

## 4. Attainment by content and skill in Northern Ireland

### Chapter outline

This chapter focuses on performance in Northern Ireland in reading, mathematics and science in Year 6 (Y6, ages 9-10). It summarises pupils' reading attainment across the PIRLS Reading Purpose and Comprehension Process domains and their mathematics and science attainment across the TIMSS content and cognitive domains. It also reports any gender differences across these domains. Findings for reading are presented first, followed by findings for mathematics and science.

PIRLS assesses two reading purposes (Literary and Informational) and two comprehension process domains (Retrieving and Straightforward Inferencing, and Interpreting, Integrating and Evaluating). TIMSS assesses content domains in mathematics and science, and the cognitive domains of Knowing, Applying and Reasoning in both subjects. More information about each of these domains is given in sections 4.1 to 4.4. Further information about international performance on these domains is available in the international reports.

### Key findings

- On the two reading purposes scales identified in PIRLS, pupils in Northern Ireland scored significantly<sup>1</sup> more highly, relative to the national average reading score, on Literary purposes and less well on Informational purposes.
- In the mathematics content domains, pupils did significantly better on Number and less well on Data Display.
- In the science content domains, they did less well on Earth Science.
- On the processes of reading comprehension scales, pupils in Northern Ireland scored higher on the Interpreting, Integrating and Evaluating scale, and lower on the Retrieving and Straightforward Inferencing scale.
- In the mathematics cognitive domains, they did better on Knowing and less well on Reasoning.
- In the science cognitive domains, they scored better on Applying and less well at Reasoning.
- In almost all countries, including Northern Ireland, girls achieved significantly higher mean scores than boys for each of the two reading purposes and each of the two comprehension processes.
- For both mathematics and science, most countries had gender differences on the content or cognitive domains. Northern Ireland was unusual in having no significant gender differences on the mathematics content or cognitive domains, and no differences on the science cognitive domains.
- There was a single gender difference for the science content domains: girls did better than boys on Life Science.

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

## 4.1 The content and skill domains, PIRLS and TIMSS 2011

### Reading: what PIRLS assesses at ages 9-10

The two reading purposes assessed in Y6 reading are:

- Reading for literary experience
- Reading to acquire and use information.

The four comprehension processes are:

- Focusing on and retrieving explicitly stated information
- Making straightforward inferences
- Interpreting and integrating ideas and information
- Examining and evaluating content, language and textual elements.

These are combined into two domains:

- Retrieving and Straightforward Inferencing
- Interpreting, Integrating and Evaluating.

More information is available in the PIRLS Assessment framework.<sup>2</sup>

### Mathematics: what TIMSS assesses at ages 9-10

The content domains assessed for Y6 mathematics are:

- Number - Whole numbers; Fractions and decimals; Number sentences with whole numbers; Patterns and relationships
- Geometric Shapes and Measures - Points, lines and angles; Two- and three-dimensional shapes
- Data Display - Reading and interpreting; Organizing and representing.

The cognitive domains are:

- Knowing – Recall; Recognize; Compute; Retrieve; Measure; Classify/Order
- Reasoning – Select; Represent; Model; Implement; Solve Routine Problems
- Applying – Analyze; Generalize/Specialize; Integrate/Synthesize; Justify; Solve Non-routine Problems.

More information is available in the TIMSS Assessment framework.<sup>3</sup>

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<sup>2</sup> Mullis *et al* (2009a)

<sup>3</sup> Mullis *et al* (2009b)

## Science: what TIMSS assesses at ages 9-10

The content domains assessed in Y6 science are:

- Life Science – Characteristics and life processes of living things; Life cycles, reproduction and heredity; Interaction with the environment; Ecosystems; Human health
- Physical Science – Classification and properties of matter; Sources and effects of energy; Forces and motion
- Earth Science - Earth's structure, physical characteristics and resources; Earth's processes, cycles and history; Earth in the solar system.

The cognitive domains are:

- Knowing – Recall/Recognize; Define; Describe; Illustrate with Examples; Demonstrate Knowledge of Scientific Instruments
- Reasoning – Compare/Contrast/Classify; Use Models; Relate; Interpret Information; Find Solutions; Explain
- Applying – Analyze; Integrate/Synthesize; Hypothesize/Predict; Draw Conclusions; Generalize; Evaluate; Justify.
- More information is available in the TIMSS Assessment Framework.<sup>4</sup>

Although the curriculum in Northern Ireland (CCEA, 2007) does not include science as a discrete subject, it is covered as part of 'The World Around Us'.<sup>5</sup> While there are some differences between the key stage 2 curriculum in Northern Ireland and the TIMSS Assessment Framework for science, all of the TIMSS science topics are included in Northern Ireland's curriculum. Chapter 1 of this report gives more information.

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4 Mullis *et al* (2009b)

5 See the TIMSS 2011 encyclopaedia (Mullis *et al*, 2012a)

## 4.2 Attainment by reading purpose and content domains, Y6

### Interpreting the data: numerical scales

In this section, pupils' attainment across the PIRLS reading purpose and comprehension process domains and 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 with each other 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.

### 4.2.1 Attainment in the reading purposes domain

Table 4.1 presents the average achievement of Northern Ireland in the two purposes for reading identified in PIRLS: reading for literary experience, and reading to acquire and use information, as compared with overall reading achievement.

Generally, the participating countries with the highest overall reading attainment in PIRLS 2011 also had the highest attainment in both Literary and Informational reading.

The performance of pupils in Northern Ireland significantly differed between the two purposes for reading with pupils scoring significantly more highly on Literary purposes and significantly less well on Informational purposes. In addition to Northern Ireland, the Republic of Ireland and New Zealand also scored significantly more highly on the Literary scale, while Hong Kong and Singapore scored significantly more highly on the Informational scale. The scores of three of Northern Ireland's comparator countries (Finland, England and Australia) did not differ significantly between the two purposes for reading.<sup>6</sup>

**Table 4.1 Y6 attainment in reading purposes**

Country	Overall Reading Average Scale Score	Literary		Informational	
		Average Scale Score	Difference from Overall Reading Score	Average Scale Score	Difference from Overall Reading Score
† Northern Ireland	558 (2.4)	564 (2.7)	5 (1.4) ⬆	555 (2.6)	-4 (1.7) ⬇

⬆ Subscale score significantly higher than overall reading score

⬇ Subscale score significantly lower than overall reading score

See Appendix C.5 in the international report 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 PIRLS report

<sup>6</sup> See Exhibit 3.1, international PIRLS report

## 4.2.2 Attainment in the mathematics content domains

Northern Ireland's mean scale score for TIMSS mathematics was 562. Pupils in Northern Ireland scored significantly above this mean score in the content domain of Number (a mean scale score of 566) and significantly below it in Data Display (555). The score on Geometric Shapes and Measures (560) was similar to the score for mathematics overall (see Table 4.2).

The general pattern internationally was for countries to perform more highly on Number than on the other areas, relative to their own mean performance. However, there was more variability in terms of 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 in these domains. There were no patterns of content domain performance among Northern Ireland's comparator countries (Australia, England, Finland, Hong Kong, Republic of Ireland, New Zealand, and Singapore): all had different relative strengths and weaknesses. Finland had a flat profile, scoring similarly to its own mean score on all three domains.<sup>7</sup>

**Table 4.2 Y6 attainment in the mathematics content domains**

Country	Overall Mathematics Average Scale Score	Number		Geometric Shapes and Measures		Data Display	
		Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score	Average Scale Score	Difference from Overall Mathematics Score
<sup>†</sup> Northern Ireland	562 (2.9)	566 (2.9)	4 (1.6) <sup>⬤</sup>	560 (3.3)	-2 (2.1)	555 (3.0)	-8 (1.5) <sup>⬇</sup>

<sup>⬤</sup> Subscale score significantly higher than overall mathematics score  
<sup>⬇</sup> Subscale score significantly lower than overall mathematics score

See Appendix C.8 in the international report for sampling guidelines and sampling participation notes <sup>†</sup> and <sup>‡</sup>.  
 ( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 3.1, international mathematics report

## 4.2.3 Attainment in the science content domains

Northern Ireland's mean scale score for TIMSS science was 517. Pupils in Northern Ireland (see Table 4.3) scored similarly to this mean in the science content domains of Life Science (a mean scale score of 519) and Physical Science (520), but significantly lower in Earth Science (507).

The international pattern was variable, although over half of the TIMSS countries had lower relative scores on Earth Science and/or Physical Science at this age range.<sup>8</sup> There were no patterns among the comparator countries: each, again, had its own profile of relative strengths and weaknesses. New Zealand and Republic of Ireland had flat profiles, each scoring similarly to its own mean score on all three content domains.<sup>9</sup>

<sup>7</sup> See Exhibit 3.1, international mathematics report

<sup>8</sup> See Exhibit 3.1, international science report

<sup>9</sup> See Exhibit 3.3, international science report

**Table 4.3 Y6 attainment in the science content domains**

Country	Overall Science Average Scale Score	Life Science		Physical Science		Earth Science	
		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	517 (2.6)	519 (2.9)	2 (1.3)	520 (3.2)	3 (2.5)	507 (2.7)	-9 (1.6) Ⓣ

Ⓢ Subscale score significantly higher than overall science score  
 Ⓣ Subscale score significantly lower than overall science score

See Appendix C.8 in the international report 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

## 4.3 Attainment by reading process and cognitive domains

### 4.3.1 Attainment in the reading process domains

The survey also provides the average achievement scales in the two comprehension process domains identified in PIRLS:

- Retrieving and Straightforward Inferencing
- Interpreting, Integrating and Evaluating.

Generally, the PIRLS 2011 participants with the highest attainment overall also had the highest attainment on both comprehension process scales.

Pupils in Northern Ireland scored significantly higher on the Interpreting, Integrating and Evaluating scale relative to their own mean and scored significantly lower than their mean on the Retrieving and Straightforward Inferencing scale. Hong Kong, Singapore, England and New Zealand also scored significantly more highly on the Interpreting, Integrating and Evaluating scale. Hong Kong, England and New Zealand scored significantly lower on the Retrieving and Straightforward Inferencing scale. Three comparator countries (Finland, Republic of Ireland and Australia) did not differ significantly on either of the two comprehension processes.<sup>10</sup>

**Table 4.4 Y6 attainment in reading comprehension processes**

Country	Overall Reading Average Scale Score	Retrieving and Straightforward Inferencing		Interpreting, Integrating, and Evaluating	
		Average Scale Score	Difference from Overall Reading Score	Average Scale Score	Difference from Overall Reading Score
† Northern Ireland	558 (2.4)	555 (2.5)	-3 (1.0) Ⓣ	562 (2.5)	4 (1.0) Ⓢ

Ⓢ Subscale score significantly higher than overall reading score  
 Ⓣ Subscale score significantly lower than overall reading score

See Appendix C.5 in the international report 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 PIRLS report

<sup>10</sup> See Exhibit 3.3, international PIRLS report

### 4.3.2 Attainment in the mathematics cognitive domains

As was the case with the content domains, Northern Ireland showed some differences in its profile of scores on the cognitive domains. Relative to their overall mathematics score of 562, pupils did significantly better on Knowing (a mean scale score of 580) but less well on Reasoning (538). Their score on Applying was similar to the average (565).

Two-fifths of the participating nations had higher scores for Knowing relative to their own mean. Relative performance on Applying and Reasoning was more variable across countries.

Again, there was variability among the comparator countries. As with the mathematics content domains, Finland had a flat profile for the cognitive domains. The other comparator countries showed different patterns of relative strength and weakness, with England and Republic of Ireland having the same pattern as Northern Ireland.<sup>11</sup>

**Table 4.5 Y6 attainment in the mathematics cognitive domains**

Country	Overall Mathematics Average Scale Score	Knowing		Applying		Reasoning	
		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	562 (2.9)	580 (3.4)	17 (1.7) ●	565 (2.9)	2 (2.0)	538 (3.3)	-25 (2.1) ▼

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

See Appendix C.8 in the international report 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

### 4.3.3 Attainment in the science cognitive domains

Whereas Northern Ireland's pupils scored better in Knowing for mathematics, they scored significantly better than their average on Applying science: a mean scale score of 521 for Applying, compared with their mean score overall of 517 (see Table 4.6). They scored significantly less well than their average on Reasoning (503), as was the case for mathematics.

Again, there was a mixed picture internationally and the comparator countries varied in their respective strengths and weaknesses: among this group, only Australia and New Zealand showed a flat profile on the science cognitive domains.<sup>12</sup>

**Table 4.6 Y6 attainment in the science cognitive domains**

Country	Overall Science Average Scale Score	Knowing		Applying		Reasoning	
		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	517 (2.6)	517 (2.9)	1 (2.1)	521 (2.6)	5 (1.4) ●	503 (3.1)	-14 (2.2) ▼

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

See Appendix C.8 in the international report 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

<sup>11</sup> See Exhibit 3.3, international mathematics report

<sup>12</sup> See Exhibit 3.3, international science report

## 4.4 Performance by gender

### 4.4.1 Attainment by gender in reading processes and purposes

Table 4.7 shows that, in Northern Ireland, girls scored significantly more highly than boys in both reading purposes and comprehension processes. In all the comparator countries girls performed better than boys on all four scales: reading purposes and reading processes.<sup>13</sup>

**Table 4.7 Achievement in reading purpose and comprehension processes by gender**

Country	Reading Purposes				Comprehension Processes			
	Literary		Informational		Retrieving and Straightforward Inferencing		Interpreting, Integrating, and Evaluating	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
† Northern Ireland	575 (3.2) ⬆	552 (3.5)	561 (3.1) ⬆	549 (3.4)	563 (2.8) ⬆	548 (3.4)	571 (2.8) ⬆	553 (3.3)
International Avg.	522 (0.5) ⬆	502 (0.5)	519 (0.5) ⬆	507 (0.5)	521 (0.5) ⬆	505 (0.5)	519 (0.5) ⬆	502 (0.5)

⬆ Average significantly higher than other gender

See Appendix C.5 in the international report 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 PIRLS report

### 4.4.2 Attainment by gender in mathematics content and cognitive domains

Northern Ireland has no significant gender differences in the Y6 mathematics content domains (see Table 4.8) or cognitive domains (Table 4.9). This is unusual internationally. The international average pattern was for boys to do significantly better than girls in Number, and for girls to do significantly better than boys in Geometric Shapes and Measures and in Data Display. For the cognitive domains, there was more variability across countries, with an average gender difference only for Reasoning, on which boys internationally did significantly better at ages 9-10.

Among the comparator countries, England, Republic of Ireland and Singapore also had no gender differences on either set of mathematics domains. Finland, Hong Kong and New Zealand had differences on the mathematics content domains (favouring girls in New Zealand and favouring boys in Finland and Hong Kong) while Australia and Hong Kong had differences on the mathematics cognitive domains (favouring boys).<sup>14</sup>

**Table 4.8 Gender differences in the Y6 mathematics content domains**

Country	Number		Geometric Shapes and Measures		Data Display	
	Girls	Boys	Girls	Boys	Girls	Boys
† Northern Ireland	566 (3.3)	567 (3.8)	561 (3.8)	559 (4.3)	558 (3.8)	552 (4.1)
International Avg.	493 (0.5)	496 (0.6) ⬆	485 (0.6) ⬆	483 (0.7)	486 (0.7) ⬆	482 (0.7)

⬆ Average significantly higher than other gender

See Appendix C.8 in the international report 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

<sup>13</sup> See Exhibit 3.7, international PIRLS report

<sup>14</sup> See Exhibit 3.9, international mathematics report



**Table 4.9 Gender differences in the Y6 mathematics cognitive domains**

Country	Knowing		Applying		Reasoning	
	Girls	Boys	Girls	Boys	Girls	Boys
† Northern Ireland	578 (4.0)	582 (4.5)	566 (3.2)	564 (3.8)	538 (4.0)	537 (4.1)
International Avg.	492 (0.6)	492 (0.6)	488 (0.6)	489 (0.6)	487 (0.6)	489 (0.6) ⬆

⬆ Average significantly higher than other gender

See Appendix C.8 in the international report 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

### 4.4.3 Attainment by gender in science content and cognitive domains

Unlike mathematics, there was one gender difference in Northern Ireland for science, relating to the content domains: girls significantly outperformed boys in Life Science (see Table 4.10). There were no significant differences in Northern Ireland for the science cognitive domains.

The international average pattern was for girls to do significantly better than boys in Life Science, while the converse was true for Physical Science and Earth Science: boys on average did better at these internationally. There were some gender differences among the group of comparator countries, mostly with boys outperforming girls at Earth Science. Three of the comparator countries (Australia, England and Republic of Ireland) had no significant gender differences on the science content domains.<sup>15</sup>

For the science cognitive domains, there was a more scattered picture internationally. The international averages showed no significant gender differences overall for Knowing or Applying, but showed that Reasoning items were generally answered better by girls overall. Hong Kong and Singapore showed some gender differences, not corresponding to the international patterns, while five of the comparator countries (Australia, England, Finland, Republic of Ireland and New Zealand) had no gender differences at all on the science cognitive domains.<sup>16</sup>

**Table 4.10 Gender differences in the Y6 science content domains**

Country	Life Science		Physical Science		Earth Science	
	Girls	Boys	Girls	Boys	Girls	Boys
† Northern Ireland	523 (3.5) ⬆	514 (3.4)	519 (3.5)	522 (3.8)	503 (3.8)	512 (4.8)
International Avg.	489 (0.6) ⬆	481 (0.6)	484 (0.6)	485 (0.7) ⬆	479 (0.7)	483 (0.7) ⬆

⬆ Average significantly higher than other gender


See Appendix C.8 in the international report 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

<sup>15</sup> See Exhibit 3.9, international science report

<sup>16</sup> See Exhibit 3.11, international science report

**Table 4.11 Gender differences in the Y6 science cognitive domains**

Country	Knowing		Applying		Reasoning	
	Girls	Boys	Girls	Boys	Girls	Boys
† Northern Ireland	518 (3.6)	517 (3.3)	520 (3.3)	523 (3.0)	505 (3.6)	500 (5.5)
International Avg.	486 (0.6)	485 (0.7)	485 (0.6)	484 (0.6)	485 (0.7) 	478 (0.7)

 Average significantly higher than other gender

See Appendix C.8 in the international report 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

## 4.5 Conclusion

Chapter 1 indicated that Northern Ireland’s pupils scored above the international average in all three subjects of reading, mathematics and science, and performed particularly well in reading and mathematics. Even so, within this overall high achievement, there were areas of relative strength and weakness, as outlined in this chapter.

In terms of content domains, there were areas of strength alongside less well developed areas, for all three subjects. For the cognitive and skill domains, Northern Ireland’s pupils performed better on the more complex reading skills, compared with the more straightforward skills. In contrast, in mathematics and science, they did less well at the more complex Reasoning items than the more straightforward Knowing and/or Applying items.

Gender differences also varied across the subjects. Girls in Northern Ireland did better than boys at reading, mirroring the international trend. However, they did not conform to the international trends in gender differences for mathematics and science. There was only one gender difference in Northern Ireland: girls outperformed boys in Life Science, and there were no other significant gender differences in content or cognitive domains for mathematics or science.