were 'Almost Never' bullied, compared with the international average of 56 per cent for mathematics and 57 per cent for science. The standard errors in the data suggest that, in Northern Ireland, the differences in average achievement in both

[40] Tests of statistical significance were not carried out in this international analysis.

mathematics and science between pupils with ‘About Weekly’ and ‘About Monthly’ experience of bullying behaviours may be statistically significant.

Finally, in terms of disruption, teachers in Northern Ireland reported that their teaching was rarely limited by disruptive or uninterested pupils. For both mathematics and science, 9 per cent of pupils had teachers who reported that their teaching was limited ‘A Lot’ by disruptive pupils, and 6 per cent of pupils had teachers who reported that their lessons were limited ‘A Lot’ by pupils who were uninterested. These figures are below the international averages of 19 per cent and 15 per cent respectively.

9 The curriculum and learning activities

Chapter outline

This chapter presents findings from TIMSS 2015 relating to teaching practices and the curriculum in mathematics and science in Year 6 (Y6, ages 9-10), as reported by teachers, principals and National Research Co-ordinators (or their designated national contact). Within each subsection, findings for mathematics are presented first, followed by findings for science. Where relevant, outcomes for Northern Ireland are compared with international averages and comparator countries.

Key findings

- In Northern Ireland, teaching time for mathematics was higher than the international average, but, for science, teaching time was lower than the international average.
- A very small proportion of Y6 pupils in Northern Ireland were taught science by teachers who reported emphasising science investigation in at least half their science lessons. This proportion is considerably below the international average and is lower than in 2011. In a number of the highest performing countries, teachers tended to report emphasising science investigation to a greater extent than in Northern Ireland.
- Computers were available for the majority of Y6 pupils in their mathematics and science lessons. This was consistent with the findings from 2011.
- According to teachers' reports of topics taught in lessons, a higher proportion of Y6 pupils were taught the TIMSS mathematics topics than the TIMSS science topics. This was also the case on average internationally.

Interpreting the data: percentages in tables

Some of the data in this chapter 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 were sampled by class. As a result, the Y6 teacher questionnaire would, in most cases, 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 because the distribution of pupils within the sample of teachers may differ by subject.

9.1 Teaching time

Total teaching time[41] for both mathematics and science, as reported by principals and teachers, was calculated using the formula in Figure 9.1. These calculations enabled direct comparison of teaching time between countries participating in TIMSS 2015.

Figure 9.1 Formula for calculation of teaching time

$$\text{Total Instructional Hours per Year} = \text{Principal Reports of School Days per Year} \times \text{Principal Reports of Instructional Hours per Day}$$

$$\text{Hours per Year for Instruction in Mathematics/ Science} = \frac{\text{Teachers Reports of Weekly Mathematics/ Science Instructional Hours}}{\text{Principal Reports of School Days per Year}} \times \text{Principal Reports of School Days per Year}$$

Source: adapted from Exhibit 9.1 TIMSS international mathematics report (Mullis *et al.*, 2016a) and Exhibit 9.1 TIMSS international science report (Martin *et al.*, 2016a).

Data was collected on total teaching time for both mathematics and science. Overall teaching time was higher in Northern Ireland than the international average. Among the comparator countries, teaching time was higher than the international average in Australia, England, Hong Kong and Singapore, and below the average in Finland, Poland and the Republic of Ireland.

9.1.1 Teaching time for mathematics

Table 9.1 shows that the amount of time spent teaching mathematics to Y6 pupils in Northern Ireland was 215 hours per year, out of a possible 962 (total hours of teaching per year). This was higher than the international average (157 hours). Among comparator

[41] Teaching time is referred to as 'instructional time' in the international data and report.

countries, Northern Ireland had the highest number of hours per year dedicated to mathematics teaching. Since 2011, there has been a slight decrease (of 17 hours) in the number of hours spent teaching mathematics. Like the majority of countries participating in TIMSS 2015, in Northern Ireland, teaching time was higher for mathematics than for science in Y6.

9.1.2 Teaching time for science

Table 9.1 shows that, in Northern Ireland, the amount of time spent teaching science to Y6 pupils was 38 hours out of 962 (total hours of teaching per year). This was half the international average (76 hours). The standard errors suggest that it is likely that the amount of time dedicated to teaching science in Northern Ireland is statistically significantly below the international average. This is perhaps not surprising given the design of the Northern Ireland Curriculum where science is included within the 'World Around Us'.

Among comparator countries, teaching time for science was considerably higher in Singapore, Poland, Finland, England and Australia[42] (85, 84, 82, 61 and 57 hours respectively), as well as in most other high performing countries. The Republic of Ireland was the only comparator country where the amount of time dedicated to teaching science was lower than in Northern Ireland.

In Northern Ireland, the amount of time dedicated to teaching science annually in Y6 decreased considerably between 2011 and 2015, from 72 hours in 2011 to almost half of this in 2015. This is notable given that the curriculum in Northern Ireland has not changed between the two cycles of TIMSS.

Table 9.1 Teaching time in Y6

Mathematics

Country	Total Instructional Hours per Year	Hours per Year for Mathematics Instruction
Northern Ireland	r 962 (10.2)	s 215 (6.5)
International Avg.	894 (1.9)	157 (0.5)

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

Science

Country	Total Instructional Hours per Year	Hours per Year for Science Instruction
Northern Ireland	r 962 (10.2)	s 38 (2.1)
International Avg.	887 (1.9)	76 (0.3)

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

Source: Exhibit 9.1 International mathematics report (Mullis *et al.*, 2016a), Exhibit 9.1 International science report (Martin *et al.*, 2016a).

[42] Comparisons cannot be made with Hong Kong as data are available for less that 50 per cent of pupils.

9.2 Teachers' emphasis on science investigation in Y6

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.

Teachers' emphasis on science investigation is measured by their responses to eight statements about teaching science (these statements can be seen below in Figure 9.2). The international analysis used responses to these statements to create the 'Emphasize Science Investigation' scale[43]. Pupils were categorised into two bands: those whose teachers emphasise science investigation in 'About Half the Lessons or More' and those whose teachers emphasise science investigation in 'Less than Half the Lessons'. (Details of how pupils were assigned to each band are provided above Table 9.2).

Table 9.2 shows that 3 per cent of Y6 pupils in Northern Ireland were taught by teachers who emphasised science investigation in 'About Half the Lessons or More'. This was considerably below the international average (27 per cent) and was the joint lowest percentage among all participating countries in TIMSS 2015, along with the Netherlands. All seven comparator countries had a higher proportion of pupils in classes where teachers emphasised science investigation in 'About Half the Lessons or More'. Among these countries, emphasis on scientific investigation was most prevalent in the high performer Singapore, where 34 per cent of pupils were in classes taught by teachers where emphasis was placed on science investigation in 'About Half the Lessons or More'. In contrast, another high performing country, Hong Kong, had only 10 per cent of pupils in classes taught by teachers which had this level of emphasis on science investigation.

There was a 10 per cent reduction between 2011[44] and 2015 in the percentage of pupils in Northern Ireland taught by teachers who emphasise science investigation in 'About Half the Lessons or More'. This was consistent with the international trend. The international average for the percentage of pupils taught by teachers who emphasised science investigation in 'About Half the Lessons or More' decreased by 13 per cent between 2011 and 2015, from 40 per cent in 2011 to 27 per cent in 2015. However, caution needs to be exercised in making direct comparisons between the 2011 and 2015 results as the scales used are not exactly the same.

[43] The scale is labelled as such in the international report; hence American spelling may be used in such scale labels in this report.

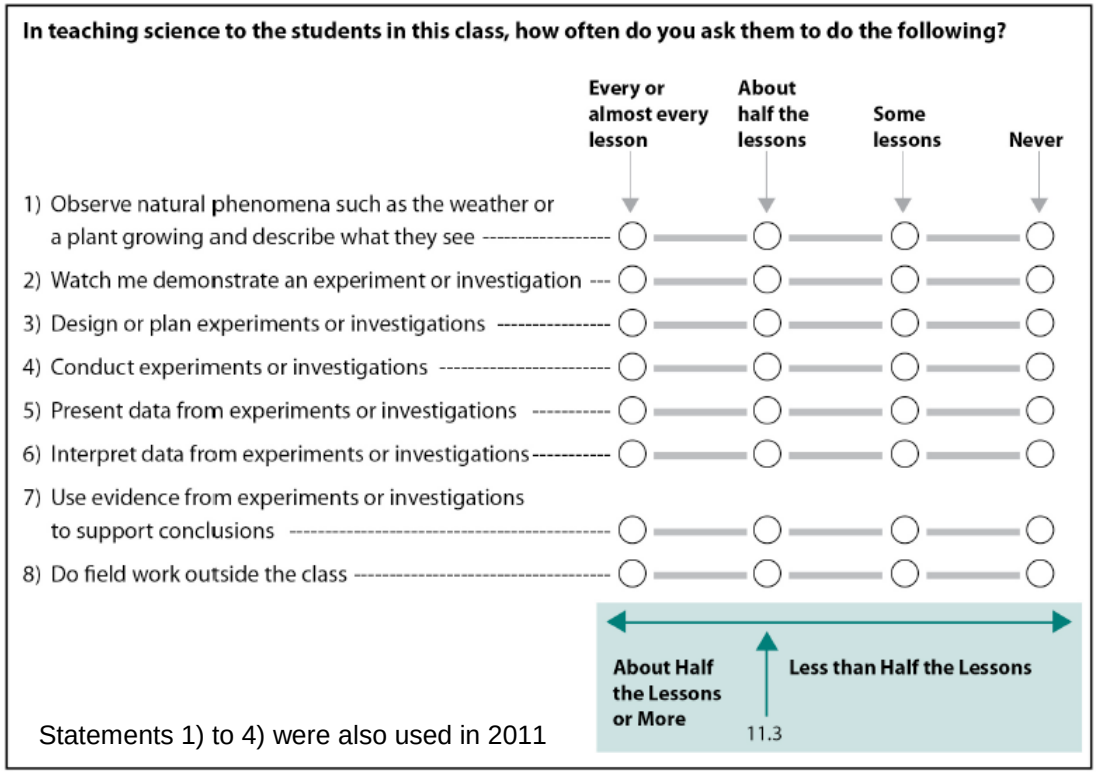
[44] The scale has changed between the 2011 and 2015 survey. In 2011, six statements contributed to the scale. In 2015, eight statements contributed. Four of the statements on the scale were common to both 2011 and 2015.

There are no clear associations between teachers' emphasis on science investigation and pupils' average achievement in Northern Ireland or in most of the main comparator countries. In 29 of the countries participating in TIMSS 2015, average achievement was higher for pupils where science investigation was emphasised in 'About Half the Lessons or More', whereas in 17 countries the opposite was true, with average achievement being higher for pupils where science investigation was emphasised in 'Less than Half the Lessons'.

The standard errors on the international averages suggest that the differences in achievement between pupils in classes where the teacher emphasised science investigation in 'About Half the Lessons or More' are likely to be significantly higher than those where the teacher emphasised science investigation in 'Less than Half of Lessons'.

Among pupils in Northern Ireland whose teachers emphasised science investigation in 'About Half the Lessons or More', average achievement appears to have been lower than among those for whom it was emphasised in 'Less Than Half the Lessons'. However, this difference is unlikely to be significant.[45] This mirrors the findings from 2011. With the exception of the Republic of Ireland, differences in average achievement between the equivalent categories of pupils in comparator countries are also unlikely to be significant.

Figure 9.2 Schools' emphasis on scientific investigation – questions for teachers



Source: Adapted from Exhibit 9.5 International science report (Martin *et al.*, 2016a).

[45] Differences in achievement between groups have not been tested formally for statistical significance in the international analysis, but the sizes of the standard errors in the national data suggest that this apparent difference between groups would not be statistically significant.

Table 9.2 Teachers' emphasis on science investigation in Y6

Students were scored according to their teachers' responses to how often they used each of eight instructional activities on the *Emphasize Science Investigation* scale. Students with teachers who emphasized science investigation in **About Half the Lessons or More** had a score on the scale of at least 11.3, which corresponds to their teachers using all eight activities in "about half the lessons," on average. All other students had teachers who emphasized science investigation in **Less than Half the Lessons**.

Country	About Half the Lessons or More		Less than Half the Lessons		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	3 (0.7)	504 (12.0)	97 (0.7)	521 (2.2)	8.5 (0.13)
International Avg.	27 (0.4)	508 (1.1)	73 (0.4)	505 (0.7)	

This TIMSS questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale points corresponded to the standard deviation of the distribution.

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

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

Source: Exhibit 9.5 International science report (Martin *et al.*, 2016a) and adapted from the international version of the TIMSS Teacher Questionnaire.[46]

9.3 Use of computers

Teachers were asked whether computers were available during mathematics and science lessons. They were also asked about the frequency of their use for different subject-specific, computer-based activities. Table 9.3 summarises this information, giving the results for Northern Ireland and the international average.

9.3.1 Use of computers in Y6 mathematics lessons

Table 9.3 shows that, in Northern Ireland, 71 per cent of pupils participating in TIMSS 2015 were taught by teachers who reported that computers were available for use in mathematics lessons; this is almost double the international average (37 per cent). Only three countries participating in TIMSS in 2015 (New Zealand, Denmark and the Netherlands) had higher computer availability in mathematics lessons. The high availability of computers in mathematics lessons in Northern Ireland was consistent with the 2011 results, where 76 per cent of Y6 pupils had access to computers.

Internationally, there was no clear link between higher computer availability and higher mathematics performance. For example in Singapore, the highest performing country in mathematics, computer availability was the same as the international average (37 per cent). In Northern Ireland, there is no statistically significant difference between the average achievement of those pupils who have access to a computer in mathematics lessons (573 scale points) and those which do not (572 scale points). The relationship between computer availability and average attainment is complex; as a result, achievement data in this area should be interpreted with caution. For example, in some cases, computers might be made available to high-achieving pupils in order to challenge them and stretch their skills. In other cases, they might be made available to lower-achieving pupils for drill and practice.

[46] http://timssandpirls.bc.edu

In Northern Ireland, as was the case in 2011, in instances where pupils did have access to computers for their mathematics lessons, they were most commonly used to practice skills and procedures. This was also the case in all seven comparator countries. In Northern Ireland, computers were used in mathematics lessons to a similar extent to explore mathematical principles and concepts, and to look up Ideas and information. This mirrors the 2011 findings.

9.3.2 Use of computers in Y6 science lessons

Table 9.3 shows that, in Northern Ireland, 76 per cent of Y6 pupils were taught by teachers who reported that computers were available for use in science lessons, 30 percentage points above the international average. As was the case for mathematics, computer availability for science in Northern Ireland was higher than in all other comparator countries, where there was considerable variation, ranging from 42 per cent in the Republic of Ireland to 71 per cent in England.

In many countries participating in TIMSS 2015, computer availability was higher for science lessons than for mathematics lessons; the international average was 9 per cent higher for science than for mathematics. In Northern Ireland and internationally, there was no clear association between science achievement and computer availability in science lessons. For example, computer availability was particularly low in Korea, the second highest performing country in science, with only 22 per cent of pupils taught by teachers who reported that computers were available for science lessons (below the international average).

In Northern Ireland, where pupils did have access to computers for science lessons, they were mainly used to look up ideas and information. This was the case across the majority of participating countries and mirrors the findings from 2011.

The use of computers in Y6 science lessons has remained stable between 2011 and 2015, with the percentage of pupils that have computers available to use in science lessons decreasing by only 2 per cent between 2011 and 2015. This slight reduction in computer availability in science lessons in Northern Ireland between 2011 and 2015 was also reflected internationally.

Table 9.3 Use of computers in Y6 lessons

Mathematics

Country	Computers Available for Students to Use in Mathematics Lessons			Percent of Students Whose Teachers Have Them Use Computers at Least Monthly		
	Percent of Students	Average Achievement				
	Yes	Yes	No	To Explore Mathematics Principles and Concepts	To Practice Skills and Procedures	To Look Up Ideas and Information
Northern Ireland	r 71 (3.8)	573 (4.1)	572 (5.1)	r 58 (3.9)	r 68 (3.8)	r 58 (5.0)
International Avg.	37 (0.5)	510 (1.0)	504 (0.6)	26 (0.4)	33 (0.4)	27 (0.4)

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

Science

Country	Computers Available for Students to Use in Science Lessons			Percent of Students Whose Teachers Have Them Use Computers at Least Monthly			
	Percent of Students	Average Achievement					
	Yes	Yes	No	To Practice Skills and Procedures	To Look Up Ideas and Information	To Do Scientific Procedures or Experiments	To Study Natural Phenomena Through Simulations
Northern Ireland	r 76 (3.9)	523 (2.8)	516 (5.7)	r 37 (4.5)	r 69 (4.2)	r 23 (4.5)	r 39 (4.8)
International Avg.	46 (0.5)	509 (0.9)	504 (0.7)	31 (0.5)	41 (0.5)	26 (0.5)	28 (0.5)

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

Source: Exhibit 9.5 international TIMSS mathematics report (Mullis *et al.*, 2016a), Exhibit 9.9, international TIMSS science report (Martin *et al.*, 2016a).

9.4 The Y6 mathematics and science curriculum

The TIMSS mathematics and science Assessment Frameworks (Mullis and Martin, 2013) are not designed to exactly match the curriculum of any one participating country.

In the Teacher Questionnaire, teachers were asked to indicate whether each of the TIMSS 2015 topics was 'mostly taught before this year', 'mostly taught this year', or 'not yet taught or just introduced' (see Figures 9.3 and 9.4 for further details). Table 9.4 shows the percentage of pupils whose teachers reported that they had been taught the topics either prior to or during the year of the assessment, averaged across topics, and presented both as an overall percentage and according to content domain.

9.4.1 The Y6 mathematics curriculum

Figure 9.3 TIMSS mathematics topics taught – questions for teachers

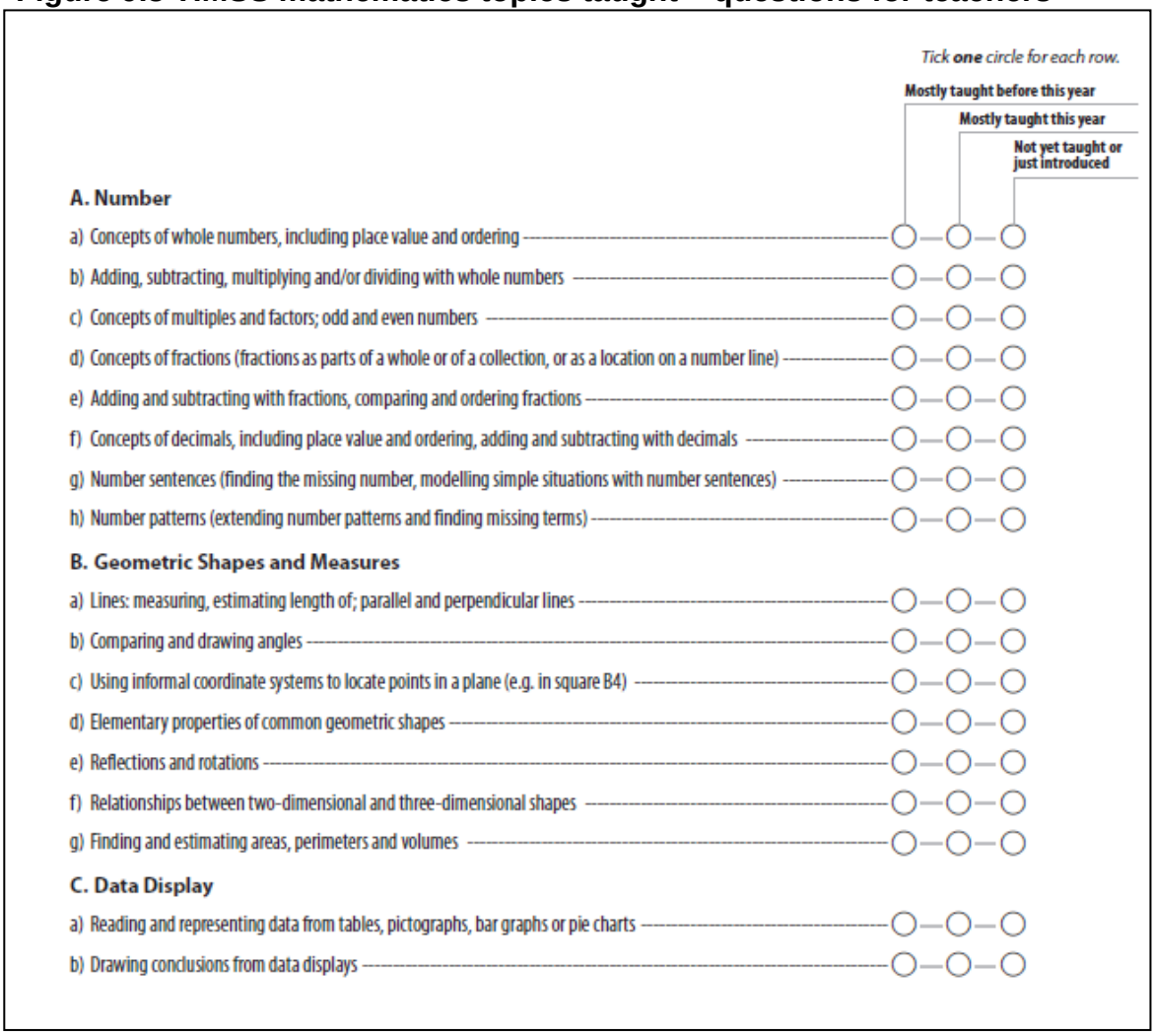


Table 9.4 shows that 92 per cent of pupils in Northern Ireland were taught the TIMSS mathematics topics either before or during the year of the TIMSS assessment. This percentage was second only to Portugal and 16 percentage points above the international average. This has remained stable between 2011 and 2015.

There was a mixed picture internationally in terms of the content domains that were most commonly taught to pupils. The most commonly taught domains in Northern Ireland were Number (97 per cent) and Data Display (94 per cent), as was the case in 2011. On average internationally, topics from these two content domains were most commonly taught (83 per cent taught Number topics and 78 per cent taught Data Display topics), while Geometric Shapes and Measures topics were less commonly taught both internationally and in Northern Ireland.

Looking across the comparator countries, in Singapore, as in Northern Ireland, Number and Data Display topics were the most commonly taught (100 per cent and 95 per cent of pupils respectively), whereas in Australia and the Republic of Ireland, Data Display topics were more commonly taught than the Number topics. It is, however, important to note that there

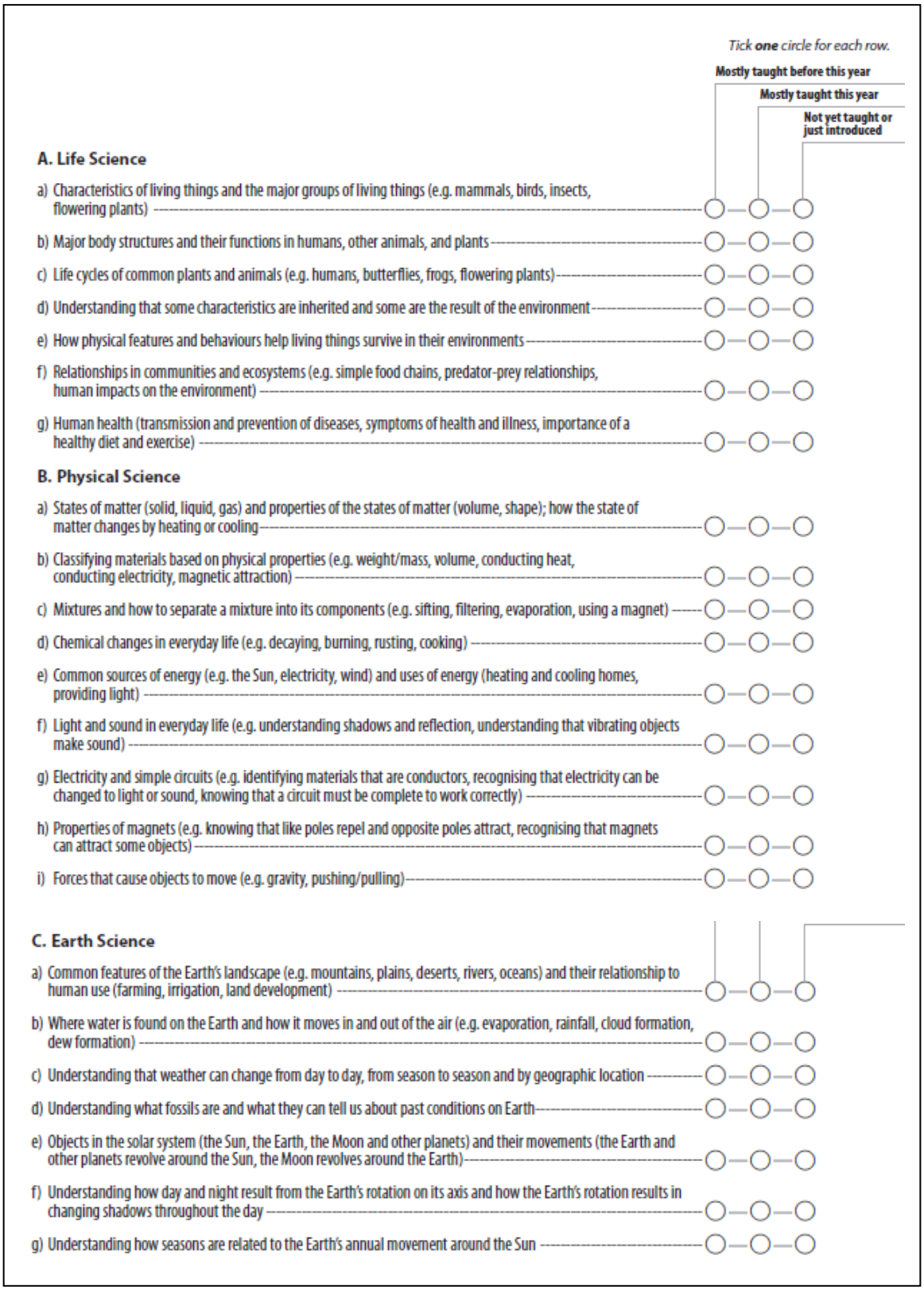
are only two topics in the TIMSS Data Display content domain, compared with eight topics for Number. In Northern Ireland, Australia and England a higher proportion of pupils were taught Geometric Shapes and Measures topics than in Finland, Hong Kong, Poland, the Republic of Ireland and Singapore.

9.4.2 The Y6 science curriculum

Table 9.4 shows that 61 per cent of pupils in Northern Ireland were taught the TIMSS science topics either before or during the year of the TIMSS assessment. This percentage remains unchanged from the 2011 TIMSS survey and was below the international average for 2015 of 65 per cent. Fewer pupils were taught the TIMSS science topics than the TIMSS mathematics topics both in Northern Ireland and on average internationally.

Among the comparator countries, the percentage of pupils taught the TIMSS science topics was lower in Finland, Hong Kong, Singapore and Poland than in Northern Ireland. However, the percentage was higher in England and the Republic of Ireland (73 per cent and 75 per cent respectively). The most commonly taught content domain in Northern Ireland was Life Science (73 per cent); this was the same in all the comparator countries other than England and Singapore, where the most commonly taught domain was Physical Science.

Figure 9.4 TIMSS science topics taught – questions for teachers



Source: Y6 Northern Ireland version of Teacher Questionnaire.

Table 9.4 Percentage of students taught the TIMSS mathematics and science topics

Mathematics

Country	All Mathematics (17 topics)	Number (8 topics)	Geometric Shapes and Measures (7 topics)	Data Display (2 topics)
Australia	87 (1.0)	89 (0.9)	83 (1.4)	93 (1.6)
England	89 (1.2)	95 (0.8)	85 (1.9)	80 (3.0)
Finland	76 (1.0)	89 (0.9)	58 (2.1)	85 (2.2)
Hong Kong SAR	85 (0.9)	94 (0.8)	71 (1.5)	93 (2.1)
Ireland,Rep. of	81 (1.0)	92 (0.8)	66 (1.7)	94 (1.9)
Northern Ireland	r 92 (0.9)	r 97 (0.6)	r 85 (1.7)	r 94 (2.7)
Poland	58 (1.3)	71 (1.4)	46 (1.4)	47 (3.7)
Singapore	85 (0.5)	100 (0.1)	66 (1.1)	95 (1.0)

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

Science

Country	All Science (23 topics)	Life Science (7 topics)	Physical Science (9 topics)	Earth Science (7 topics)
Australia	61 (1.4)	72 (1.6)	52 (2.0)	62 (2.3)
England	r 73 (2.0)	r 67 (2.5)	r 78 (2.2)	r 72 (2.7)
Finland	60 (1.4)	72 (1.4)	48 (2.2)	64 (1.7)
Hong Kong SAR	52 (1.6)	67 (2.1)	45 (2.2)	47 (2.4)
Ireland, Rep. of	75 (1.3)	78 (1.6)	74 (1.4)	74 (2.3)
Northern Ireland	r 61 (1.9)	r 73 (2.6)	r 50 (2.9)	r 64 (2.5)
Poland	33 (0.9)	53 (1.7)	16 (1.2)	37 (1.4)
Singapore	40 (0.6)	52 (0.9)	58 (0.8)	6 (0.8)

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

Source: Exhibit 9.3, international Mathematics report (Mullis *et al.*, 2016a), Exhibit 9.3 international science report (Martin *et al.*, 2016a).

9.5 Conclusion

Teachers and principals were asked a range of questions relating to learning activities and the curriculum in Y6 mathematics and science lessons. This included total teaching time and use of computers for both subjects. For science, teachers were asked about the extent to which they emphasised science investigation. For both mathematics and science, to assess the degree of correspondence between participants' curricula and the TIMSS Assessment Frameworks (Mullis and Martin, 2013), teachers reported on whether the TIMSS topics were covered in lessons, according to content domain.

In Northern Ireland, although teaching time for mathematics was higher than the international average, teaching time for science was lower than the international average.

In Northern Ireland, a very small proportion (3 per cent) of Y6 pupils were taught science by teachers who emphasise science investigation in at least half of their science lessons. This proportion was considerably lower than the international average (27 per cent) and the joint lowest internationally. In some (but not all) of the highest performing countries, science investigation was emphasised to a greater extent. However, there was no clear association between emphasis on science investigation and average achievement within countries.

There was a high level of computer availability for both mathematics and science lessons in Y6 in Northern Ireland. A slightly higher proportion of pupils had access to computers in science lessons compared with mathematics lessons. This trend was consistent with the picture internationally. No clear patterns emerged relating computer availability to average achievement in either subject. This was the case on average internationally and in Northern Ireland.

According to teachers' reports of topics taught in lessons, a higher proportion of Y6 pupils were taught the TIMSS mathematics topics than the TIMSS science topics, as was also the case on average internationally.

10 Characteristics of pupils and home

Chapter outline

This chapter summarises teacher and parent reports to consider the relationship between children's home circumstances in Northern Ireland and their performance in mathematics and science in TIMSS 2015. Outcomes for Northern Ireland are compared with international averages and with comparator countries of interest where relevant.

Key findings

- In Northern Ireland, the majority of children reported having 'Many Resources' or 'Some Resources' for learning at home. Children with access to more home resources for learning had higher average achievement in both mathematics and science.
- A higher proportion of children in Northern Ireland reported having 'Many Resources' compared with the average internationally.
- Parents in Northern Ireland had relatively positive attitudes towards mathematics and science. A higher proportion of children had parents with a 'Very Positive' or 'Positive Attitude' to mathematics and science compared with the international average. Children with parents who had a 'Very Positive Attitude' had higher average achievement in both mathematics and science.
- A high proportion of teachers reported that their teaching was limited to 'Some' extent by pupils' lack of prerequisite knowledge or skills, in both subjects. The proportion was similar to those on average internationally.
- Teachers of pupils in Northern Ireland were more likely to report pupils' lack of sleep as limiting their teaching compared with pupils' lack of nutrition.
- The proportion of pupils whose teachers reported lack of sleep as a limiting factor was greater in Northern Ireland than the international average for both mathematics and science.
- Pupils in Northern Ireland whose teachers reported that pupils' lack of basic nutrition and lack of sufficient sleep limited teaching had lower average achievement in both mathematics and science than those whose teachers reported not having these limitations. This mirrors the international data.

10.1 Home resources for learning

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.

Possessions in the home, as well as indicators of socio-economic status such as parents' education level and occupation, are associated with educational achievement (OECD, 2013). The TIMSS 2015 study acquired information about these background factors from pupils and parents. In the international data and report these are referred to as 'Home Resources for Learning'.

The 'Early Learning Survey' asked the parents of children involved in TIMSS 2015 to report on the availability of three key home variables highly related to achievement in school:

- parents' education
- parents' occupation
- number of children's books in the home.

In addition, in the Pupil Questionnaire children were asked about:

- the number of books in the home and
- the availability of key study supports at home: their own computer, an internet connection and their own room.

Table 10.1 presents the results for the 'Home Resources for Learning scale' for Northern Ireland. The scale was created using parents' and children's reports about the variables listed above. Pupils were categorised into three groups ('Many Resources', 'Some Resources' and 'Few Resources') according to the availability of these 'Home Resources for Learning'. (Details of how responses were categorised during analysis are given in Figure 10.1, below Table 10.1).

In Northern Ireland, 35 per cent of children were in the 'Many Resources' category, 64 per cent were in the 'Some Resources' category, and 1 per cent were in the 'Few Resources' category. Compared with the 2011 study, there was a 5 per cent increase in the percentage of children in Northern Ireland in the highest category. A higher proportion of children were also reported to have 'Many Resources' in Northern Ireland than on average internationally, mirroring the findings from 2011. In Table 10.1, the percentages of children in each category are the same for both mathematics and science since they refer to the same children, but the data on average achievement is different for each.

In Northern Ireland, there were patterns of achievement across the categories. Children who were in the 'Many Resources' category scored higher in mathematics and science than those who were in the 'Some Resources' category[47]. This mirrors 2011 and is also the case on average internationally. No comparisons could be made between achievement of children in the 'Many Resources' and 'Few Resources' categories (for both subjects) because only 1 per cent of children in Northern Ireland were categorised as having 'Few Resources'.

Table 10.1 Home resources for learning

Mathematics

Reported by parents, except 'Number of Books' and 'Home Study Supports', which were reported by pupils.

Students were scored according to their own and their parents' responses concerning the availability of five resources on the *Home Resources for Learning* scale. Students with **Many Resources** had a score of at least 11.9, which is the point on the scale corresponding to students reporting they had more than 100 books in the home and both of the home study supports, and parents reporting that they had more than 25 children's books in the home, that at least one parent had finished university, and that at least one parent had a professional occupation, on average. Students with **Few Resources** had a score no higher than 7.4, which is the scale point corresponding to students reporting that they had 25 or fewer books in the home and neither of the home study supports, and parents reporting that they had 10 or fewer children's books in the home, that neither parent had gone beyond upper-secondary education, and that neither parent was a small business owner or had a clerical or professional occupation, on average. All other students were assigned to the **Some Resources** category.

Country	Many Resources		Some Resources		Few Resources		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 s	35 (1.4)	632 (3.2)	64 (1.4)	564 (3.9)	1 (0.3)	~ ~	11.1 (0.06)	s 0.2 (0.09)
International Avg.	17 (0.2)	569 (0.9)	74 (0.2)	501 (0.4)	9 (0.1)	427 (1.5)		

Significantly higher than 2011 ▲
Significantly lower than 2011 ▼

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 "s" indicates data are available for at least 50% but less than 75% of the pupils.

Source: Exhibit 4.1, international mathematics report (Mullis *et al.*, 2016a).

Science

Reported by parents, except 'Number of Books' and 'Home Study Supports', which were reported by pupils.

Students were scored according to their own and their parents' responses concerning the availability of five resources on the *Home Resources for Learning* scale. Students with **Many Resources** had a score of at least 11.9, which is the point on the scale corresponding to students reporting they had more than 100 books in the home and both of the home study supports, and parents reporting that they had more than 25 children's books in the home, that at least one parent had finished university, and that at least one parent had a professional occupation, on average. Students with **Few Resources** had a score no higher than 7.4, which is the scale point corresponding to students reporting that they had 25 or fewer books in the home and neither of the home study supports, and parents reporting that they had 10 or fewer children's books in the home, that neither parent had gone beyond upper-secondary education, and that neither parent was a small business owner or had a clerical or professional occupation, on average. All other students were assigned to the **Some Resources** category.

Country	Many Resources		Some Resources		Few Resources		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 s	35 (1.4)	570 (3.1)	64 (1.4)	511 (3.1)	1 (0.3)	~ ~	11.1 (0.06)	s 0.2 (0.09)
International Avg.	18 (0.2)	567 (0.9)	74 (0.2)	503 (0.5)	8 (0.1)	426 (1.9)		

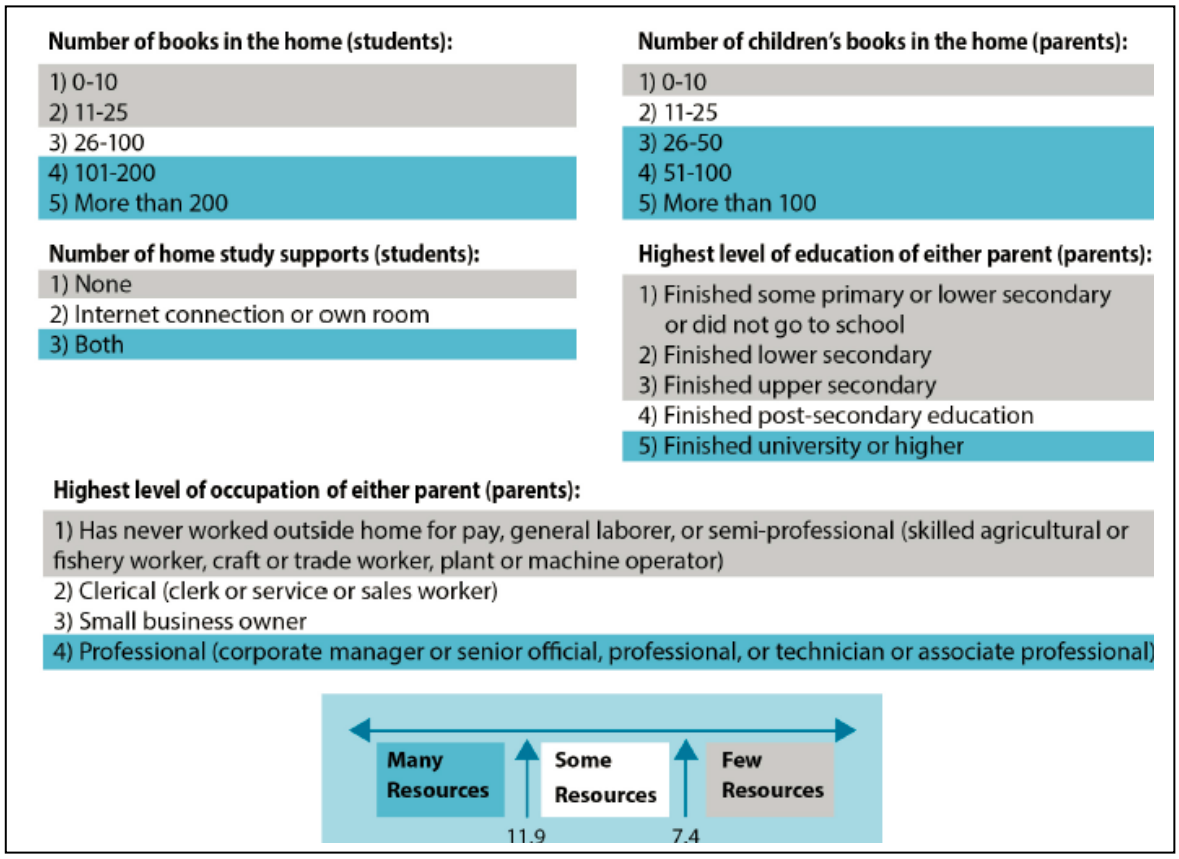
Significantly higher than 2011 ▲
Significantly lower than 2011 ▼

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 "s" indicates data are available for at least 50% but less than 75% of the pupils.

Source: Exhibit 4.1, international science report (Martin *et al.*, 2016a).

[47] The differences in achievement have not been tested for statistical significance in the international analysis but, based on the size of the standard errors, are likely to be significant.

Figure 10.1 The 'Home Resources for Learning' scale



Source: Exhibit 4.1, international mathematics report (Mullis *et al.*, 2016a) and international science report (Martin *et al.*, 2016a).

10.2 Parental attitudes towards mathematics and science

Research evidence suggests that the importance parents place on education and how they convey this to their children when discussing future goals can be associated with educational achievement (Mullis and Martin, 2013). In TIMSS 2015, parent's attitudes were measured by their responses to eight statements about their feelings towards mathematics and science. (These statements are provided in Figure 10.2). The international analysis uses responses to these statements to create the 'Parental Attitude Toward Mathematics and Science' scale. It categorises children into having parents in one of three bands: 'Very Positive Attitude', 'Positive Attitude' and 'Less than Positive Attitude'. (Details of how pupils were assigned to each band are also provided in Figure 10.2.) As this data was not collected in 2011, no trend comparisons can be made.

In Northern Ireland, 77 per cent of children participating in TIMSS 2015 were categorised as having parents with a 'Very Positive Attitude' towards mathematics and science. A further 22 per cent of children were categorised as having parents with a 'Positive Attitude' and a very small proportion (1 per cent) as having parents with a 'Less than Positive Attitude' towards mathematics and science. Northern Ireland had a higher percentage of children with parents who had a 'Very Positive Attitude' than the international average (66 per cent for both mathematics and science). In Table 10.2, the percentages of children in each category are

the same for both subjects since they refer to the same children, but the data on average achievement is different for each subject.

In Northern Ireland, there were also patterns of achievement across the categories. Children who were in the parents with a 'Very Positive Attitude' category scored higher in mathematics and science than those who were in the 'Positive Attitude' category. [48] This was also the case on average internationally. No comparisons could be made between achievements of children in the 'Very Positive Attitude' and 'Less than Positive Attitude' categories (for both subjects), because only 1 per cent of children in Northern Ireland had parents with a 'Less than Positive Attitude'.

Table 10.2 Parental attitude towards mathematics and science

Mathematics

Reported by parents

Students were scored on the *Parental Attitude Toward Mathematics and Science* scale according to their parents' responses to eight statements about their feelings toward the subjects. Students whose parents have a **Very Positive Attitude** had a score on the scale of at least 9.3, which corresponds to their parents "agreeing a lot" with four of the eight statements and "agreeing a little" with the other four, on average. Students whose parents have a **Less than Positive Attitude** had a score no higher than 5.9, which corresponds to their parents "disagreeing a little" with four of the eight statements and "agreeing a little" with the other four, on average. All other students had parents who have a **Positive Attitude** toward mathematics and science.

Country	Very Positive Attitude		Positive Attitude		Less than Positive Attitude		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland s	77 (1.1)	588 (3.7)	22 (1.1)	577 (5.3)	1 (0.3)	~ ~	10.4 (0.05)
International Avg.	66 (0.1)	510 (0.5)	32 (0.1)	495 (0.6)	2 (0.0)	509 (2.9)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An "s" indicates data are available for at least 50% but less than 70% of the pupils.

Source: Exhibit 4.5, international mathematics report (Mullis *et al.*, 2016a).

Science

Reported by parents

Students were scored on the *Parental Attitude Toward Mathematics and Science* scale according to their parents' responses to eight statements about their feelings toward the subjects. Students whose parents have a **Very Positive Attitude** had a score on the scale of at least 9.3, which corresponds to their parents "agreeing a lot" with four of the eight statements and "agreeing a little" with the other four, on average. Students whose parents have a **Less than Positive Attitude** had a score no higher than 5.9 which corresponds to their parents "disagreeing a little" with four of the eight statements and "agreeing a little" with the other four, on average. All other students had parents who have a **Positive Attitude** toward mathematics and science.

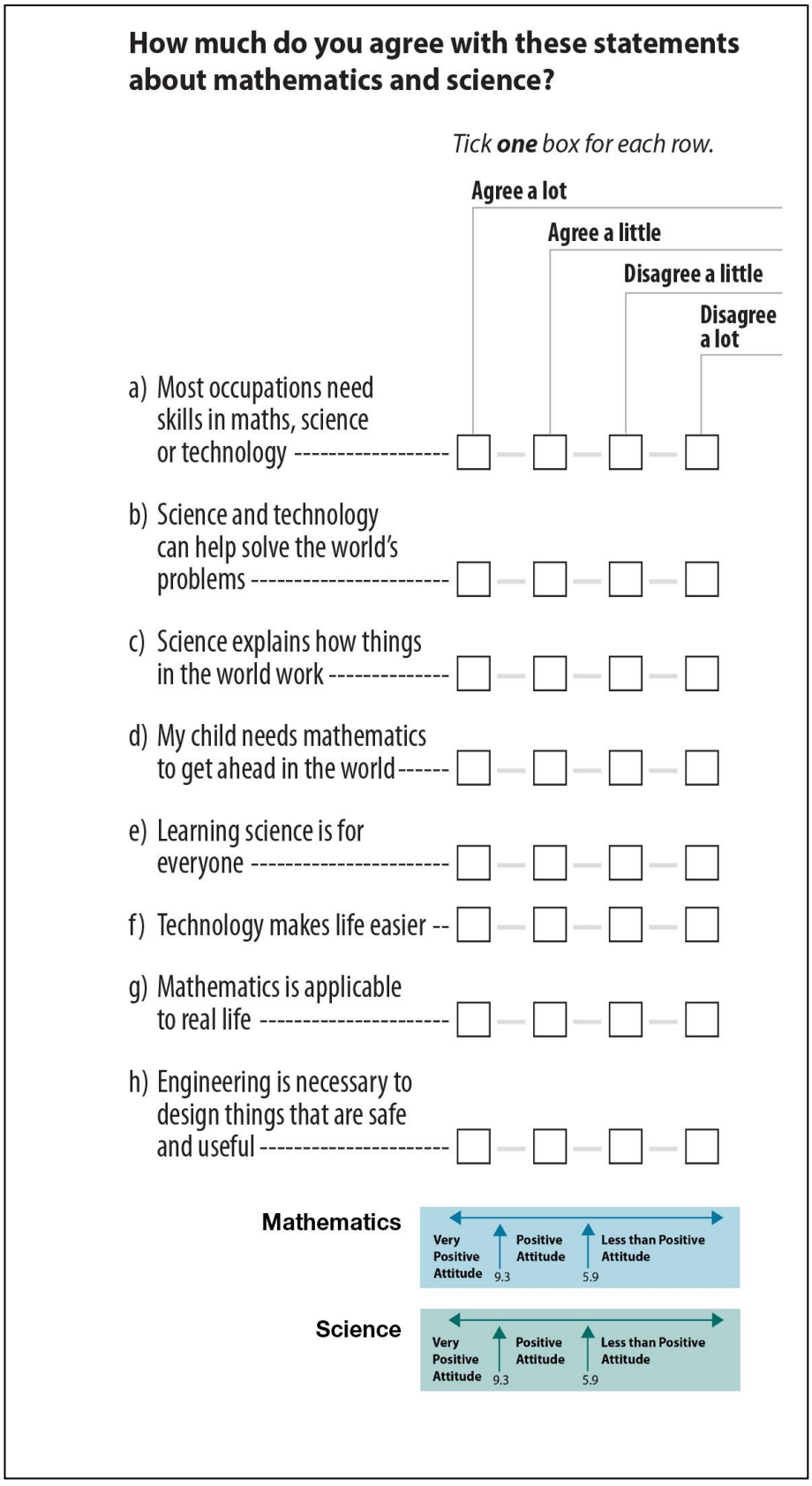
Country	Very Positive Attitude		Positive Attitude		Less than Positive Attitude		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland s	77 (1.1)	533 (2.9)	22 (1.1)	522 (3.9)	1 (0.3)	~ ~	10.4 (0.05)
International Avg.	66 (0.1)	512 (0.5)	32 (0.1)	496 (0.8)	2 (0.0)	504 (3.0)	

Centre point of scale set at 10.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An "s" indicates data are available for at least 50% but less than 70% of the pupils.

Source: Exhibit 4.5, international science report (Martin *et al.*, 2016a).

[48] The differences in achievement have not been tested for statistical significance in the international analysis but, based on the size of the standard errors, are unlikely to be significant.

Figure 10.2 Parental attitude towards mathematics and science



Source: Exhibit 4.5, international mathematics report (Mullis *et al.*, 2016a) and international science report (Martin *et al.*, 2016a), and adapted from the international version of the TIMSS 2015 Home Questionnaire.

10.3 Pupil level factors that limit teaching

Interpreting the data: percentages in tables

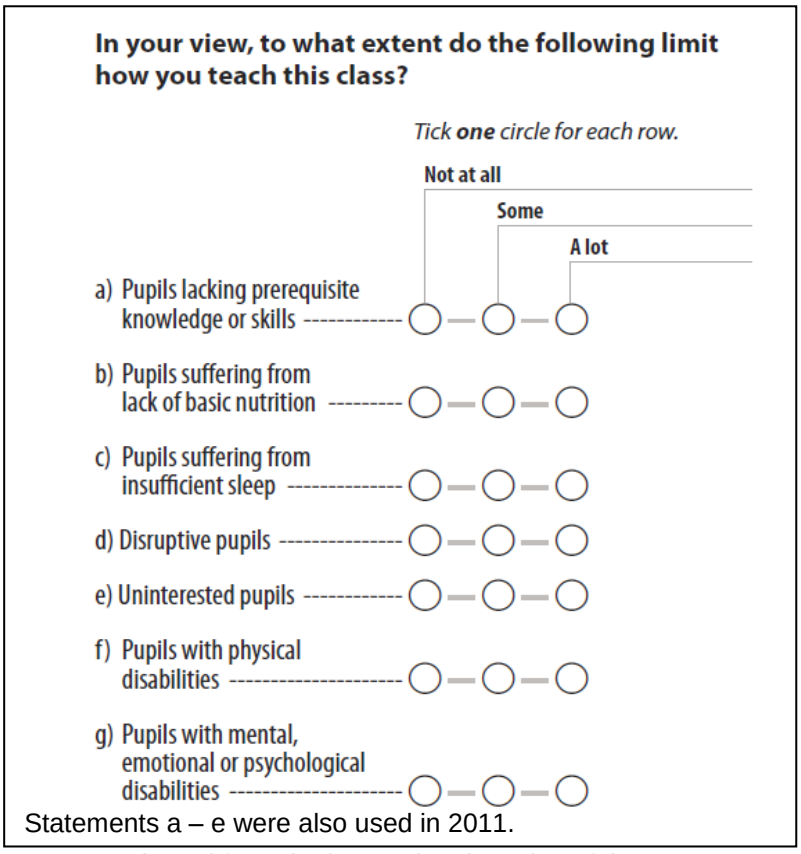
Some of the data in this chapter is derived from teacher reports. Reported percentages refer to pupils and can usually be interpreted as the percentage of pupils whose teachers reported a particular practice or circumstance.

Year 6 (Y6) pupils (ages 9-10) were sampled by class. As a result, the Y6 Teacher Questionnaire would, in most cases, 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 because the distribution of pupils within the sample of teachers may differ by subject.

Teachers were asked to report the extent to which a number of pupil level factors limited their teaching. The question to which teachers responded is shown in Figure 10.3. This section focuses on the first three elements of this question: teachers' perceptions of pupils' lack of prerequisite skills and knowledge, pupils' lack of basic nutrition and pupils suffering from not enough sleep.

Figure 10.3 The limitations on teaching question



Statements a – e were also used in 2011.

Source: Adapted from the international version of the TIMSS 2015 Teacher Questionnaire.

10.3.1 Pupils lacking prerequisite knowledge or skills

Table 10.3 shows that, in Northern Ireland, over two thirds of pupils were taught by teachers who reported that their teaching was limited to 'Some' extent by pupils lacking prerequisite knowledge or skills. At the same time just under a quarter (21 per cent) reported that their teaching was 'Not at all' limited by pupils' lack of prerequisite skills. This was similar to 2011.

In all seven comparator countries, for both mathematics and science, the percentage of pupils whose teachers reported that their teaching was limited to 'Some' extent by pupils' lack of prerequisite knowledge or skills was similar to or lower than that for Northern Ireland. This mirrors the results from 2011. The majority of comparator countries also had similar percentages of pupils whose teachers reported that their teaching was limited 'A lot' by pupils' lack of prerequisite knowledge or skills as Northern Ireland. This is in contrast to 2011, where the comparator countries generally had higher percentages of pupils in this category.

In Northern Ireland, and internationally, there appears to be an association between attainment and teachers' reports of limitations based on pupils' lack of prerequisite knowledge or skills.[49] That is, pupils whose teachers reported that their teaching was limited 'A lot' had a lower average achievement than those who teaching was limited to 'Some' extent or 'Not at all'.

Table 10.3 Y6 teaching limited by pupils lacking prerequisite knowledge or skills

Mathematics

Country	Percentage of pupils in classrooms where teachers reported teaching is limited by pupils lacking prerequisite knowledge or skills					
	Not at all		Some		A lot	
	%	Mean score	%	Mean score	%	Mean score
Northern Ireland	21	597	67	570	12	545
International Avg.	**16**	**524**	**65**	**511**	**19**	**489**

Source: 2015 Mathematics Teacher Context Data Almanac by Mathematics Achievement question ATBG15A.

[49] The differences in achievement have not been tested for statistical significance in this international analysis.

Country	Percentage of pupils in classrooms where teachers reported teaching is limited by pupils lacking prerequisite knowledge or skills					
	Not at all		Some		A lot	
	%	Mean score	%	Mean score	%	Mean score
Northern Ireland	21	539	67	519	12	504
International Avg.	**18**	**521**	**64**	**507**	**17**	**485**

Source: 2015 Science Teacher Context Data Almanac by Science Achievement question ATBG15A.

10.3.2 Pupils suffering from a lack of basic nutrition / lack of sleep

In Northern Ireland, 75 per cent of pupils participating in TIMSS 2015 were taught by teachers who reported that their teaching was 'Not at all' affected by pupils lacking in basic nutrition (Table 10.4). This is a slightly lower percentage than in 2011. As was the case in 2011, the percentage of pupils in this category was higher than the international average. Across the comparator countries, Poland and Finland had the highest percentages of pupils taught by teachers reporting that their teaching was 'Not at all' affected by pupils' lack of basic nutrition, for both mathematics and science (over 90 per cent of pupils).

Teachers of pupils in Northern Ireland were more likely to report pupils' lack of sleep as limiting their teaching than their lack of nutrition, as in 2011[50]. In Northern Ireland, 60 per cent of pupils in mathematics and 61 per cent of pupils in science were taught by teachers who reported that their teaching was limited to 'Some' extent by their pupils' lack of sleep. This is higher than the international averages (50 per cent and 48 per cent respectively).

Across the comparator countries, the results for mathematics and science mirror those in Northern Ireland, where a lack of sleep was more likely to be reported by teachers as limiting their teaching than pupils' lack of nutrition.

Pupils in Northern Ireland, and internationally, whose teachers reported that pupils' lack of basic nutrition and lack of sufficient sleep limited their teaching 'A lot' appeared to have lower average achievement in mathematics and science than those whose teachers reported not having these limitations[51]. In addition, in Northern Ireland, there was a difference between the average achievement of pupils who were taught by teachers limited to 'Some' extent and 'A lot' by pupils suffering from lack of basic nutrition and not enough sleep. This was not the case internationally, however, where the average achievement of pupils in these categories was similar.

[50] In 2011, the response categories 'Some' and 'A lot' were combined, both for pupils suffering from a lack of basic nutrition and for pupils suffering from not enough sleep. Caution is therefore required when making direct comparisons.
[51] The differences in achievement have not been tested for statistical significance in this international analysis.

Table 10.4 Y6 teaching limited by pupils' lack of basic nutrition / sleep

Mathematics

Country	Percentage of pupils in classrooms where teachers reported teaching is limited by pupils lacking basic nutrition					
	Not at all		Some		A lot	
	%	Mean score	%	Mean score	%	Mean score
Northern Ireland	75%	579	24%	555	2%	524
International Avg.	**67%**	**518**	**28%**	**498**	**5%**	**482**

Country	Percentage of pupils in classrooms where teachers reported teaching is limited by pupils not getting enough sleep					
	Not at all		Some		A lot	
	%	Mean score	%	Mean score	%	Mean score
Northern Ireland	32%	592	60%	564	8%	557
International Avg.	**42%**	**519**	**50%**	**506**	**9%**	**492**

Source: 2015 Mathematics Teacher Context Data Almanac by Mathematics Achievement, question ATBG15B and ATBG15C.

Country	Percentage of pupils in classrooms where teachers reported teaching is limited by pupils lacking basic nutrition					
	Not at all		Some		A lot	
	%	Mean score	%	Mean score	%	Mean score
Northern Ireland	75%	526	24%	507	2%	486
International Avg.	**68%**	**514**	**28%**	**495**	**5%**	**474**

Country	Percentage of pupils in classrooms where teachers reported teaching is limited by pupils not getting enough sleep					
	Not at all		Some		A lot	
	%	Mean score	%	Mean score	%	Mean score
Northern Ireland	31%	536	61%	515	8%	507
International Avg.	**44%**	**514**	**48%**	**502**	**8%**	**491**

Source: 2015 Science Teacher Context Data Almanac by Science Achievement, question ATBG15B and ATBG15C.

10.4 Conclusion

Possessions in the home, as well as indicators of socio-economic status such as parents' education level and occupation, are associated with educational achievement (OECD, 2013). It is therefore reassuring that, overall, the majority of children in Northern Ireland were categorised as having access to 'Some' or 'Many' resources, slightly higher than in 2011 and higher than the international average. The findings for Northern Ireland in TIMSS 2015 support the findings from the OECD research. That is, there were differences in achievement between children categorised as having access to 'Many resources', compared with those having access to 'Some'. This mirrors the findings from 2011.

Research suggests that the value parents place on mathematics and science, and how this is conveyed to their children, can have an impact on achievement in these subjects (Mullis and Martin, 2013). It is therefore encouraging that the majority of children in Northern Ireland participating in TIMSS 2015 had parents with a positive attitude towards mathematics and science. This positive parental attitude was also reflected internationally and appeared to be significantly associated with achievement[52]. However, in Northern Ireland, the difference in achievement between children categorised as having parents with a 'Very Positive Attitude' and those with parents with a 'Positive Attitude' is unlikely to be significant.

[52] Although significance tests have not been conducted in the international analysis, based on the size of the standard errors, the differences in international average achievement scores are likely to be statistically significant.

In Northern Ireland, a high proportion of teachers reported that their teaching was limited to 'Some' extent by pupils' lack of prerequisite knowledge or skills, in both mathematics and science, as was the case in 2011. This was consistent with the international averages. There appears to be an association between attainment and teaching being limited by a lack of prerequisite knowledge or skills.

Three-quarters of pupils in Northern Ireland were taught by teachers who reported that their teaching was 'Not at all' limited by pupils' lack of nutrition. However, teachers of more pupils reported that pupils' lack of sleep limited teaching. There was a similar pattern in the international averages and across the comparator countries, and this reflects the findings from the TIMSS 2011 study. In addition, the average achievement of pupils whose teachers reported that pupils' lack of basic nutrition and / or sleep limited their teaching was lower than that of pupils whose teachers reported that these factors did not limit their teaching at all.

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Appendix A

Trends in International Mathematics and Science Study (TIMSS) 2015: Overview

A.1 TIMSS 2015: Introduction

The TIMSS 2015 survey is the sixth in the IEA's[53] series of comparative international surveys of mathematics and science achievement. TIMSS is administered on a four-yearly cycle, so the 2015 survey updates the picture of performance from 2011. Earlier cycles took place in 2007, 2003, 1999 and 1995[54]. The next TIMSS cycle is planned for 2019.

A brief description of the survey is given below.

A.2 TIMSS 2015 participants

TIMSS 2015 involved 64 participants: 57 countries and 7 benchmarking participants,[55] taking part at one or both of the target grades: 'fourth grade', ages 9-10 and 'eighth grade', ages 13-14 (Year 6 and Year 10 respectively in Northern Ireland).[56] Participant numbers for fourth grade (the target grade in Northern Ireland) were: 57 participants (50 countries and 7 benchmarking participants).

Table A.1 below gives the list of participants in TIMSS 2015. This shows participants for the fourth grade assessment only and indicates the previous cycles in which each participant was involved.

TIMSS 2015 participants are varied, ranging from highly developed countries or regions through to developing ones. Their education systems also vary, differing, for example, in the age at which children start school. More information about the education system in each participating country and region can be found in the TIMSS encyclopaedia (Mullis *et al.*, 2016a).

[53] International Association for the Evaluation of Educational Achievement (IEA): http://www.iea.nl/
[54] The 1995 TIMSS study was originally entitled the Third International Mathematics and Science Study, and followed earlier mathematics surveys in 1964 and 1980-1982 and science surveys in 1970 and 1984.
[55] Countries participating in TIMSS follow guidelines and strict sampling targets to provide samples that are nationally representative. 'Benchmarking participants' are regional entities which follow the same guidelines and targets to provide samples that are representative at regional level.
[56] Norway assessed at the fifth and ninth grades (but collected benchmark data at fourth and eighth grades). Botswana and South Africa assessed at ninth grade rather than eighth grade.

Table A.1 TIMSS 2015 participants

Country	Grade 4					Grade 8					
	2015	2011	2007	2003	1995	2015	2011	2007	2003	1999	1995
Armenia	○	●	○	●		○	●	○	●		
Australia	●	●	●	●	●	●	●	●	●	○	●
Bahrain	●	●				●	●	●	●		
Belgium (Flemish)	●	●		●					●	●	●
Botswana (6, 9)		●				●	●	○	○		
Bulgaria	●							●	●	●	
Canada	●				○	●				○	○
Chile	●	●				●	●		●	●	
Chinese Taipei	●	●	●	●		●	●	●	●	●	
Croatia	●	●									
Cyprus	●			●	●			●	●	●	●
Czech Republic	●	●	●		●			●		●	●
Denmark	●	●	●								●
Egypt						●		●	●		
England	●	●	●	●	●	●	●	●	●	●	●
Finland	●	●					●			○	
France	●										●
Georgia	●	●	●			●	●	●			
Germany	●	●	●								●
Hong Kong SAR	●	●	●	●	●	●	●	●	●	●	●
Hungary	●	●	●	●	●	●	●	●	●	●	●
Indonesia	●				○		●	●	○	○	○
Iran, Islamic Rep. of	●	●	●	●	●	●	●	●	●	●	●
Ireland	●	●			●	●					●
Israel					○	●	●	○	○	○	○
Italy	●	●	●	●	○	●	●	●	●	●	○
Japan	●	●	●	●	●	●	●	●	●	●	●
Jordan	●					●	●	●	●	●	
Kazakhstan	●	●	○			●	●				
Korea, Rep. of	●	●			●	●	●	●	●	●	●
Kuwait	●	●	○		○	●		○			○
Lebanon						●	●	●	●		
Lithuania	●	●	●	●		●	●	●	●	●	●
Malaysia						●	●	●	●	●	
Malta		●				●		●			
Morocco	●	●	○	○		●	●	○	○	○	
Netherlands	●	●	●	●	●				●	●	●
New Zealand	●	●	●	●	●	●	●		●	●	●
Northern Ireland	●	●									
Norway (5,9)	●					●					
Oman	●	●				●	●	●			
Poland	●	○									
Portugal	●	●			●						●
Qatar	●	●	○			●	●	○			
Russian Federation	●	●	●	●		●	●	●	●	●	●
Saudi Arabia	●	●				●	●	○	○		
Serbia	●	●						●	●		
Singapore	●	●	●	●	●	●	●	●	●	●	●
Slovak Republic	●	●	●						●	●	●
Slovenia	●	●	●	●	●	●	●	●	●	○	●
South Africa (5, 9)	●					●	●		○	○	○
Spain	●	●									●
Sweden	●	●	●			●	●	●	●		●
Thailand		●			○	●	●	●		●	○
Turkey	●	●				●	●	○		○	
United Arab Emirates	●	●				●	●				
United States	●	●	●	●	●	●	●	●	●	●	●

● Indicates participation in that testing cycle.

○ Indicates participation but data not comparable for measuring trends to 2015, primarily due to countries improving translations or increasing population coverage.

Source: Exhibit A.1, international mathematics and science reports (Mullis *et al.*, 2016a; Martin *et al.*, 2016a).

A.3 TIMSS 2015 in the UK

The countries which comprise the United Kingdom are regarded separately by the IEA and, of the four, Northern Ireland and England chose to participate in the 2015 survey. The 2015 cycle represented Northern Ireland's second TIMSS participation, so comparisons can be made with the 2011 cycle where appropriate. England has participated in all TIMSS cycles, so comparisons can be made with all earlier cycles where appropriate. Scotland has also participated in previous cycles.

The TIMSS 2011 survey in Northern Ireland was administered by NFER. Outcomes from the 2011 cycle of TIMSS internationally and in the UK are available through the NFER website: www.nfer.ac.uk/timss

A.4 TIMSS 2015 sampling strategy

The TIMSS samples are drawn based on internationally specified criteria, and are designed to be representative of the national population of pupils in the target age group (or regional population, for benchmarking participants). Each participant is therefore expected to provide a sampling pool that covers all or almost all of the target national population. Where exclusions are considered necessary, these must be within set limits. Exclusions may be for a variety of reasons, including:

- geographical (e.g. remote and/or very small schools may be excluded at sampling stage)
- linguistic (e.g. participants may exclude some language groups at sampling stage if they opt to translate the assessment into majority languages only, not all languages spoken within the country/region)
- special educational needs (e.g. special schools teaching pupils who cannot access the assessment may be excluded at sampling stage, or individual pupils who cannot access the assessment may be excluded at the administration stage).

The guidance for both the mathematics and science surveys stipulates that no more than 5 per cent of the population in total should be excluded across all stages of the survey. See the technical report (Martin *et al.*, 2016b) and Appendix C of the international reports (Mullis *et al.*, 2016a; Martin *et al.*, 2016a) for more information.

Each participating country has a 'main sample' and two matched 'replacement samples' which are used if the main sample schools decline to participate. The main sample is designed to be nationally representative of pupils in the target age group and so the sampling criteria ('stratifiers') for each country are designed to address key characteristics of the nation's school system.[57] Each main sample school is then assigned a 'first replacement' school and a 'second replacement' school, both of which share the same key sampling characteristics as the main sample school. This ensures that, if the main sample school declines to participate, its first replacement school can be used instead and the sample will still be nationally representative. If the first replacement school also declines to participate,

[57] Schools are sampled using systematic, random sampling with probability proportional to their measures of size.

the second replacement school will be invited to participate and, again, the sample will remain nationally representative. If the second replacement school declines to participate, then the country cannot include any other school, to avoid skewing the sample.

Classes of pupils of the target age are then randomly sampled within the participating schools and 95 per cent of these classes are expected to take part. Within each sampled class, at least 85 per cent of pupils are expected to take part. Samples are inspected and, if they meet the sampling criteria, accepted by the IEA's sampling referee.

In order to meet the stringent TIMSS participation targets, countries are expected to achieve participation of:

- at least 85 per cent of their main sample schools; OR
- at least 85 per cent of sampled schools of which at least 50 per cent must be from the main sample and the remainder matched replacement schools; OR
- a combined pupil / school rate of at least 75 per cent.

Participants achieving at least 85 per cent of the main sample schools or a combined pupil / school figure of at least 75 per cent are deemed to have met the sampling requirements fully. Those achieving at least 85 per cent with the use of replacement schools are deemed to have achieved a sample that is suitably representative at national level, but are 'annotated' in the international report, to indicate that replacement schools were used.

A.5 Northern Ireland's TIMSS 2015 samples

Northern Ireland's sampling strategy

Samples for Northern Ireland were drawn by Statistics Canada, assisted by the NFER Research and Statistics teams. The sample was stratified by region and deprivation level. Schools were recruited by the NFER Research and Products Operations team. Once a school had agreed to participate, one or more Y6 classes were randomly sampled, using the IEA's within-school sampling software. This selected the number of classes automatically. Pupils in the sampled classes were required to complete both the TIMSS assessments (mathematics and science). Irish-medium schools were offered the option to offer the TIMSS assessments to all of their pupils in Irish instead of English. No schools took up this option.

Northern Ireland's sample

The sample in Northern Ireland did not meet the international sampling standards described above, even with the inclusion of replacement schools. Of 154 schools sampled, a total of 118 primary schools took part (100 main sample schools and 18 replacement schools). In order to ensure that the Northern Ireland sample was not biased the NFER statistics team undertook a bias analysis.

The results of the bias analysis showed that the 118 schools in Northern Ireland that took part in TIMSS 2015 were representative of the population of schools from which the sample of schools was drawn. Table A.2 shows the number and proportion of schools in each

region, county and deprivation level in the population and in the sample that participated in TIMSS 2015. There are some small differences in the proportion of schools of different types between the population and the schools that participated. However, a statistical test of significance confirmed that the differences are not statistically significant and are likely to be due to chance.

Table A.2 Region, county and deprivation level of the population of schools and schools that participated in TIMSS 2015

		Population		Participated in TIMSS 2015	
		Number	Proportion	Number	Proportion
Region	Belfast	97	11	12	10
	Western	185	21	24	20
	North Eastern	218	24	27	23
	South Eastern	163	18	24	20
	Southern	230	26	31	26
Deprivation level	Low	178	20	24	20
	Low to moderate	179	20	24	20
	Moderate	179	20	27	23
	Moderate to high	179	20	23	19
	High	178	20	20	17
	Missing	*15*	*2*		
County	Antrim	298	33	41	35
	Armagh	76	9	9	8
	Down	192	22	33	28
	Fermanagh	42	5	7	6
	Londonderry	126	14	16	14
	Tyrone	144	16	12	10

Class participation was 100 per cent and pupil participation 93 per cent (see Table A.3). Overall participation was 71 per cent, which did not exceed the combined target of at least 75 per cent of pupils and schools. Total exclusions for Northern Ireland were just 2.7 per cent.

Internationally, participation rates at this grade ranged from 71 per cent in Northern Ireland to 99 per cent in Bahrain, Chinese Taipei, Indonesia, Iran, Morocco and Qatar. For TIMSS 2015 the exclusion rates ranged from 0.2 per cent in Indonesia to 11.3 per cent in Serbia.

The average age of participating pupils in Northern Ireland was 10.4 years. The range internationally for those in the target grade was from 9.6 years (in Oman) to 10.9 years in

Denmark for TIMSS at grade 4. See Appendix C of the international reports for more information (Mullis *et al.*, 2016a; Martin *et al.*, 2016a).

Table A.3 Sample information for Northern Ireland

The information in this table is taken from the international reports. The source of each element within the reports is indicated.

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
Northern Ireland	154	154	100	18	118

Source: Exhibit C.3, international mathematics and science reports (Mullis *et al.*, 2016a; Martin *et al.*, 2016a).

Country	Within-School Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
Northern Ireland	93%	3,388	17	2	3,369	253	3,116

Source: Exhibit C.5, international mathematics and science reports (Mullis *et al.*, 2016a; Martin *et al.*, 2016a).

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
‡ Northern Ireland	65%	76%	100%	93%	60%	71%

‡ Nearly satisfied guidelines for sample participation rates after replacement schools were included.

Source: Exhibit C.7, international mathematics and science reports (Mullis *et al.*, 2016a; Martin *et al.*, 2016a).

Country	International Target Population		Exclusions from National Target Population		
	Coverage	Notes on Coverage	School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
Northern Ireland	100%		2.6%	0.1%	2.7%

Source: Exhibit C.1, international mathematics and science reports (Mullis et al., 2016a; Martin et al., 2016a).

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