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TIMSS 2019 in Northern Ireland: Mathematics and Science

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Bethan Burge
Rachel Classick
Tara Paxman
David Thomas

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By the National Foundation for Educational Research,

The Mere, Upton Park, Slough, Berkshire SL1 2DQ

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Contents

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TIMSS 2019 in Northern Ireland: Executive summary

This summary describes the attainment of Year 6 pupils in Northern Ireland in the TIMSS 2019 survey and explores the context of that attainment.

Northern Ireland's performance in TIMSS is compared in more detail with that of eight other countries: the six PISA countries which outperformed Northern Ireland in all three subject domains in the most recent PISA cycle (2018). These main comparator countries comprise:

- Canada
- England
- Finland
- Hong Kong
- Korea
- Poland
- Republic of Ireland
- Singapore.

A key objective of International Large Scale Assessments, such as TIMSS, is to learn from high performing countries. However, it is also important to look to countries that are geographically close and culturally similar, therefore Northern Ireland is also compared with England (as the only other constituent country of the UK to participate) and the Republic of Ireland. These are referenced throughout this summary and report as applicable.

Attainment

- Mathematics and science attainment for 9 and 10-year-olds in Northern Ireland remains high. Northern Ireland's mathematics and science scores in 2019 were not significantly different from scores in 2015 or 2011.

- Pupils in Northern Ireland performed very well in TIMSS 2019 mathematics. They significantly[1] outperformed 51 of the 58 participating countries and were significantly outperformed by only five countries.

- The average score for science (518) was lower than for mathematics (566), although still above the TIMSS science International Average. In terms of science performance, pupils in England and the Republic of Ireland achieved scores that were, on average, significantly higher than Northern Ireland.

- Northern Ireland's position in science, relative to other countries, improved compared with TIMSS 2015. In 2019, fewer countries significantly outperformed Northern Ireland in the science assessment: 18 countries compared with 21 in 2015.

- In terms of trends over time, Northern Ireland's performance in mathematics and science has remained stable. Average scores in both subjects in 2019 was not significantly different from the scores in 2015. Of the 45 countries that participated in both cycles of TIMSS mathematics, 23 countries had scores that were not significantly different from their scores in 2015; and of the 44 countries that participated in science, 24 had scores that were not significantly different from their scores in 2015.

- For mathematics and science, the distribution of attainment across the international benchmarks[2] has remained stable since 2015.

- Reflecting the high performance in mathematics overall in Northern Ireland, just over a quarter of pupils reached the Advanced International Benchmark, the sixth highest percentage internationally. This mirrors the findings from 2015.

[1] Throughout this summary and the national report, the term 'significant' refers to statistical significance. When statistical significance is reported, it indicates that the compared mean scores are significantly different at the five per cent level.

[2] The TIMSS International Benchmarks describe both what pupils typically know and what they can do in mathematics and science. The proportion of pupils at the Low International Benchmark are those who have *Some basic knowledge of mathematics* or a *Limited understanding of scientific concepts*. The proportion of pupils at the Advanced International Benchmark are those that can A*pply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning* or *Communicate their understanding of life, physical and Earth sciences and demonstrate some knowledge of the process of scientific enquiry*.

- Five per cent of Northern Ireland's pupils reached the Advanced International Benchmark for science.

- In terms of the lower performing pupils, in Northern Ireland, four per cent and six per cent of pupils did not reach the Low International Benchmarks for mathematics and science respectively. This compares with zero to one per cent for mathematics, and zero to six per cent for science, in the countries performing better than Northern Ireland.

- In both 2019 and 2015, there was a relatively wide spread of attainment for mathematics in Northern Ireland, whereas for science the difference between the scores of the highest (95th percentile) and lowest (5th percentile) attainers was smaller.

Attainment by gender

- In Northern Ireland, there was gender equality in the mathematics and science attainment of Year 6 pupils. As in 2011 and 2015, there were no significant differences in attainment between girls and boys in either mathematics or science.

- Of the 58 countries that participated in TIMSS 2019, 27 had no significant gender differences in mathematics, 27 favoured boys and four favoured girls. In science, 33 countries had no significant gender differences, 18 favoured girls and seven favoured boys.

- In Northern Ireland, across the content and cognitive domains for mathematics and science, there were no significant gender differences, except for science reasoning skills, where girls scored higher than boys.

- The International Average performance for boys was significantly higher than for girls in all content and cognitive domains for mathematics, except for the Data domain where there was no significant gender difference.

- The International Average performance for girls was significantly higher than for boys in Life Science, whereas boys scored significantly higher in Physical Science and Earth Science. Internationally in the cognitive domains, boys scored significantly higher in the Knowing domain, while girls scored significantly higher in both the Applying and Reasoning domains.

Socio-economic disadvantage and achievement in TIMSS 2019

- According to parents and pupils, the vast majority of pupils in Northern Ireland were categorised as having access to *some* or *many* resources (98 per cent), higher than the International Average (92 per cent) and similar to 2015.

- As in 2015 and 2011, there were differences in achievement between pupils categorised as having *Many resources* or *Some resources*. Pupils categorised as having *Many resources* had significantly higher mathematics and science scores.

- In Northern Ireland, pupils taught in schools categorised as *Most affluent* had significantly higher scores in mathematics and science than pupils taught in schools categorised as *Most disadvantaged*. Pupils in the *Most affluent* schools scored 586 points in mathematics, significantly above those in the *Most disadvantaged* schools (539). In science, scores were 532 and 500 respectively. This significant difference in performance was seen in all eight comparator countries.

Attainment in mathematics and science by content and skill

- In the mathematics content domains, pupils in Northern Ireland did significantly better on Number questions and less well on Measures and Geometry questions compared to their performance overall. In the mathematics cognitive domains, which define mathematical skills, they did significantly better on questions that assessed Knowing skills and less well on questions which required them to use Reasoning skills.

- In the science content domains, pupils did significantly better on Earth Science and less well on Physical Science. In the science cognitive domains, they performed significantly less well on questions that tested Applying skills.

- Performance in the content and cognitive domains was compared to the results from 2015 to identify any statistically significant changes over time:

    - In mathematics, performance in Reasoning skills increased significantly (by nine scale score points) while performance in Measurement and Geometry, and Applying skills decreased significantly (by 10 and 11 points respectively).

    - In science, there were no significant changes in performance in the content and cognitive domains.

- Since Northern Ireland first participated in TIMSS in 2011, some significant longer term trends have emerged:

    - In mathematics, there have been significant improvements in the Data domain (by nine points) and in Reasoning skills (by 20 points).

    - In science, there have been significant improvements in the Earth Science domain (by 17 points) and Reasoning skills (by 16 points) and a significant decrease in Applying skills (by seven points).

Pupil attitudes to mathematics and science learning

- In Northern Ireland, and within countries internationally, the pupils who had the most positive attitudes towards mathematics and science had higher average achievement scores.
- There was a higher proportion of pupils in Northern Ireland (and internationally) who *Very much like learning science* (56 per cent in Northern Ireland, 52 per cent on average internationally) than *Very much like learning mathematics* (31 per cent in Northern Ireland, 45 per cent on average internationally).
- The proportion of pupils internationally who *Very much like learning mathematics* was higher than in Northern Ireland. The proportions who *Very much like learning science* were more similar.
- In Northern Ireland and internationally, pupils who were categorised as *Very confident* had higher achievement scores. This was the case for both mathematics and science.
- Countries with the highest performing pupils overall in mathematics had a low percentage of pupils categorised as *Very confident*. This is evident in the data from four of the five highest-performing countries: Korea, Chinese Taipei, Japan and Hong Kong. These countries had between 15 per cent and 18 per cent of pupils in the highest category for confidence, compared with 29 per cent in Northern Ireland and 32 per cent internationally.
- In Northern Ireland, pupils' attitudes towards mathematics and science were similar to those seen in 2015.
- Northern Ireland had a higher proportion of pupils reporting *High clarity of instruction* in their mathematics (80 per cent) and science (73 per cent) lessons than the comparator countries.
- In mathematics, there was an association between clarity in lessons and achievement; this pattern was not seen for science.
- In mathematics and science, the most popular instructional practices used *Every or almost every lesson* by teachers in Northern Ireland were asking pupils to explain their answers and linking new content to pupils' prior knowledge.
- Compared to the International Average, more pupils in Northern Ireland had teachers encouraging classroom discussions among pupils in *Every or almost every lesson.* However, fewer pupils had teachers relating the lesson to the pupils' daily lives and bringing interesting materials to class regularly. This was the case for both mathematics and science.

Education workforce

- In Northern Ireland, a large proportion of pupils (75 per cent) attended schools where the principal had completed a postgraduate degree; considerably higher than the International Average (54 per cent).
- In Northern Ireland, most pupils (85 per cent) were taught mathematics and science by teachers with a degree; a larger proportion than seen internationally (56 per cent).
- Fifteen per cent of pupils were taught mathematics and science by teachers with a postgraduate degree. This was lower than the International Averages for both subjects (28 per cent for mathematics, 29 per cent for science).
- Across comparator countries, pupils in Finland and Poland were most likely to be taught by teachers with a postgraduate degree and pupils in England were least likely to be taught by a teacher with that level of qualification.
- In Northern Ireland, around two-thirds of pupils (65 per cent in mathematics and 67 per cent in science) were taught by teachers whose main area of study was primary education without a subject specialism. In contrast, all pupils in Poland were taught mathematics and science by teachers with a specialism in that area.
- There was not a clear or stable association in Northern Ireland or across individual countries between teacher specialisation during training and average achievement in mathematics and science.
- Overall the levels of participation in Northern Ireland in professional development activities were positive: more pupils in Northern Ireland had teachers who had engaged in professional development in the last two years than was the case, on average, internationally.
- In Northern Ireland, 79 per cent of pupils were taught by teachers who indicated they had participated in professional development in mathematics. For science, the figure was lower, with 42 per cent of pupils taught by teachers who indicated they had participated in professional development in science in the last two years. The level of teachers' professional development in mathematics was similar to 2015 (78 per cent) and the level of teachers' professional development in science has decreased by nine percentage points since 2015.
- In Northern Ireland, the most common mathematics professional development topics were mathematics pedagogy (57 per cent) and improving pupils' critical thinking or problem solving skills (56 per cent). For science, the most common topic was improving pupils' critical thinking or problem solving skills (31 per cent).

- Participation in two of the mathematics professional development topics has decreased since 2015: namely mathematics curriculum by 15 percentage points and mathematics assessment by 27 percentage points. As the amount of time teachers spent on professional development related to mathematics was stable across the two cycles of TIMSS, this indicates a change of emphasis among teachers' reported mathematics professional development activities as opposed to a reduction in the amount of time teachers spent participating in mathematics professional development.

- There was also a moderate increase in the percentage of pupils whose teachers reported participating in no science professional development between the two cycles.

- For the first time in TIMSS, teachers were asked which areas of professional development they may need in the future. Nearly three-quarters of pupils (71 per cent in maths and 74 per cent in science) were taught by teachers who reported needing future professional development on integrating technology into mathematics and science.

- Half of pupils in Northern Ireland in 2019 were taught mathematics and science by teachers who were *Very satisfied* with their job. This was lower than in 2015 (59 per cent) and the 2019 International Average (61 per cent).

- In Northern Ireland, job satisfaction did not appear to be linked with achievement as there were only small differences in the mean scores between pupils in the highest categories (566 for mathematics and 518 for science) and lowest categories (561 for mathematics and 515 for science) on this scale for both mathematics and science.

- Among the comparator countries, Canada had the largest percentage of pupils taught by *Very satisfied* teachers (59 per cent in mathematics, 58 per cent in science).

School resources

- In Northern Ireland, more than 80 per cent of pupils attended schools where the principal reported that teaching was *Somewhat affected* by a shortage of resources, this was true for both mathematics (82 per cent) and science (85 per cent). The percentages internationally were 68 per cent and 69 per cent for mathematics and science, respectively.

- Between 2015 and 2019, the percentages of pupils that attended schools where the principal reported that teaching was *Somewhat affected* by a shortage of resources increased. The increase was larger in mathematics (15 percentage points) than in science (five percentage points).

- In Northern Ireland, two per cent or less of Year 6 pupils attended schools where the principal reported that teaching was *Affected a lot* by shortages in science and mathematics resources, below the International Averages of seven per cent and six per cent respectively.

- Pupils in Northern Ireland were less likely than those in comparator countries, with the exception of Finland and the Republic of Ireland, to attend schools with a school library. However, they were more likely than pupils in comparator countries, except for Canada and the Republic of Ireland, to attend a school with classroom libraries.

- In 2019, no schools in Northern Ireland reported having a science laboratory for Year 6 pupils, as was the case in 2015. This compares to 36 per cent of pupils, on average internationally, who attended schools with a science laboratory. Among comparator countries, only the Republic of Ireland had a similar percentage of pupils to Northern Ireland, while in England, 24 per cent of pupils attended schools with a science laboratory.

- In Northern Ireland, 19 per cent of pupils were taught by teachers with access to assistance when the pupils were conducting science experiments, below both the International Average (35 per cent) and all the comparator countries, with the exception of Canada, which had a similar percentage.

Digital learning environment

- The vast majority of pupils in Northern Ireland had access to a computer or tablet at home (96 per cent) and an internet connection (99 per cent), more so than seen internationally, with the exception of Norway, where the level was the same. This suggests that a high proportion of pupils in Northern Ireland had a means of accessing educational material online at home.

- In Northern Ireland, the availability of computers in schools was favourable compared with the other countries; they were ranked[3] eleventh for availability of computers in mathematics lessons and eighth for science lessons. However, the way in which pupils who have computers available to them for lessons access them is different to what is seen internationally.

- In Northern Ireland, it was most common for teachers to report the school having computers that the class can sometimes use (58 per cent mathematics, 71 per cent science) rather than a shared set in the class (48 per cent mathematics, 60 per

[3] This finding should be interpreted with caution, as rankings can be volatile, varying according to the mix of countries participating in any given cycle. In addition, small differences may or may not be statistically significant, depending on the size of the standard error for each country.

cent science) or each pupil having their own computer (three per cent mathematics, seven per cent science).

- Schools in Northern Ireland had a smaller number of computers available for Year 6 pupils to access (34, on average) than the International Average (40). This difference is likely to be explained by the smaller number of Year 6 pupils on roll in Northern Ireland (47) than on average internationally (90).

- The percentage of pupils' who had access to computers in lessons was higher for science lessons (80 per cent) than for mathematics lessons (69 per cent). However, teachers used computers for activities less often in science than in mathematics. The finding that teachers use computers less frequently to support science learning is more likely to be a result of teachers in Northern Ireland spending considerably less time teaching science.

- Using digital devices for science tests was much less common than for mathematics in Northern Ireland with almost all pupils (99 per cent) reported by their teachers as never taking a science test on a computer. This compares to 23 per cent of pupils for mathematics. However, this is perhaps less reflective of the use of digital devices in science assessments and more a result of less testing in general in science than mathematics at primary level.

- There was no clear link between higher computer availability and higher mathematics or science performance in Northern Ireland and on average internationally.

- Principals were asked to what extent teaching in their school was limited by a shortage or inadequacy of specific digital resources. In Northern Ireland, the biggest issue was *A shortage or inadequacy of computer software / applications for science.* One-fifth of pupils in Northern Ireland were taught in schools affected *A lot* by shortages or inadequacies of software or applications, and this has increased since 2015.

- Less than one-tenth of pupils in Northern Ireland were reported as having teaching affected *A lot* by inadequacies of *Technologically competent staff* according to principals' responses. However, the principals' views are not reflected in the responses of teachers regarding needing professional development in integrating technology into their lessons. Over 70 per cent of teachers reported a need for professional development in this area.

- In Northern Ireland and across comparator countries, teachers reported a need for future professional development on integrating technology into science and mathematics lessons. This is likely to reflect the growing role technology is having in education.

School learning environment

- The findings from TIMSS 2019 characterise education for Year 6 pupils in Northern Ireland as having a *high emphasis* on academic success with *hardly any problems* with school discipline and *very safe and orderly* classrooms. *Some* teaching is limited by pupils who are not ready for instruction and pupils *never* or *almost never* experience bullying behaviours.

- There is evidence that the performance of Northern Ireland on the measures of school learning environment has fallen since 2015. This is particularly apparent in the decrease in percentage of pupils experiencing a S*afe and orderly* classroom, (a decrease of ten percentage points since 2015).

- Northern Ireland is one of the top ten countries with regard to the schools' emphasis on academic success scale.

- A school's emphasis on academic success has an association with pupil scores. In Northern Ireland, pupils in schools with a *Very high* emphasis on academic success scored higher in mathematics and science than those from schools with a *High* emphasis, with average scale scores of 590 and 569 in mathematics and scores of 534 and 524 in science, respectively.

- The school learning environment in Northern Ireland compares well internationally. However, performance on the *Teaching limited by pupils who are not ready for instruction* measure is below the International Average. In Northern Ireland, 26 per cent of pupils had teachers who reported that their teaching was limited *Very little* by pupils not ready for instruction compared with 37 per cent on average internationally.

- There is evidence that the experience of bullying is associated with performance in mathematics and science. In Northern Ireland, pupils that *Never or almost never* experience bullying performed much better on average than those who experience bullying *About weekly*; a difference of 73 scale points for mathematics and 68 scale points for science. The pattern was similar to the International Average.

- Seventy-three per cent of pupils in Northern Ireland were in schools whose principals reported *Hardly Any Problems* with discipline or safety; this was above the International Average. This was a small decrease of five percentage points from 2015.

- The TIMSS 2019 data suggests that pupils experiencing positive school learning environment factors have higher levels of achievement than pupils that do not. Pupils in *safe and orderly* classrooms had higher levels of achievement than pupils who are not. This was the case in both mathematics and science in Northern Ireland and internationally. Performance gaps for both subjects were larger in

Northern Ireland than those seen internationally, and slightly larger than the gap seen in 2015.

Curriculum and learning activities

- In Northern Ireland, teaching time for mathematics was considerably higher than the International Average (203 hours and 154 hours respectively). However, for science, teaching time was considerably below the International Average (38 hours compared with 75 hours). These patterns were also seen in 2015 and 2011.
- The evidence from TIMSS 2019 suggests there is no clear pattern between the amount of time spent on mathematics teaching per year and achievement in mathematics.
- A small proportion of Year 6 pupils (14 per cent) in Northern Ireland were taught science by teachers who reported emphasising science investigation in at least half of their science lessons; this proportion is considerably below the International Average (31 per cent) but a large increase of 11 percentage points since 2015.
- Among pupils in Northern Ireland whose teachers emphasised science investigation in *About Half the Lessons or More*, average achievement was slightly higher than among those for whom it was emphasised in *Less Than Half the Lessons* (average scale scores of 528 and 517 respectively). This is in contrast to the findings from 2015, where higher average achievement was associated with pupils whose teachers emphasised science investigation in Less Than Half the Lessons.
- The evidence from TIMSS 2019 suggests that there is no clear relationship between the level of emphasis placed on scientific investigations in lessons and achievement in science.
- According to teachers' reports of topics taught in lessons, a higher proportion of Year 6 pupils are taught the TIMSS mathematics topics than the TIMSS science topics, 94 per cent and 62 per cent respectively. This is also the case on average internationally.

Pupil factors impacting on classroom instruction

- In Northern Ireland the pupil factors that had the largest association with achievement in both mathematics and science were those linked to pupils' readiness for lessons: pupils lacking knowledge and skills; pupils suffering from a lack of basic nutrition; pupils suffering from not enough sleep. There was also an association between the pupil engagement factor of pupils' absence from the class and mathematics and science achievement. In each case the association was that greater the reported limitation to teaching, the lower the pupils' scores. For all

these factors, the association with achievement was greater for mathematics than science.

- Pupils suffering from not enough sleep was a larger issue for teaching of Year 6 lessons in Northern Ireland than internationally. Findings from TIMSS 2019 indicate that in Northern Ireland, this has become a bigger issue over time, with 78 per cent of pupils taught by teachers who reported their teaching was affected (*A lot* or Some) by pupils suffering from not enough sleep, an increase of ten percentage points since 2015. However, a lack of nutrition was a less common issue for teaching in Northern Ireland than internationally.

- Pupils lacking the prerequisite knowledge and skills for Year 6 lessons is an increasing issue for teaching in Northern Ireland. In 2019, 13 per cent of pupils were taught by teachers who reported their teaching was *Not at all* affected by pupils' prerequisite knowledge and skills, a decrease of eight per cent since 2015. Internationally the percentage of pupils in this category remains unchanged.

- In Northern Ireland, 18 per cent of pupils were taught by teachers who reported their teaching was *Not at all* affected by pupil absenteeism, compared with 37 per cent internationally. This means that over 80 per cent of pupils in Northern Ireland are taught by teachers who report that teaching is limited to some degree by pupil absenteeism.

- In Northern Ireland, teaching was limited to a lesser extent by disruptive pupils than internationally, but there was evidence of an increase in the impact of disruptive pupils on teaching. Since 2015, there has been a moderate decrease in the percentage of pupils taught by teachers who reported their teaching was *Not at all* affected by disruptive pupils (44 per cent in 2015 compared with 36 per cent in 2019).

- A higher percentage of pupils were in lessons limited to *Some* extent by pupils with mental, emotional or psychological impairment in Northern Ireland than internationally, but fewer were impacted *A lot* by this factor (five per cent and 12 per cent respectively).

- The evidence shows teaching in Northern Ireland was limited less by pupils who had difficulties understanding the language of the lesson than is the case internationally.

TIMSS 2019 in Northern Ireland: Introduction

Report outline

This report summarises Year 6 (Y6, ages 9-10) pupils' attainment in the 2019 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, Northern Ireland participated only at the younger age range). TIMSS has a four-yearly cycle. Northern Ireland took part in TIMSS for the third time in the 2019 cycle having previously participated in 2011 and 2015.

What TIMSS assesses at ages 9-10

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

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

TIMSS 2019 offered the 58 participating countries an option to administer the assessment in a digital format (e-TIMSS). Twenty-eight countries participated in e-TIMSS. Northern Ireland administered the paper-based assessment, in which 30 countries participated.

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

A key objective of International Large Scale Assessments, such as TIMSS, is to learn from high performing countries. Given Northern Ireland's strong performance in the TIMSS mathematics assessment, drawing a comparator group from the small number of countries that outperform Northern Ireland in both mathematics and science may not provide particularly valuable insights in terms of the factors that influence achievement. Therefore, in order to broaden the comparator group, countries were selected using the same methodology employed in TIMSS 2015. That is countries which outperformed Northern Ireland in the most recent Programme for International Student Assessment (PISA[4]) in all three subject domains (mathematics, science and reading). This report compares performance in Northern Ireland with that of the six countries which outperformed Northern Ireland in all three subject domains in PISA 2018. It is also important to look at the performance of countries which are geographically close and culturally similar, therefore England (as the only other constituent country of the UK to participate) and the Republic of Ireland are also included in the comparator group.

The report compares Northern Ireland's pupils with all participating countries in TIMSS at ages 9-10, and a subset of these countries are also used as the main comparator countries to Northern Ireland. These comparator countries are:

Canada[5]

England

Finland

Hong Kong

Korea

Poland

Republic of Ireland

Singapore.

[4] PISA is an international comparison study assessing students' mathematics, science and reading skills at age 15. In 2018 the main subject for PISA was reading.
[5] The provinces in Canada that participate in TIMSS are: Alberta, Manitoba, Newfoundland, Ontario, and Quebec which covers 79 per cent of the national population.

Trend Comparisons: TIMSS 2019, TIMSS 2015 and TIMSS 2011

The report compares Northern Ireland's performance in TIMSS 2019 with performance in TIMSS 2015, and in some case where there are clear trends the results from 2011 are also compared. Where possible the report explores whether the background factors that impact on attainment have changed between 2015 and 2019.

It should be noted that the contextual questionnaires (school questionnaire, teacher questionnaire, pupil questionnaire and home questionnaire) have undergone some changes since TIMSS 2015. In some cases the changes are minimal and comparisons with the 2015 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 Attainment in TIMSS 2019 in Northern Ireland

Chapter outline

This chapter summarises pupils' attainment in mathematics and science in Year 6 (Y6, ages 9-10) in 2019. 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 countries.

Key findings

- Mathematics and science attainment for 9 and 10-year-olds in Northern Ireland remains high. Northern Ireland's mathematics and science scores in 2019 were not significantly[6] different from scores in 2015 or 2011.
- The average score for science (518) was lower than for mathematics (566), although still above the TIMSS science International Average[7].
- Pupils in Northern Ireland significantly outperformed 51 of the 58 participating countries in mathematics and were significantly outperformed by five countries.
- Pupils in Northern Ireland significantly outperformed 28 of the 58 participating countries in science and were significantly outperformed by 18 countries.
- Northern Ireland's position in science, relative to other countries, improved compared with TIMSS 2015. Fewer countries significantly outperformed Northern Ireland in the TIMSS 2019 science assessment, although pupils in England and the Republic of Ireland achieved scores that were on average significantly higher than in Northern Ireland.
- There was some movement amongst the group of countries outperforming Northern Ireland in science. Northern Ireland pupils had similar average science scores in 2019 to Germany, Denmark, Bulgaria and Croatia; these countries having outperformed Northern Ireland in 2015.

[6] Throughout this report, the term 'significant' refers to statistical significance. When statistical significance is reported, it indicates that the compared mean scores are significantly difference at the 5% level.

[7] Throughout this chapter 'International Average' refers to the TIMSS scale centre point.

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.

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 (58 countries[8] in total took part in TIMSS). 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.

[8] Fifty-eight countries and six benchmarking participants administered the fourth grade assessments. Each of these participating countries or entities administered the mathematics and science assessment.

Interpreting differences between countries

It is important to know what can reasonably be concluded from the TIMSS data and which interpretations would be going beyond what can be reliably supported by the results. Some important points need to be kept in mind while reading this report.

Sources of uncertainty

There are two sources of uncertainty which have to be taken into account in the statistical analysis and interpretation of any test results. These are described as *sampling error* and *measurement error*. The use of the term 'error' does not imply that a mistake has been made; it simply highlights the necessary uncertainty.

Sampling error stems from the inherent variation of human populations which can never be summarised with absolute accuracy. It affects virtually all research and data collection that makes use of sampling. Only if every 9 and 10-year-old in each participating country had taken part in the TIMSS Grade 4 assessment could it be stated with certainty that the results are totally representative of the attainment of the entire population of pupils in those countries. In reality, the data was collected from a sample of 9-10-year-olds. Therefore, the results are a best estimation of how the total population of 9-10-year-olds could be expected to perform in these tests. There are statistical methods to measure how good the estimation is. It is important to recognise that all data on human performance or attitudes which is based on a sample carries a margin of error.

Measurement error relates to the results obtained by each individual pupil. It takes account of variations in their score which are not directly due to underlying ability in the subject, but which are influenced by other factors related to individuals or to the nature of the tests or testing conditions.

1.1.1 Attainment in mathematics

Table 1.1 TIMSS 2019 performance groups: Mathematics at ages 9-10

HIGHER performance compared with Northern Ireland **Participants performing at a significantly higher level than Northern Ireland (scale score 566)**			
Country	**Scale score**	**Country**	**Scale score**
Singapore	625	Chinese Taipei	599
Hong Kong	602	Japan	593
Korea	600		

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**
Russian Federation	567	Northern Ireland	566

LOWER performance compared with Northern Ireland **Participants performing at a significantly lower level than Northern Ireland (scale score 566)**			
Country	**Scale score**	**Country**	**Scale score**
England	556	Croatia	509
Rep. of Ireland	548	Malta	509
Latvia	546	Serbia	508
Norway (5)*	543	Spain	502
Lithuania	542	Armenia	498
Austria	539	Albania	494
Netherlands	538	New Zealand	487
United States	535	France	485
Czech Republic	533	Georgia	482
Belgium (Flemish)	532	United Arab Emirates	481
Cyprus	532	Bahrain	480
Finland	532	North Macedonia	472
Portugal	525	Montenegro	453
Denmark	525	Bosnia and Herzegovina	452
Hungary	523	Qatar	449
Turkey (5)*	523	Kosovo	444
Sweden	521	Iran	443
Germany	521	Chile	441
Poland	520	Oman	431
Australia	516	Saudi Arabia	398
Azerbaijan	515	Morocco	383
Bulgaria	515	Kuwait	383
Italy	515	South Africa (5)*	374
Kazakhstan	512	Pakistan	328
Canada	512	Philippines	297
Slovak Republic	510		

*Norway, Turkey and South Africa assessed their fifth grade pupils (pupils aged 10 – 11).

The TIMSS 2019 mathematics score for Y6 pupils in Northern Ireland was 566, significantly above the centre point of the international scale (500) and ranking seventh[9] 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 and 2015, Northern Ireland was significantly outperformed by only five of the 58 participating countries (all Asian Pacific Rim countries). Only one country, the Russian Federation, performed similarly to Northern Ireland and both significantly outperformed the remaining 51 participating countries.

Overall, Northern Ireland's mathematics performance in TIMSS 2019 was similar to that seen in TIMSS 2015 and 2011, indicating that this high level of achievement has been maintained over time.

1.1.2 Attainment in science

Table 1.2 TIMSS 2019 performance groups: Science at ages 9-10

HIGHER performance compared with Northern Ireland **Participants performing at a significantly higher level than Northern Ireland (scale score 518)**			
Country	**Scale score**	**Country**	**Scale score**
Singapore	595	Lithuania	538
Korea	588	Sweden	537
Russian Federation	567	England	537
Japan	562	Czech Republic	534
Chinese Taipei	558	Australia	533
Finland	555	Hong Kong	531
Latvia	542	Poland	531
Norway (5)*	539	Hungary	529
United States	539	Rep. of Ireland	528

*Norway assessed its fifth grade pupils (pupils aged 10 – 11).

[9] Rankings should be treated with caution as some apparent differences in attainment may not be significant. See 'Interpreting the data: international rankings' in section 1.2 for more information. In absolute terms, Northern Ireland is ranked 7th, but the Russian Federation ranked 6th has an achievement score that is not significantly different from that of Northern Ireland (see Table 1.1).

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**
Turkey (5)*	526	Slovak Republic	521
Croatia	524	**Northern Ireland**	**518**
Canada	523	Netherlands	518
Denmark	522	Germany	518
Austria	522	Serbia	517
Bulgaria	521	Cyprus	511

*Turkey assessed its fifth grade pupils (pupils aged 10 – 11).

LOWER performance compared with Northern Ireland **Participants performing at a significantly lower level than Northern Ireland (scale score 518)**			
Country	**Scale score**	**Country**	**Scale score**
Spain	511	Georgia	454
Italy	510	Montenegro	453
Portugal	504	Qatar	449
New Zealand	503	Iran	441
Belgium (Flemish)	501	Oman	435
Malta	496	Azerbaijan	427
Kazakhstan	494	North Macedonia	426
Bahrain	493	Kosovo	413
Albania	489	Saudi Arabia	402
France	488	Kuwait	392
United Arab Emirates	473	Morocco	374
Chile	469	South Africa (5)*	324
Armenia	466	Pakistan	290
Bosnia and Herzegovina	459	Philippines	249

* South Africa assessed its fifth grade pupils (pupils aged 10 – 11).

The TIMSS 2019 science score for Y6 pupils in Northern Ireland was 518, significantly above the centre point of the international scale (500) and ranking 26th among participating nations.[10]

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, they were outperformed by 18 countries, including all but one of the selected comparator countries. Of the remaining participating countries, 11 performed similarly to Northern Ireland and 28 were significantly outperformed by Northern Ireland in science. There was some movement amongst the group of countries outperforming Northern Ireland in science, notably the movement of Australia into this group and four countries out of this group. In 2019 Germany, Denmark, Bulgaria and Croatia all had similar scores to Northern Ireland and no longer outperformed them in science.

Science is included in key stage 1 and key stage 2 of the Northern Ireland curriculum (CCEA, 2007) as part of 'The World Around Us' (Kelly *et al*, 2020) area of learning. A comparison was made between the key stage 2 curriculum in Northern Ireland and the TIMSS Assessment Framework for science and showed that 23 of the 26 TIMSS science topics are in the Northern Ireland curriculum and all of Northern Ireland's pupils had been taught these topics before or were engaged in these studies over the TIMSS assessment period (higher than the average internationally).[11]

1.2 Attainment rankings: TIMSS 2019

Tables 1.3 and 1.4 below show the full international rankings for mathematics and science, and indicate Northern Ireland's ranking in each. The tables are presented and then discussed, with mathematics first followed by science.

[10] As noted above, rankings should be treated with caution: in absolute terms, Northern Ireland is ranked 26th, but the countries ranked 23rd to 30th have achievement scores that are not significantly different from that of Northern Ireland (see Table 1.2).
[11] See Chapter 5 of this report for more information.

Interpreting the data: international rankings

The mean scores on the TIMSS achievement scales (with 95 per cent confidence intervals) are shown graphically as the black bar 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 can be found in Chapter 1 of the international report (Mullis *et al*, 2020).

Interpreting the data: participation notes

Northern Ireland met the sampling guidelines for participation rates once replacement schools were included. As the sampling requirements were achieved further analysis of the sample to ensure it was not biased was not required.

1.2.1 Attainment rankings in mathematics

Table 1.3 Mean scores and distribution of Mathematics achievement at ages 9-10, TIMSS 2019

Country	Average Scale Score	
[3] Singapore	625 (3.9)	▲
† Hong Kong SAR	602 (3.3)	▲
Korea, Rep. of	600 (2.2)	▲
Chinese Taipei	599 (1.9)	▲
Japan	593 (1.8)	▲
[2] Russian Federation	567 (3.3)	▲
† Northern Ireland	566 (2.7)	▲
[2] England	556 (3.0)	▲
Ireland, Rep. of	548 (2.5)	▲
[2] Latvia	546 (2.6)	▲
† Norway (5)	543 (2.2)	▲
[2] Lithuania	542 (2.8)	▲
Austria	539 (2.0)	▲
≡ Netherlands	538 (2.2)	▲
[2] † United States	535 (2.5)	▲
Czech Republic	533 (2.5)	▲
† Belgium (Flemish)	532 (1.9)	▲
Cyprus	532 (2.9)	▲
Finland	532 (2.3)	▲
[2] Portugal	525 (2.6)	▲
† Denmark	525 (1.9)	▲
Hungary	523 (2.6)	▲
[2] Turkey (5)	523 (4.4)	▲
Sweden	521 (2.8)	▲
Germany	521 (2.3)	▲
Poland	520 (2.7)	▲
Australia	516 (2.8)	▲
Azerbaijan	515 (2.7)	▲
Bulgaria	515 (4.3)	▲
Italy	515 (2.4)	▲
[2] Kazakhstan	512 (2.5)	▲
[1 2] Canada	512 (1.9)	▲
[2] Slovak Republic	510 (3.5)	▲
Croatia	509 (2.2)	▲
Malta	509 (1.4)	▲
[2] Serbia	508 (3.2)	▲
Spain	502 (2.1)	
TIMSS Scale Centerpoint	**500**	
Armenia	498 (2.5)	
Albania	494 (3.4)	
[2] New Zealand	487 (2.6)	▽
France	485 (3.0)	▽
[1] Georgia	482 (3.7)	▽
United Arab Emirates	481 (1.7)	▽
Bahrain	480 (2.6)	▽
North Macedonia	472 (5.3)	▽
Montenegro	453 (2.0)	▽
Bosnia and Herzegovina	452 (2.4)	▽
Qatar	449 (3.4)	▽
[2] Kosovo	444 (3.0)	▽
Iran, Islamic Rep. of	443 (3.9)	▽
Chile	441 (2.7)	▽
Oman	431 (3.7)	▽
[2] Saudi Arabia	398 (3.6)	▽
Morocco	383 (4.3)	▽
Kuwait	383 (4.7)	▽
South Africa (5)	374 (3.6)	▽
[2 Ψ] Pakistan	328 (12.0)	▽
[2 Ψ] Philippines	297 (6.4)	▽

The TIMSS achievement scale was established in 1995 based on the combined achievement distribution of all countries that participated in TIMSS 1995. To provide a point of reference for country comparisons, the scale centerpoint of 500 was located at the mean of the combined achievement distribution. The units of the scale were chosen so that 100 scale score points corresponded to the standard deviation of the distribution.
Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
See Appendix B.2 for population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.1, TIMSS 2019 International Results in Mathematics and Science

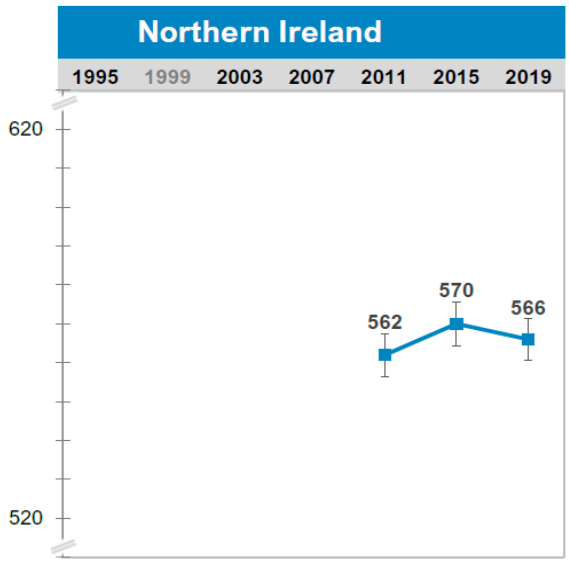
Table 1.3 emphasises how well Northern Ireland performed in TIMSS 2019 mathematics. Northern Ireland's mean scale score of 566 is 59 scale points behind that of the highest performing country, Singapore. This gap has increased since 2015, when the difference between Northern Ireland and the highest performing country, again Singapore, was 48 scale points. The widening of the gap is due, in part, to an increase in Singapore's scale score for mathematics from 2015 to 2019, but also due to a decrease in Northern

Ireland's scale score between the two TIMSS cycles. Northern Ireland remains 269 scale points ahead of the lowest performing country, which in 2019 was the Philippines.

In 2019, three of the comparator countries outperformed Northern Ireland (Singapore, Hong Kong and Korea at 625, 602 and 600 respectively), and all three outperformed Northern Ireland in both 2015 and 2011. The remaining comparator countries performed significantly less well than Northern Ireland. Of these, the nearest scoring comparator countries were England (556) and the Republic of Ireland (548). An increase of 10 scale points for England from 2015 to 2019 made it the nearest scoring comparator country, swapping places with the Republic of Ireland. The lowest scoring comparator country was Canada (512), 54 points below Northern Ireland, but still 12 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. ++ 1.1 shows that mathematics attainment of Y6 pupils (9 and 10-year-olds) in Northern Ireland has remained stable since 2011. Northern Ireland's score of 566 in 2019 is not significantly different from the scores in 2015 and 2011 at 570 and 562 respectively. This shows that although the scale score for mathematics has fluctuated the changes are not sufficiently large to indicate a significant increase or decrease in performance over time, Northern Ireland has maintained a high level of achievement in mathematics across the cycles.

Figure 1.1 Trends in Y6 Mathematics achievement in Northern Ireland

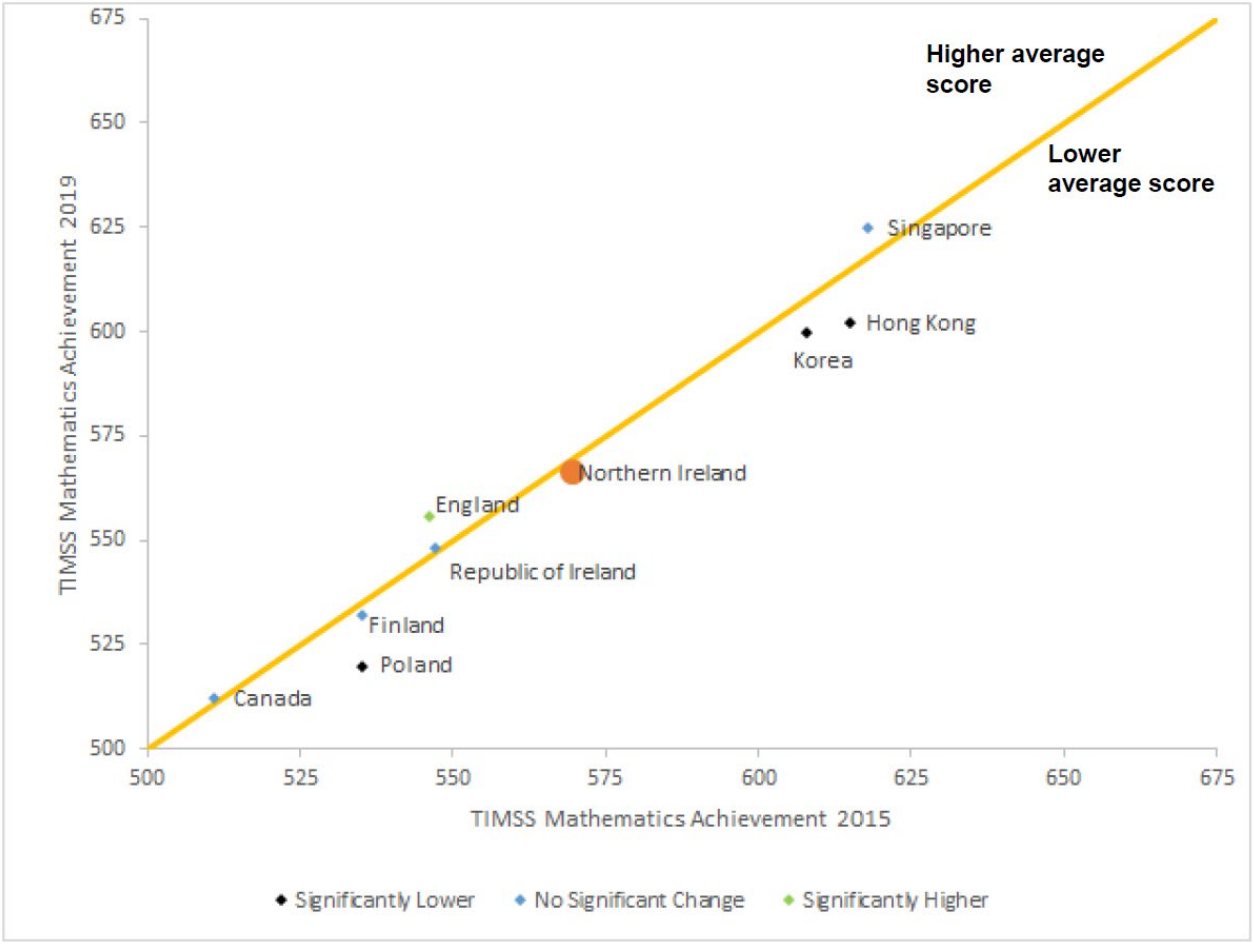


Source: Exhibit 1.3, TIMSS 2019 International Results in Mathematics and Science

As shown in Figure 1.2, half of the comparator countries had similar scale scores in mathematics in 2019 compared with 2015. In England the overall mathematics achievement in 2019 was significantly higher than in 2015. In contrast, in Hong Kong,

Korea and Poland, mathematics achievement in 2019 was significantly lower than in 2015.

Figure 1.2 TIMSS Mathematics achievement in 2019 compared with TIMSS 2015



Source: IEA TIMSS 2019 International Database

1.2.2 Attainment rankings in science

Table 1.4 Mean scores and distribution of Science achievement at ages 9-10, TIMSS 2019

Country	Average Scale Score	
[3] Singapore	595 (3.4)	▲
Korea, Rep. of	588 (2.1)	▲
[2] Russian Federation	567 (3.0)	▲
Japan	562 (1.8)	▲
Chinese Taipei	558 (1.8)	▲
Finland	555 (2.6)	▲
[2] Latvia	542 (2.4)	▲
† Norway (5)	539 (2.2)	▲
[2] † United States	539 (2.7)	▲
[2] Lithuania	538 (2.5)	▲
Sweden	537 (3.3)	▲
[2] England	537 (2.7)	▲
Czech Republic	534 (2.6)	▲
Australia	533 (2.4)	▲
† Hong Kong SAR	531 (3.3)	▲
Poland	531 (2.6)	▲
Hungary	529 (2.7)	▲
Ireland, Rep. of	528 (3.2)	▲
[2] Turkey (5)	526 (4.2)	▲
Croatia	524 (2.2)	▲
[1 2] Canada	523 (1.9)	▲
† Denmark	522 (2.4)	▲
Austria	522 (2.6)	▲
Bulgaria	521 (4.9)	▲
[2] Slovak Republic	521 (3.7)	▲
† Northern Ireland	518 (2.3)	▲
≡ Netherlands	518 (2.9)	▲
Germany	518 (2.2)	▲
[2] Serbia	517 (3.5)	▲
Cyprus	511 (3.0)	▲
Spain	511 (2.0)	▲
Italy	510 (3.0)	▲
[2] Portugal	504 (2.6)	
[2] New Zealand	503 (2.3)	
† Belgium (Flemish)	501 (2.1)	
TIMSS Scale Centerpoint	**500**	
Malta	496 (1.3)	▽
[2] Kazakhstan	494 (3.1)	
Bahrain	493 (3.4)	▽
Albania	489 (3.5)	▽
France	488 (3.0)	▽
United Arab Emirates	473 (2.1)	▽
Chile	469 (2.6)	▽
Armenia	466 (3.4)	▽
Bosnia and Herzegovina	459 (2.9)	▽
[1] Georgia	454 (3.9)	▽
Montenegro	453 (2.5)	▽
Qatar	449 (3.9)	▽
Iran, Islamic Rep. of	441 (4.1)	▽
Oman	435 (4.1)	▽
Azerbaijan	427 (3.3)	▽
North Macedonia	426 (6.2)	▽
[2] Kosovo	413 (3.7)	▽
[2] Saudi Arabia	402 (4.1)	▽
Kuwait	392 (6.1)	▽
Ψ Morocco	374 (5.8)	▽
ж South Africa (5)	324 (4.9)	▽
[2] ж Pakistan	290 (13.4)	▽
[2] ж Philippines	249 (7.5)	▽

The TIMSS achievement scale was established in 1995 based on the combined achievement distribution of all countries that participated in TIMSS 1995. To provide a point of reference for country comparisons, the scale centerpoint of 500 was located at the mean of the combined achievement distribution. The units of the scale were chosen so that 100 scale score points corresponded to the standard deviation of the distribution.
Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
ж Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 25%.
See Appendix B.2 for population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 2.1, TIMSS 2019 International Results in Mathematics and Science

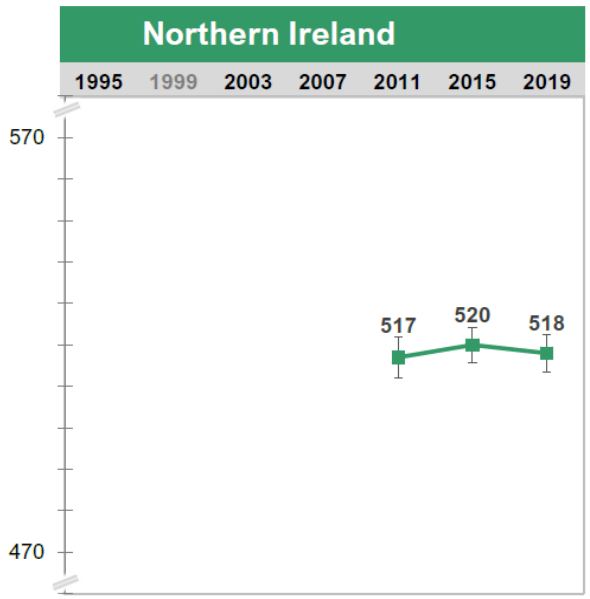
Table 1.4 shows that, as in 2011 and 2015, although Northern Ireland's average scale score for science is significantly above the International Average (517 in 2011, 520 in 2015 and 518 in 2019), performance in science compares somewhat less favourably than mathematics in international terms. In science, Northern Ireland is over 70 scale points behind the highest performing country (Singapore); this gap has increased slightly between the 2015 and 2019 TIMSS cycles. There remains a large difference between Northern Ireland and the lower performing countries, it is 269 scale points ahead of the lowest performing country, the Philippines.

In science, Northern Ireland was outperformed by seven of the eight comparator countries (Singapore, Korea, Finland, England, Hong Kong, Poland and the Republic of Ireland, with scores between 595 and 528 inclusive). The only comparator country not to outperform Northern Ireland was Canada (523), whose performance was not significantly different. When looking at Northern Ireland's performance compared to the comparator countries, there has been no change since 2015 when the same seven comparator countries outperformed Northern Ireland.

As noted above, rankings can be volatile, varying according to which countries have participated in the study. However, 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 TIMSS 2011. Northern Ireland's score then was 517, not significantly different from its 2015 score of 520 or its 2019 score of 518.

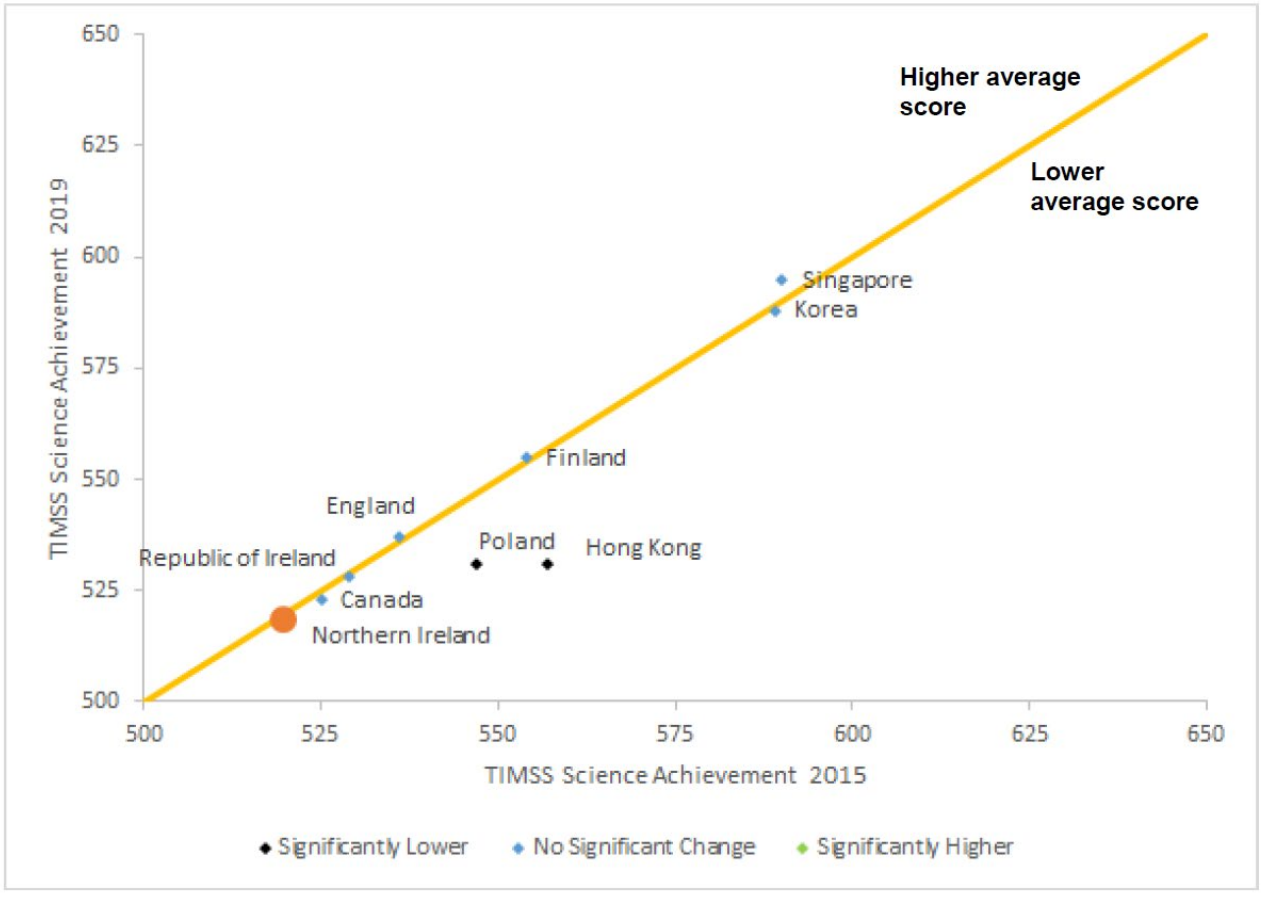
The trends in the science results of the comparator countries does not mirror that seen in the mathematics. When looking at the trends over time for the majority of the comparator countries, the performance in science in 2019 was not significantly different from the performance in 2015. Only Hong Kong and Poland had science achievement in 2019 that was significantly lower than in 2015, similar to the change in the mathematics scores of these countries.

Figure 1.3 Trends in Y6 Science achievement in Northern Ireland



Source: Exhibit 2.3, TIMSS 2019 International Results in Mathematics and Science

Figure 1.4 TIMSS Science achievement in 2019 compared with TIMSS 2015



Source: IEA TIMSS 2019 International Database

1.3 Conclusion

Pupils in Northern Ireland have continued to perform at a very high level in mathematics. In TIMSS 2019 they were outperformed by only five of the 58 participating countries. Performance in science remains notably weaker, although significantly above the International Average.

Overall, Northern Ireland's performance in mathematics and science was similar to that seen in 2015 and in 2011; scores in TIMSS 2019 were not significantly different from those in either of the previous two rounds of the study. This shows that the performance of pupils in Northern Ireland in mathematics and science, as measured by the TIMSS assessments, has been stable between 2015 and 2019. This reflects what is seen in a number of comparator countries, including Singapore, Finland and the Republic of Ireland. However this is in contrast to Hong Kong and Poland, where scores in mathematics and science were significantly lower than in 2015.

2 Attainment in TIMSS 2019 by gender

Chapter outline

This chapter summarises pupils' attainment by gender in mathematics and science in Year 6 (Y6, ages 9-10) in 2019. Findings for mathematics are discussed first, followed by findings for science. Outcomes for Northern Ireland are compared with those of other relevant countries.

Key finding

- In Northern Ireland, there was no significant[12] difference in the attainment of boys and girls for either mathematics or science. This was also the case in the 2015 and 2011 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 the gender differences. The countries shown at the top of the tables have gender differences favouring girls and countries at the bottom of the table have gender differences favouring boys. Countries towards the middle of the table have smaller gender differences than those at either end of the table. Outcomes for Northern Ireland are discussed for each subject in turn.

Interpreting the data: gender differences

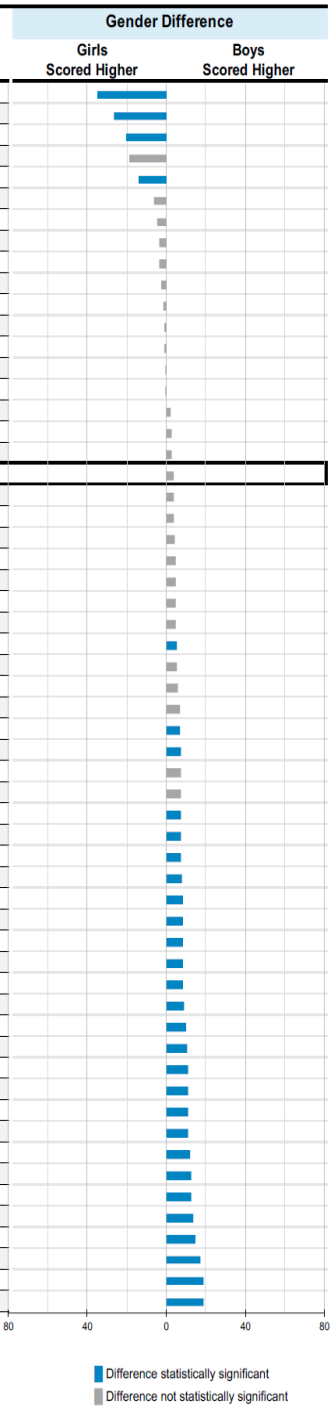
The TIMSS achievement scales have a centre point of 500 and a standard deviation of 100. The graphic shows the direction and size of any gender difference for each country. Statistically significant differences are shown in colour while non-significant differences are greyed out.

[12] Throughout this report, the term 'significant' refers to statistical significance. When statistical significance is reported, it indicates that the compared mean scores are significantly different at the 5 per cent level.

2.1.1 Gender differences in mathematics attainment

Table 2.1 TIMSS 2019 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
2 Ψ Philippines	48 (0.7)	315 (6.6)	52 (0.7)	280 (6.4)	35 (3.7)	
2 Saudi Arabia	48 (0.8)	412 (4.9)	52 (0.8)	385 (5.8)	26 (8.1)	
South Africa (5)	50 (0.6)	384 (4.0)	50 (0.6)	364 (3.7)	20 (2.9)	
2 Ψ Pakistan	45 (4.7)	338 (16.4)	55 (4.7)	319 (11.8)	19 (16.0)	
Oman	50 (0.7)	438 (3.6)	50 (0.7)	424 (4.4)	14 (2.9)	
Kuwait	47 (2.6)	387 (6.0)	53 (2.6)	380 (6.9)	7 (8.9)	
Bahrain	49 (1.2)	482 (3.2)	51 (1.2)	477 (3.5)	5 (4.3)	
Azerbaijan	47 (0.9)	517 (3.1)	53 (0.9)	514 (3.1)	4 (3.0)	
Morocco	49 (0.7)	385 (4.8)	51 (0.7)	382 (4.3)	3 (2.9)	
Armenia	48 (0.8)	499 (2.6)	52 (0.8)	497 (3.2)	2 (2.8)	
2 Serbia	50 (0.9)	509 (3.4)	50 (0.9)	507 (4.0)	2 (3.9)	
Qatar	50 (1.5)	450 (5.1)	50 (1.5)	449 (3.2)	1 (5.2)	
Japan	48 (0.5)	593 (2.2)	52 (0.5)	593 (1.9)	1 (2.2)	
2 Kazakhstan	49 (0.7)	512 (3.0)	51 (0.7)	512 (2.6)	0 (2.4)	
North Macedonia	48 (0.6)	472 (5.9)	52 (0.6)	472 (5.4)	0 (4.0)	
Bulgaria	48 (0.9)	514 (4.7)	52 (0.9)	516 (4.6)	2 (3.6)	
Finland	49 (0.9)	531 (2.9)	51 (0.9)	533 (2.8)	3 (3.2)	
Albania	49 (0.9)	493 (3.8)	51 (0.9)	495 (3.9)	3 (3.6)	
† Northern Ireland	50 (1.0)	564 (3.2)	50 (1.0)	568 (3.7)	3 (4.2)	
2 Turkey (5)	52 (1.4)	521 (4.5)	48 (1.4)	525 (5.6)	3 (4.9)	
Chinese Taipei	48 (0.6)	597 (2.4)	52 (0.6)	601 (2.3)	4 (2.7)	
† Norway (5)	48 (0.9)	540 (2.7)	52 (0.9)	545 (2.9)	4 (3.5)	
2 Kosovo	49 (1.0)	442 (3.1)	51 (1.0)	447 (3.7)	5 (3.3)	
2 Lithuania	49 (0.9)	540 (2.9)	51 (0.9)	544 (3.7)	5 (3.8)	
2 Latvia	50 (0.9)	544 (2.9)	50 (0.9)	548 (3.0)	5 (2.7)	
Montenegro	47 (0.6)	450 (2.6)	53 (0.6)	455 (2.4)	5 (3.0)	
Korea, Rep. of	47 (0.7)	597 (2.3)	53 (0.7)	602 (2.8)	5 (2.5)	
2 New Zealand	48 (1.3)	484 (3.7)	52 (1.3)	490 (3.3)	5 (4.6)	
† Hong Kong SAR	46 (1.3)	599 (3.5)	54 (1.3)	604 (3.9)	6 (3.3)	
Ireland, Rep. of	50 (1.1)	545 (3.2)	50 (1.1)	552 (2.9)	7 (3.7)	
† Denmark	50 (0.8)	521 (2.2)	50 (0.8)	528 (2.6)	7 (2.9)	
Sweden	50 (1.1)	518 (3.2)	50 (1.1)	525 (3.1)	7 (2.8)	
2 England	50 (1.0)	552 (4.0)	50 (1.0)	560 (3.0)	7 (3.8)	
Iran, Islamic Rep. of	49 (2.1)	439 (6.4)	51 (2.1)	447 (5.3)	7 (8.8)	
Malta	49 (0.7)	505 (2.1)	51 (0.7)	513 (1.9)	7 (2.7)	
1 Georgia	49 (0.9)	478 (3.9)	51 (0.9)	486 (4.1)	7 (3.3)	
Austria	49 (1.0)	535 (2.8)	51 (1.0)	543 (2.1)	8 (2.9)	
3 Singapore	49 (0.5)	621 (4.0)	51 (0.5)	629 (4.2)	8 (2.8)	
Poland	49 (0.8)	516 (3.0)	51 (0.8)	524 (3.0)	8 (2.8)	
United Arab Emirates	50 (1.1)	477 (2.5)	50 (1.1)	486 (2.3)	8 (3.4)	
2 Russian Federation	51 (1.1)	563 (3.6)	49 (1.1)	571 (3.5)	8 (2.5)	
≡ Netherlands	49 (1.0)	533 (2.2)	51 (1.0)	542 (3.0)	9 (3.0)	
Chile	50 (1.3)	437 (3.4)	50 (1.3)	445 (3.1)	9 (3.7)	
Bosnia and Herzegovina	49 (0.7)	447 (2.7)	51 (0.7)	456 (2.8)	9 (2.6)	
Australia	49 (0.8)	511 (2.9)	51 (0.8)	521 (3.3)	10 (2.9)	
Germany	50 (0.8)	516 (2.8)	50 (0.8)	526 (2.4)	10 (2.5)	
† Belgium (Flemish)	51 (0.8)	527 (2.1)	49 (0.8)	538 (2.8)	11 (3.2)	
Czech Republic	49 (0.9)	527 (2.7)	51 (0.9)	538 (3.1)	11 (2.9)	
2 † United States	49 (0.8)	529 (3.0)	51 (0.8)	540 (2.9)	11 (2.9)	
Hungary	48 (1.0)	518 (3.0)	52 (1.0)	529 (3.1)	11 (3.0)	
Croatia	50 (1.2)	504 (2.6)	50 (1.2)	515 (2.7)	12 (3.1)	
Italy	50 (0.8)	509 (2.7)	50 (0.8)	521 (3.2)	12 (3.4)	
2 Slovak Republic	49 (1.0)	503 (3.5)	51 (1.0)	516 (4.2)	12 (3.6)	
France	49 (1.0)	478 (3.3)	51 (1.0)	491 (3.5)	14 (3.0)	
Spain	47 (0.8)	495 (2.5)	53 (0.8)	509 (2.6)	15 (2.8)	
2 Portugal	48 (0.9)	516 (2.9)	52 (0.9)	533 (2.9)	17 (2.6)	
Cyprus	52 (0.7)	523 (3.0)	48 (0.7)	542 (3.5)	19 (3.2)	
1 2 Canada	49 (0.8)	502 (2.5)	51 (0.8)	521 (2.0)	19 (2.4)	
International Average	**49 (0.2)**	**499 (0.5)**	**51 (0.2)**	**503 (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 B.2 for target population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

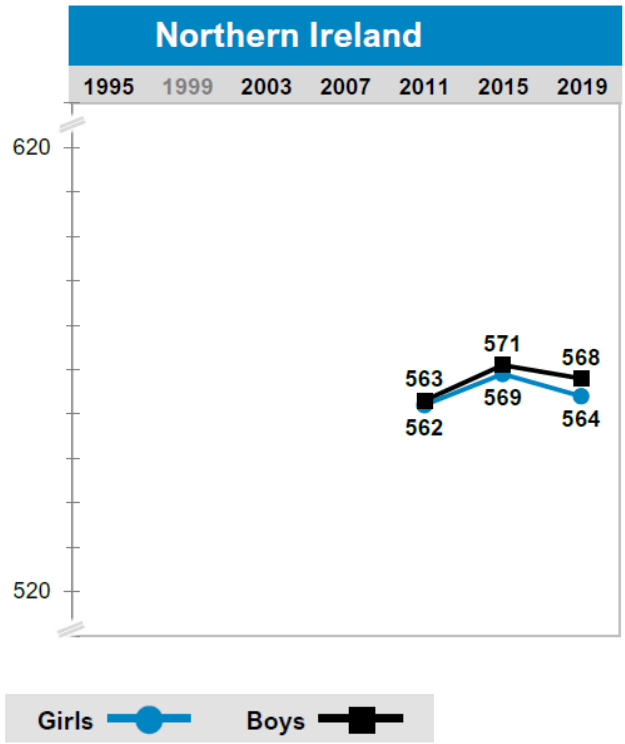
Source: Exhibit 1.5, TIMSS 2019 International Results in Mathematics and Science.

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 568 for mathematics and girls an average of 564.

Of the 58 participating countries, just over half (31 countries) had a significant gender difference. In four countries this gender difference favoured girls, whilst in the remaining 27 countries it favoured boys. A similar picture was seen in 2015 with more countries having a gender difference for mathematics that favoured boys, however, in 2019 the proportion of countries with a gender difference favouring boys has increased. Northern Ireland was one of 27 countries with no overall gender difference for mathematics at this age, including Republic of Ireland, England and Finland and the high performers Japan, Chinese Taipei and Hong Kong. In contrast, Canada, Poland and the high performers Korea and Singapore all had significant gender differences for mathematics, favouring boys. Notable changes since 2015 are that in England the gender difference in attainment for mathematics is no longer significantly in favour of boys, whilst in Singapore and Poland there is now a significant gender gap favouring boys.

There has been no change in the gender difference in Y6 mathematics attainment in Northern Ireland since 2011, as shown in Figure 2.1 below. In 2019 the mathematics score for boys (568) was not significantly different to the score for girls (564).

Figure 2.1 Trends in Mathematics achievement by gender

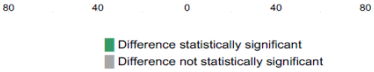


Source: Exhibit 1.6, TIMSS 2019 International Results in Mathematics and Science.

2.1.2 Gender differences in science attainment

Table 2.2 TIMSS 2019 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
² Saudi Arabia	48 (0.8)	434 (4.8)	52 (0.8)	373 (6.5)	60 (8.3)	
Kuwait	47 (2.6)	413 (6.9)	53 (2.6)	374 (8.7)	39 (10.3)	
²ϗ Pakistan	45 (4.7)	311 (15.4)	55 (4.7)	273 (14.5)	38 (15.8)	
Bahrain	49 (1.2)	510 (3.8)	51 (1.2)	476 (5.1)	34 (6.1)	
Oman	50 (0.7)	447 (3.8)	50 (0.7)	423 (5.0)	24 (3.6)	
²ϗ Philippines	48 (0.7)	261 (7.8)	52 (0.7)	238 (7.8)	24 (4.9)	
ϗ South Africa (5)	50 (0.6)	335 (5.4)	50 (0.6)	314 (5.2)	21 (3.9)	
North Macedonia	48 (0.6)	433 (6.5)	52 (0.6)	419 (6.7)	14 (4.3)	
² Kosovo	49 (1.0)	420 (4.2)	51 (1.0)	407 (4.0)	13 (3.6)	
Qatar	50 (1.5)	456 (6.0)	50 (1.5)	443 (3.7)	13 (6.1)	
Armenia	48 (0.8)	471 (3.5)	52 (0.8)	462 (4.0)	9 (3.1)	
Ψ Morocco	49 (0.7)	379 (6.4)	51 (0.7)	370 (5.8)	9 (3.7)	
Albania	49 (0.9)	494 (3.9)	51 (0.9)	485 (3.9)	8 (3.4)	
Bulgaria	48 (0.9)	525 (5.3)	52 (0.9)	518 (5.4)	7 (4.3)	
² Serbia	50 (0.9)	521 (3.5)	50 (0.9)	513 (4.3)	7 (3.5)	
Bosnia and Herzegovina	49 (0.7)	462 (3.1)	51 (0.7)	455 (3.5)	7 (2.9)	
² Kazakhstan	49 (0.7)	497 (3.6)	51 (0.7)	491 (3.1)	6 (2.8)	
Montenegro	47 (0.6)	457 (2.9)	53 (0.6)	451 (2.8)	6 (2.8)	
Japan	48 (0.5)	565 (2.0)	52 (0.5)	559 (2.1)	6 (2.0)	
Finland	49 (0.9)	557 (3.5)	51 (0.9)	552 (2.4)	5 (3.1)	
² Latvia	50 (0.9)	544 (2.6)	50 (0.9)	540 (3.0)	5 (2.9)	
² New Zealand	48 (1.3)	505 (3.2)	52 (1.3)	500 (2.8)	5 (3.9)	
² Lithuania	49 (0.9)	540 (2.8)	51 (0.9)	536 (3.3)	4 (3.4)	
United Arab Emirates	50 (1.1)	475 (3.1)	50 (1.1)	471 (2.6)	4 (4.0)	
Azerbaijan	47 (0.9)	429 (3.9)	53 (0.9)	425 (3.5)	4 (3.2)	
† Norway (5)	48 (0.9)	541 (2.4)	52 (0.9)	538 (3.1)	3 (3.5)	
Poland	49 (0.8)	532 (2.8)	51 (0.8)	529 (3.2)	3 (3.0)	
Sweden	50 (1.1)	538 (3.6)	50 (1.1)	536 (3.8)	2 (3.3)	
France	49 (1.0)	489 (3.2)	51 (1.0)	487 (3.4)	2 (2.8)	
† Northern Ireland	50 (1.0)	519 (2.9)	50 (1.0)	518 (2.8)	1 (3.4)	
† Denmark	50 (0.8)	523 (2.7)	50 (0.8)	522 (2.8)	1 (2.8)	
Australia	49 (0.8)	533 (2.9)	51 (0.8)	532 (2.7)	1 (2.9)	
≡ Netherlands	49 (1.0)	519 (3.1)	51 (1.0)	518 (3.3)	0 (2.8)	
Croatia	50 (1.2)	524 (2.6)	50 (1.2)	524 (2.7)	0 (3.1)	
† Hong Kong SAR	46 (1.3)	531 (3.1)	54 (1.3)	531 (4.3)	0 (3.6)	
² England	50 (1.0)	537 (3.6)	50 (1.0)	537 (2.7)	0 (3.5)	
² Russian Federation	51 (1.1)	567 (3.5)	49 (1.1)	568 (3.3)	1 (3.0)	
Spain	47 (0.8)	511 (2.4)	53 (0.8)	512 (2.5)	1 (2.9)	
Iran, Islamic Rep. of	49 (2.1)	440 (6.6)	51 (2.1)	442 (5.4)	2 (8.7)	
Chinese Taipei	48 (0.6)	557 (2.0)	52 (0.6)	559 (2.2)	2 (2.3)	
† Belgium (Flemish)	51 (0.8)	499 (2.3)	49 (0.8)	503 (2.8)	4 (2.9)	
Cyprus	52 (0.7)	509 (2.8)	48 (0.7)	514 (4.1)	4 (3.3)	
Ireland, Rep. of	50 (1.1)	526 (3.8)	50 (1.1)	530 (3.4)	4 (3.5)	
Germany	50 (0.8)	516 (2.8)	50 (0.8)	520 (2.4)	4 (2.8)	
Malta	49 (0.7)	493 (2.1)	51 (0.7)	498 (2.4)	5 (3.7)	
¹ Georgia	49 (0.9)	452 (4.7)	51 (0.9)	457 (4.2)	5 (4.1)	
¹² Canada	49 (0.8)	520 (2.1)	51 (0.8)	526 (2.2)	5 (2.1)	
² Turkey (5)	52 (1.4)	524 (4.4)	48 (1.4)	529 (5.2)	5 (4.6)	
² Slovak Republic	49 (1.0)	518 (3.8)	51 (1.0)	523 (4.4)	5 (3.8)	
²† United States	49 (0.8)	536 (3.0)	51 (0.8)	541 (3.2)	5 (2.7)	
² Portugal	48 (0.9)	501 (3.1)	52 (0.9)	506 (2.7)	6 (2.9)	
Austria	49 (1.0)	519 (3.1)	51 (1.0)	525 (3.0)	6 (3.3)	
Chile	50 (1.3)	466 (3.1)	50 (1.3)	472 (3.3)	6 (3.7)	
Hungary	48 (1.0)	526 (3.2)	52 (1.0)	533 (3.1)	6 (3.3)	
Italy	50 (0.8)	506 (3.3)	50 (0.8)	514 (3.3)	8 (2.8)	
³ Singapore	49 (0.5)	591 (3.6)	51 (0.5)	598 (3.8)	8 (2.8)	
Czech Republic	49 (0.9)	529 (3.0)	51 (0.9)	538 (3.0)	8 (3.1)	
Korea, Rep. of	47 (0.7)	583 (2.4)	53 (0.7)	592 (2.5)	9 (2.5)	
International Average	**49 (0.2)**	**493 (0.6)**	**51 (0.2)**	**489 (0.6)**		



Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
ϗ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 25%.
See Appendix B.2 for target population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

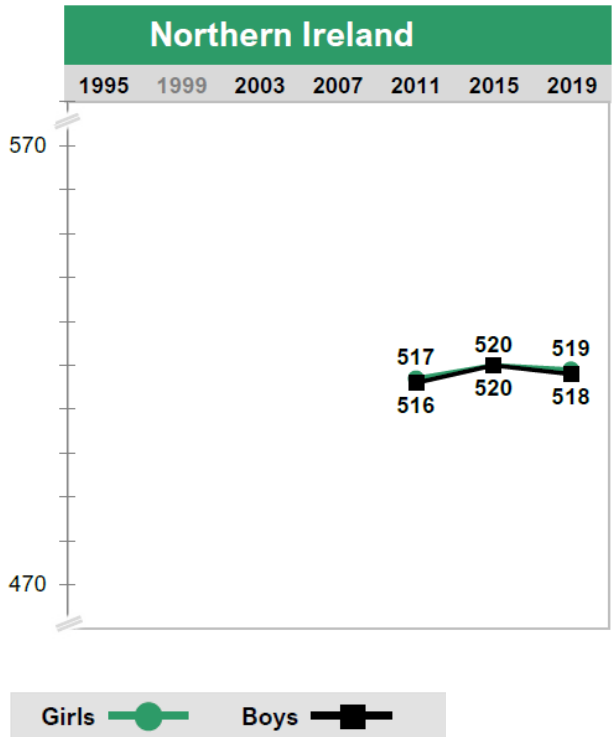
Source: Exhibit 1.10, TIMSS 2019 International Results in Mathematics and Science.

Northern Ireland also had no significant gender difference in science attainment in Y6 (see Table 2.2). Girls in Northern Ireland scored an average of 519 for science and boys an average of 518. Just under half of the participating countries (25 of 58) showed a significant gender difference for science. In contrast to mathematics, in science the number of countries with a significant gender difference favouring girls (18 countries) was greater than the number of countries with a gender difference favouring boys (seven countries). This is a change to what was seen in 2015 where the number of countries with a gender difference favouring boys and the number of countries with a gender difference favouring girls was the same.

Northern Ireland was one of 33 countries showing no overall gender difference for science at this age. The other countries included Finland, Poland, Hong Kong, England and Republic of Ireland. By contrast, Canada and the high performers of Singapore and Korea all had a gender difference for science in favour of boys, just as they had for mathematics. Notably, in the case of Singapore the significant gender gap in science in 2019 was not seen in 2015.

As shown in Figure 2.2, there has been no change in the gender difference in science attainment in Northern Ireland between 2011 and 2019. In all three cycles of TIMSS there were no statistically significant differences in the science scores for girls and boys in Northern Ireland, with the girls score always within one scale point of the boys score.

Figure 2.2 Trends in Science achievement by gender



Source: Exhibit 2.6, TIMSS 2019 International results in Mathematics and Science.

2.2 Conclusion

In 2019, 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.

Furthermore the equality of attainment in mathematics and science between boys and girls first seen in TIMSS 2011 has been maintained in both 2015 and 2019.

3 Distribution of attainment in TIMSS 2019

Chapter outline

This chapter outlines the distribution of attainment in mathematics and science in Northern Ireland in Year 6 (Y6, ages 9-10) in 2019. It describes the TIMSS 'benchmarks' of attainment, the proportions 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 eight comparator countries (Canada, England, Finland, Hong Kong, Korea, Poland, Republic of Ireland and Singapore).

Key findings

- Twenty-six per cent of pupils in Northern Ireland reached the Advanced International Benchmark in mathematics, the sixth highest percentage of the participating countries.
- Five per cent of Northern Ireland's pupils reached the Advanced International Benchmark for science.
- For mathematics and science respectively, four per cent and six per cent of pupils failed to reach the Low International Benchmarks. This compares with 0 to one per cent for mathematics, and 0 to six per cent for science, in the countries performing better than Northern Ireland.
- For mathematics and science the distribution of attainment across the international benchmarks has remained stable since 2015.
- As was the case in 2015, in Northern Ireland there was a relatively wide spread of attainment for mathematics, whereas for science the difference between the scores of the highest (95th percentile) and lowest (5th percentile) attainers was smaller.

3.1 Distribution of attainment in TIMSS

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 and across the different content and cognitive domains assessed in TIMSS (for more details 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). For example,

a country with a wide spread of attainment may have large proportions of pupils who are underachieving as well as pupils performing at the highest levels, whereas a country with a lower spread of attainment may have fewer very high achievers but 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' (i.e. levels of attainment within the overall achievement).

Tables 3.1 and 3.2 below summarise the international benchmarks for mathematics and science.

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. TIMSS 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 each TIMSS International Benchmark typically know and can do in the target subject.

Table 3.1 Summary of international benchmarks for Mathematics, Y6

	Advanced International Benchmark
625	*Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning.* Students can solve a variety of multistep word problems involving whole numbers and show an understanding of fractions and decimals. They can apply knowledge of two- and three-dimensional shapes in a variety of situations. Students can interpret and represent data to solve multistep problems.
	High International Benchmark
550	*Students apply conceptual understanding to solve problems.* They can apply conceptual understanding of whole numbers to solve two-step word problems. They show understanding of the number line, multiples, factors, and rounding numbers, and operations with fractions and decimals. Students can solve simple measurement problems. They demonstrate understanding of geometric properties of shapes and angles. Students can interpret and use data in tables and a variety of graphs to solve problems.
	Intermediate International Benchmark
475	*Students can apply basic mathematical knowledge in simple situations.* They can compute with three- and four-digit whole numbers in a variety of situations. They have some understanding of decimals and fractions. Students can identify and draw shapes with simple properties. They can read, label, and interpret information in graphs and tables.
	Low International Benchmark
400	*Students have some basic mathematical knowledge.* They can add, subtract, multiply, and divide one- and two-digit whole numbers. They can solve simple word problems. They have some knowledge of simple fractions and common geometric shapes. Students can read and complete simple bar graphs and tables.

Source: Exhibit 1.7.1, TIMSS 2019 International Results in Mathematics and Science.

Further detail about each benchmark is given in the international report (Mullis *et al*, 2020).

Table 3.2 Summary of international benchmarks for Science, Y6

●	**Advanced** International Benchmark
625	*Students communicate their 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. They can communicate understanding of relationships in ecosystems and interactions between organisms and their environment. They communicate understanding of properties and states of matter and physical and chemical changes. Students communicate understanding of Earth's physical characteristics, processes, and history and show knowledge of Earth's revolution and rotation.
○	**High** International Benchmark
550	*Students communicate and apply knowledge of life, physical, and Earth sciences.* 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 demonstrate knowledge of states and properties of matter and of energy transfer in practical contexts, and show some understanding of forces and motion. Students know various facts about the Earth's physical characteristics and show basic understanding of the Earth-Moon-Sun system.
●	**Intermediate** International Benchmark
475	*Students show knowledge and understanding of some aspects of science.* Students demonstrate some basic knowledge of plants and animals. They demonstrate knowledge about some properties of matter and some facts related to electricity, and can apply elementary knowledge of forces and motion. They show some understanding of Earth's physical characteristics.
○	**Low** International Benchmark
400	*Students show limited understanding of scientific concepts and limited knowledge of foundational science facts.*

Source: Exhibit 2.7.1, TIMSS 2019 International Results in Mathematics and Science.

Further detail about each benchmark is given in the international report (Mullis *et al*, 2020).

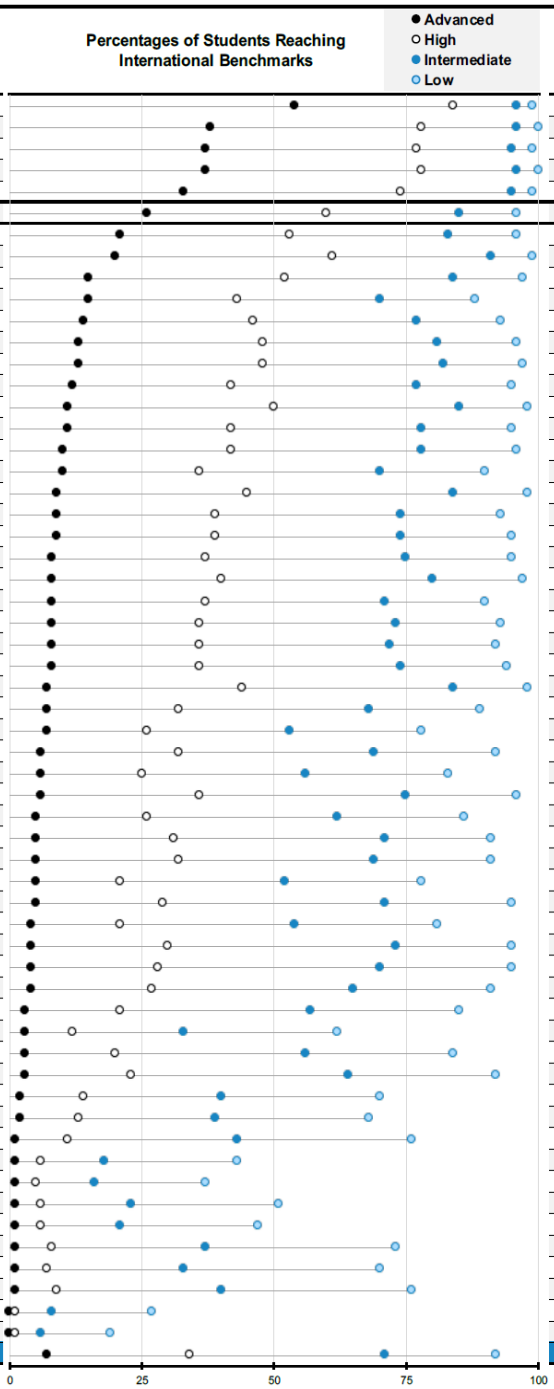
Tables 3.3 and 3.4 show the percentage of pupils reaching each benchmark for mathematics and science in Northern Ireland and all participating countries. The outcomes for Northern Ireland are then discussed for each subject in turn.

Interpreting the data: performance at the international benchmarks

These tables indicate the percentage of pupils reaching each of the four benchmarks and this information is summarised in the series of dots on the chart to the left and the corresponding percentages in the table on the right. Percentages are cumulative (reading the chart from left to right). Thus, 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, including those who reached the Advanced International Benchmark. The darker shaded dot indicates the percentage reaching at least the Intermediate International Benchmark, including those in the two previous categories. The lighter shaded dot shows cumulatively how many reached at least the Low International Benchmark. The percentage of pupils who did not reach any of the benchmarks can be calculated as 100 per cent minus the cumulative percentage for the Low International Benchmark.

3.1.1 Distribution of attainment in mathematics; international benchmarks

Table 3.3 Percentages reaching each benchmark for Mathematics, Y6



Country	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
[3] Singapore	54 (2.2)	84 (1.5)	96 (0.7)	99 (0.3)
† Hong Kong SAR	38 (1.9)	78 (1.6)	96 (0.7)	100 (0.2)
Korea, Rep. of	37 (1.4)	77 (1.2)	95 (0.5)	99 (0.2)
Chinese Taipei	37 (1.3)	78 (1.1)	96 (0.5)	100 (0.2)
Japan	33 (1.3)	74 (0.9)	95 (0.4)	99 (0.2)
† Northern Ireland	26 (1.4)	60 (1.4)	85 (1.1)	96 (0.6)
[2] England	21 (1.4)	53 (1.5)	83 (1.2)	96 (0.5)
[2] Russian Federation	20 (1.6)	61 (1.9)	91 (1.0)	99 (0.3)
Ireland, Rep. of	15 (1.0)	52 (1.4)	84 (1.0)	97 (0.5)
[2] Turkey (5)	15 (1.3)	43 (1.8)	70 (1.7)	88 (1.3)
[2] † United States	14 (0.8)	46 (1.3)	77 (1.1)	93 (0.6)
[2] Lithuania	13 (1.1)	48 (1.6)	81 (1.1)	96 (0.6)
† Norway (5)	13 (0.9)	48 (1.3)	82 (1.2)	97 (0.6)
Cyprus	12 (0.9)	42 (1.6)	77 (1.3)	95 (0.6)
[2] Latvia	11 (0.9)	50 (1.7)	85 (1.2)	98 (0.6)
Finland	11 (0.8)	42 (1.3)	78 (1.2)	95 (0.6)
Czech Republic	10 (1.0)	42 (1.5)	78 (1.3)	96 (0.6)
Australia	10 (0.9)	36 (1.2)	70 (1.3)	90 (1.0)
Austria	9 (0.7)	45 (1.4)	84 (1.1)	98 (0.4)
Hungary	9 (0.8)	39 (1.4)	74 (1.3)	93 (0.8)
[2] Portugal	9 (0.7)	39 (1.6)	74 (1.2)	95 (0.7)
† Denmark	8 (0.9)	37 (1.3)	75 (1.0)	95 (0.5)
† Belgium (Flemish)	8 (0.5)	40 (1.2)	80 (1.2)	97 (0.4)
Bulgaria	8 (0.6)	37 (1.7)	71 (1.9)	90 (1.5)
Poland	8 (0.8)	36 (1.4)	73 (1.4)	93 (0.6)
Azerbaijan	8 (0.6)	36 (1.3)	72 (1.5)	92 (0.8)
Sweden	8 (0.8)	36 (1.7)	74 (1.4)	94 (0.7)
≡ Netherlands	7 (0.9)	44 (1.7)	84 (1.1)	98 (0.4)
[2] Serbia	7 (0.7)	32 (1.4)	68 (1.5)	89 (1.1)
United Arab Emirates	7 (0.3)	26 (0.6)	53 (0.8)	78 (0.7)
[1 2] Canada	6 (0.6)	32 (1.0)	69 (0.9)	92 (0.6)
[2] New Zealand	6 (0.5)	25 (1.2)	56 (1.3)	83 (0.9)
Germany	6 (0.6)	36 (1.5)	75 (1.2)	96 (0.6)
Albania	5 (0.6)	26 (1.4)	62 (1.8)	86 (1.3)
[2] Slovak Republic	5 (0.7)	31 (1.7)	71 (1.7)	91 (1.2)
Malta	5 (0.5)	32 (0.9)	69 (0.8)	91 (0.6)
North Macedonia	5 (0.8)	21 (1.8)	52 (2.4)	78 (1.7)
[2] Kazakhstan	5 (0.6)	29 (1.5)	71 (1.4)	95 (0.6)
Bahrain	4 (0.4)	21 (1.0)	54 (1.2)	81 (1.0)
Italy	4 (0.5)	30 (1.5)	73 (1.3)	95 (0.5)
Croatia	4 (0.6)	28 (1.3)	70 (1.5)	95 (0.7)
Spain	4 (0.4)	27 (0.9)	65 (1.3)	91 (1.0)
France	3 (0.5)	21 (1.2)	57 (1.6)	85 (1.2)
Oman	3 (0.8)	12 (1.3)	33 (1.5)	62 (1.3)
[1] Georgia	3 (0.4)	20 (1.4)	56 (2.0)	84 (1.4)
Armenia	3 (0.5)	23 (1.4)	64 (1.6)	92 (0.7)
Qatar	2 (0.4)	14 (1.2)	40 (1.6)	70 (1.4)
Iran, Islamic Rep. of	2 (0.3)	13 (1.0)	39 (1.6)	68 (1.5)
Montenegro	1 (0.2)	11 (0.7)	43 (0.9)	76 (0.9)
Morocco	1 (0.8)	6 (1.1)	18 (1.4)	43 (1.7)
South Africa (5)	1 (0.2)	5 (0.5)	16 (1.1)	37 (1.5)
[2] Saudi Arabia	1 (0.2)	6 (0.6)	23 (1.2)	51 (1.4)
Kuwait	1 (0.2)	6 (0.9)	21 (1.6)	47 (1.8)
[2] Kosovo	1 (0.2)	8 (0.8)	37 (1.5)	73 (1.4)
Chile	1 (0.1)	7 (0.6)	33 (1.4)	70 (1.5)
Bosnia and Herzegovina	1 (0.2)	9 (0.7)	40 (1.5)	76 (1.1)
[2 Ψ] Pakistan	0 (0.1)	1 (0.3)	8 (1.5)	27 (4.7)
[2 Ψ] Philippines	0 (0.1)	1 (0.2)	6 (0.8)	19 (1.8)
International Median	**7**	**34**	**71**	**92**

Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
See Appendix B.2 for target population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.8, TIMSS 2019 International Results in Mathematics and Science.

In Northern Ireland, 26 per cent of Y6 pupils reached the Advanced International Benchmark in mathematics, with a further 34 per cent reaching the High benchmark (i.e. 60 per cent in total reaching at least the High benchmark). This compared with 74 to 84 per cent reaching at least the High benchmark in the highest scoring Pacific Rim countries.

The country with the most pupils reaching the Advanced benchmark was Singapore, with 54 per cent reaching that level in mathematics. Compared with 2015, a similar percentage of pupils in Northern Ireland reached the Advanced benchmark (in 2015, 27 per cent of pupils reached this benchmark). Among the comparator countries, England and Finland showed a significant[13] increase in the percentage of pupils reaching this benchmark (four per cent and three per cent respectively), whereas, in Hong Kong and Korea the percentage of pupils reaching this benchmark has significantly decreased since 2015 (seven per cent and four per cent respectively).

At the High bench mark there were also some notable changes among the comparator countries, England showed a small but significant increase in the percentage of pupils reaching this benchmark (four per cent the same size increase as was seen at the Advanced benchmark), whereas, in Hong Kong, Korea and Poland the percentage of pupils reaching this benchmark has significantly decreased since 2015.

At the other end of the scale, 96 per cent of pupils in Northern Ireland reached at least the Low International Benchmark for Y6 mathematics, with only four 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 benchmark. This closely mirrors the findings from both 2015 and 2011, indicating a stable trend in the distribution of mathematics attainment in Northern Ireland and the other high achieving countries.

Figures 3.1 to 3.4 below provide examples of mathematics items from TIMSS 2019 at each of the international benchmarks. These items cover a range of the mathematics content and cognitive domains, more information about these can be found in Chapter 4. The examples show how the items were presented in the TIMSS e-assessment[14], pupils in Northern Ireland accessed the same questions in the paper-based assessment.

[13] Throughout this report, the term ‘significant’ refers to statistical significance. When statistical significance is reported, it indicates that the compared mean scores are significantly different at the 5 per cent level.
[14] These examples are taken from the international report and therefore do not reflect the national adaptations that were made to the test materials before they were administered to pupils in Northern Ireland.

Figure 3.1 Example Mathematics item – Low International Benchmark

Content Domain: Data

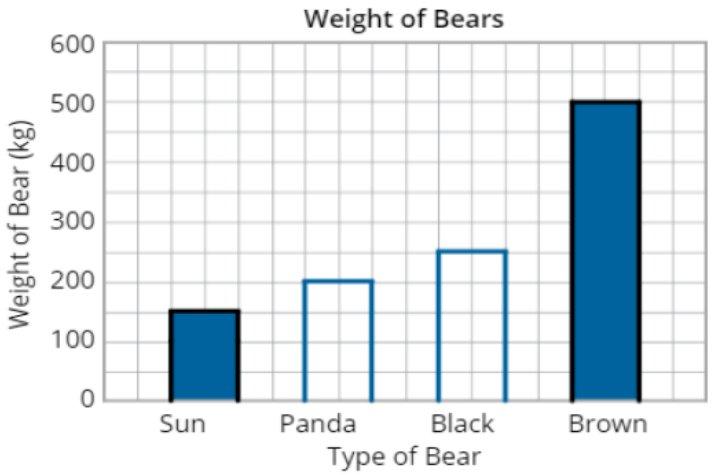
Cognitive Domain: Applying

Description: Represents data from a table in a bar graph

The table shows the weights of 4 bears.

Type of Bear	Weight (kg)
Sun	150
Panda	200
Black	250
Brown	500

Use the data to complete the graph.



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

Source: Exhibit 1.10.1, TIMSS 2019 International Results in Mathematics and Science.

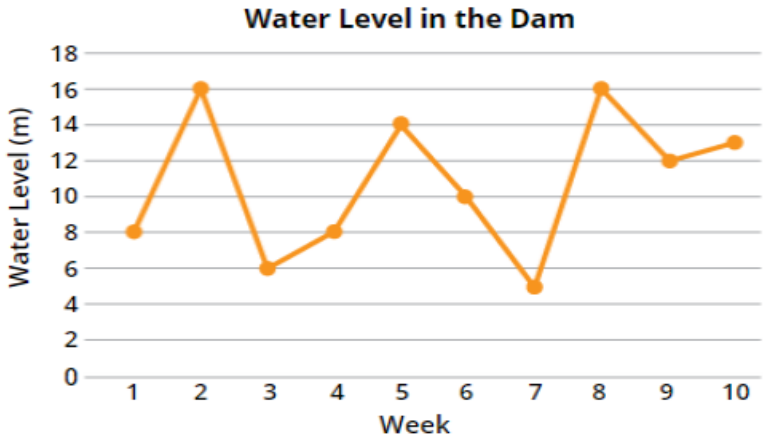
Figure 3.2 Example Mathematics item – Intermediate International Benchmark

Content Domain: Data

Cognitive Domain: Knowing

Description: Reads data from a line graph

The graph shows the water level in a dam for 10 weeks.



What was the water level for week 8?

Answer: 16 m

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

Source: Exhibit 1.11.2, TIMSS 2019 International Results in Mathematics and Science.

Figure 3.3 Example Mathematics item – High International Benchmark

Content Domain: Number
Cognitive Domain: Applying
Description: Identifies an expression that represents a situation

There were 12 liters of water in the tank.

Ravi then poured 3 liters of water into the tank and Indira poured another 3 liters of water into the tank.

How can the amount of water in the tank be calculated?

A $12 + (2 + 3)$

B $(12 + 3) + (12 + 3)$

C $(12 + 2) \times 3$

D $12 + (2 \times 3)$

As noted above, this example is taken from the international report. In the version of the question adapted for pupils in Northern Ireland the word ‘litres’ was used in place of ‘liters’.

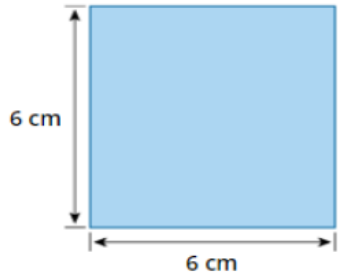
Source: Exhibit 1.12.1, TIMSS 2019 International Results in Mathematics and Science.

Figure 3.4 Example Mathematics item – Advanced International Benchmark

Content Domain: Measurement and Geometry

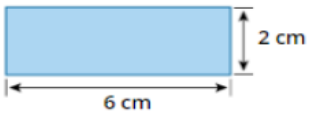
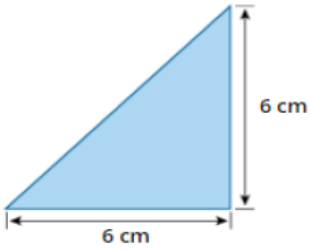
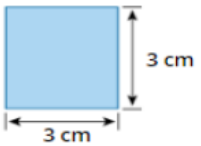
Cognitive Domain: Applying

Description: Determines the number of three different shapes that cover the area of a square (2 of 2 points)



The square above can be made by putting together smaller shapes.

Complete the table with the number of each shape that are needed to cover the whole square.

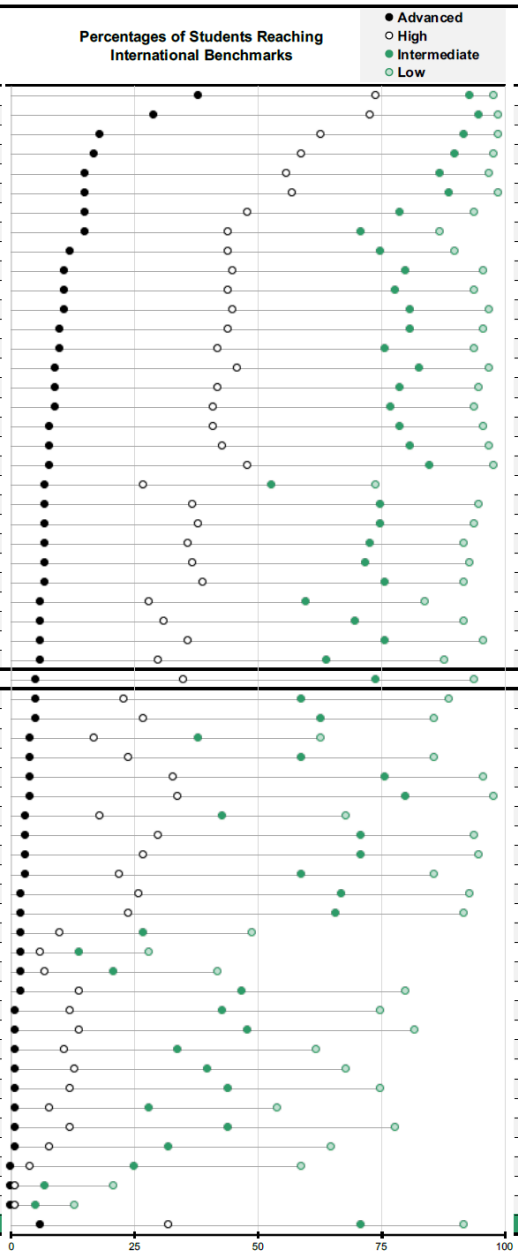
Shape	Number Needed to Cover the Square Above
	3
	2
	4

The answer shown illustrates the type of response that would receive full credit (2 points).

Source: Exhibit 1.13.2, TIMSS 2019 International Results in Mathematics and Science

3.1.2 Distribution of attainment in science; international benchmarks

Table 3.4 Percentages reaching each benchmark for Science, Y6



Country	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
3 Singapore	38 (1.9)	74 (1.7)	93 (0.9)	98 (0.4)
Korea, Rep. of	29 (1.2)	73 (1.3)	95 (0.6)	99 (0.2)
2 Russian Federation	18 (1.3)	63 (1.9)	92 (1.0)	99 (0.3)
Japan	17 (0.8)	59 (1.2)	90 (0.7)	98 (0.4)
Finland	15 (1.1)	56 (1.4)	87 (1.0)	97 (0.5)
Chinese Taipei	15 (0.9)	57 (1.1)	89 (0.9)	99 (0.3)
2 † United States	15 (0.8)	48 (1.3)	79 (1.1)	94 (0.6)
Bulgaria	15 (1.0)	44 (2.0)	71 (2.1)	87 (1.4)
2 Turkey (5)	12 (1.0)	44 (1.9)	75 (1.7)	90 (1.1)
Sweden	11 (1.0)	45 (1.8)	80 (1.5)	96 (0.6)
Australia	11 (0.9)	44 (1.5)	78 (1.2)	94 (0.7)
2 Lithuania	11 (0.9)	45 (1.5)	81 (1.4)	97 (0.4)
2 England	10 (1.1)	44 (1.7)	81 (1.2)	96 (0.6)
Hungary	10 (0.6)	42 (1.3)	76 (1.4)	94 (0.7)
† Norway (5)	9 (0.7)	46 (1.6)	83 (1.2)	97 (0.5)
Poland	9 (0.8)	42 (1.6)	79 (1.3)	95 (0.5)
Ireland, Rep. of	9 (0.6)	41 (1.6)	77 (1.7)	94 (0.8)
† Hong Kong SAR	8 (0.9)	41 (1.8)	79 (1.6)	96 (0.6)
Czech Republic	8 (0.9)	43 (2.2)	81 (1.2)	97 (0.5)
2 Latvia	8 (0.9)	48 (1.6)	85 (1.2)	98 (0.5)
United Arab Emirates	7 (0.4)	27 (0.7)	53 (0.9)	74 (0.7)
† 2 Canada	7 (0.6)	37 (1.1)	75 (1.0)	95 (0.4)
Austria	7 (0.7)	38 (1.4)	75 (1.4)	94 (0.8)
2 Serbia	7 (0.7)	36 (1.7)	73 (1.5)	92 (1.0)
Germany	7 (0.9)	37 (1.3)	72 (1.2)	93 (0.7)
2 Slovak Republic	7 (0.8)	39 (1.5)	76 (1.6)	92 (1.2)
Bahrain	6 (0.7)	28 (1.3)	60 (1.5)	84 (1.1)
Cyprus	6 (0.8)	31 (1.6)	70 (1.5)	92 (0.8)
† Denmark	6 (0.7)	36 (1.3)	76 (1.3)	96 (0.5)
2 New Zealand	6 (0.5)	30 (1.3)	64 (1.2)	88 (0.8)
† Northern Ireland	5 (0.7)	35 (1.4)	74 (1.5)	94 (0.7)
2 Kazakhstan	5 (0.8)	23 (1.5)	59 (1.7)	89 (1.0)
Malta	5 (0.4)	27 (0.8)	63 (0.8)	86 (0.7)
Oman	4 (0.8)	17 (1.3)	38 (1.4)	63 (1.2)
Albania	4 (0.5)	24 (1.5)	59 (1.8)	86 (1.4)
≡ Netherlands	4 (0.9)	33 (1.7)	76 (1.7)	96 (0.6)
Croatia	4 (0.5)	34 (1.4)	80 (1.3)	98 (0.4)
Qatar	3 (0.6)	18 (1.2)	43 (1.7)	68 (1.5)
Spain	3 (0.5)	30 (1.1)	71 (1.3)	94 (0.7)
Italy	3 (0.7)	27 (1.8)	71 (1.6)	95 (0.8)
France	3 (0.4)	22 (1.3)	59 (1.6)	86 (1.0)
2 Portugal	2 (0.4)	26 (1.4)	67 (1.5)	93 (0.6)
† Belgium (Flemish)	2 (0.3)	24 (1.1)	66 (1.5)	92 (0.6)
Kuwait	2 (0.4)	10 (1.3)	27 (2.0)	49 (2.1)
Ж South Africa (5)	2 (0.3)	6 (0.6)	14 (1.2)	28 (1.5)
Ψ Morocco	2 (0.7)	7 (1.1)	21 (1.6)	42 (2.0)
Armenia	2 (0.4)	14 (1.2)	47 (1.7)	80 (1.5)
‡ Georgia	1 (0.4)	12 (1.1)	43 (2.1)	75 (1.8)
Chile	1 (0.2)	14 (0.9)	48 (1.8)	82 (1.3)
North Macedonia	1 (0.4)	11 (1.3)	34 (2.5)	62 (2.6)
Iran, Islamic Rep. of	1 (0.3)	13 (1.0)	40 (1.7)	68 (1.8)
Montenegro	1 (0.2)	12 (0.9)	44 (1.6)	75 (0.9)
2 Saudi Arabia	1 (0.2)	8 (0.6)	28 (1.1)	54 (1.5)
Bosnia and Herzegovina	1 (0.2)	12 (0.9)	44 (1.5)	78 (1.4)
Azerbaijan	1 (0.2)	8 (0.6)	32 (1.3)	65 (1.5)
2 Kosovo	0 (0.1)	4 (0.6)	25 (1.6)	59 (1.7)
2 Ж Pakistan	0 (0.1)	1 (0.4)	7 (1.4)	21 (3.2)
2 Ж Philippines	0 (0.0)	1 (0.3)	5 (0.7)	13 (1.4)
International Median	**6**	**32**	**71**	**92**

Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
Ж Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 25%.
See Appendix B.2 for target population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 2.8, TIMSS 2019 International Results in Mathematics and Science.

For Y6 science, five per cent of pupils in Northern Ireland reached the Advanced International Benchmark, with a further 30 per cent achieving the High benchmark (making a total of 35 per cent reaching at least the High international benchmark). This distribution of attainment at the highest international benchmarks is similar to that seen in 2015 and 2011.

In the two highest scoring countries in science, Singapore and Korea, nearly three quarters of pupils reached at least the High benchmark (74 and 73 per cent respectively).

The country with the most pupils reaching the Advanced benchmark was, again, Singapore, with 38 per cent reaching that level in science. All eight comparator countries had a higher percentage of pupils reaching the Advanced benchmark, this ranged from seven to 38 per cent.

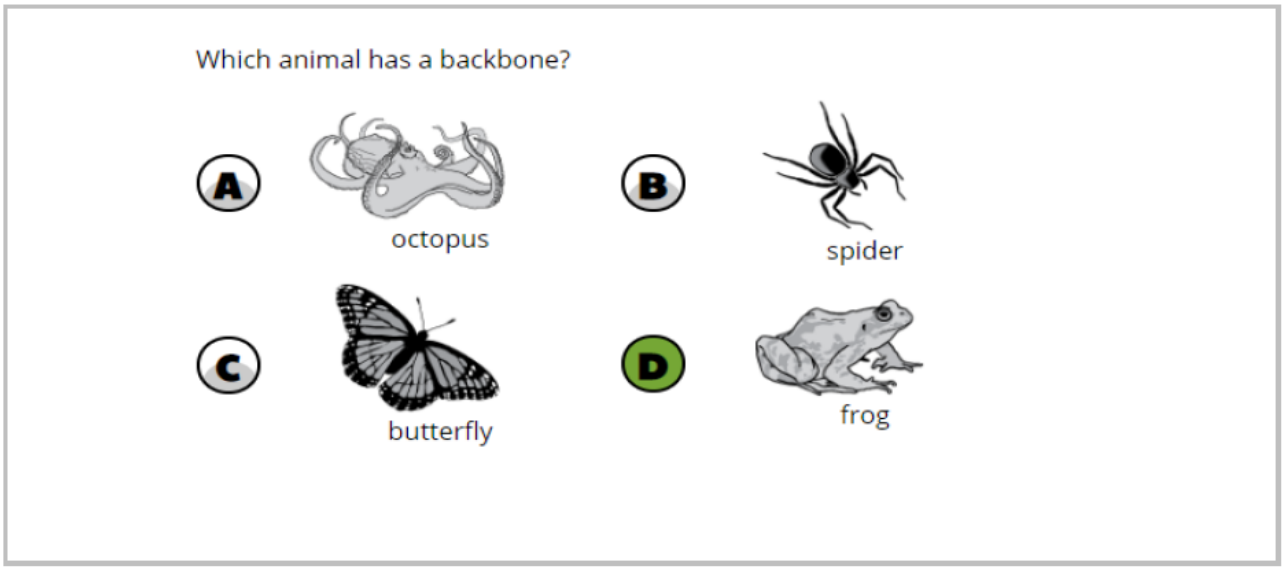
For science, 94 per cent of pupils in Northern Ireland reached at least the Low international benchmark for Y6, with six per cent achieving below that level. Again this was similar to the distribution seen in the two previous cycles of TIMSS. Among the two highest performers, the comparable percentages reaching at least the Low benchmark were 98 to 99 per cent. Compared with Northern Ireland, none of the comparator countries had 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 2019 at each of the international benchmarks. As with the mathematics items, the examples below show how the items were presented to pupils taking the TIMSS e-assessment. Pupils in Northern Ireland accessed the same questions in the paper-based assessment[15]. These items cover a range of the science content and cognitive domains, more information about these can be found in Chapter 5.

[15] As for mathematics these examples are taken from the international report and therefore do not reflect the national adaptations that were made to the test materials before they were administered to pupils in Northern Ireland.

Figure 3.5 Example Science item – Low International Benchmark

Content Domain: Life Science
Cognitive Domain: Knowing
Description: Recognizes an animal that has a backbone



Source: Exhibit 2.10.1, TIMSS 2019 International Results in Mathematics and Science

Figure 3.6 Example Science item – Intermediate International Benchmark

Content Domain: Physical Science
Cognitive Domain: Applying
Description: Recognizes the best explanation for why a box on a cart is easier to pull than a box resting directly on the floor

Tina and Mary need to move identical heavy boxes. Tina has to pull harder on her box to move it than Mary does.

Why is it easier for Mary to move her box?

A Gravity acting on Tina's box is much stronger.

B Air resistance acting on Tina's box is much greater.

C The cart increases the magnetic force acting on Mary's box.

D The cart's wheels decrease the force needed to move Mary's box.

Source: Exhibit 2.11.2, TIMSS 2019 International Results in Mathematics and Science

Figure 3.7 Example Science item – High International Benchmark

Content Domain: Earth Science

Cognitive Domain: Applying

Description: Using two pictures of the same location, explains that the Moon can look different at different times

One evening Peter went outside and made a drawing of a house, a tree, and the Moon. About 2 weeks later, Peter's brother, John, went outside and made a drawing of the same house, the same tree, and the Moon.

When they compared their drawings, they saw that they drew the Moon differently.

Peter's Drawing

John's Drawing

Whose drawing of the moon is correct?

(Click one box.)

- ☐ Only Peter's drawing of the moon can be correct.
- ☐ Only John's drawing of the moon can be correct.
- ☑ Both drawings of the moon can be correct.

Explain your answer.

The shape of the moon in the sky changes during the month. It looks different on different days.

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

Source: Exhibit 2.12.3, TIMSS 2019 International Results in Mathematics and Science

Figure 3.8 Example Science item – Advanced International Benchmark

Content Domain: Physical Science

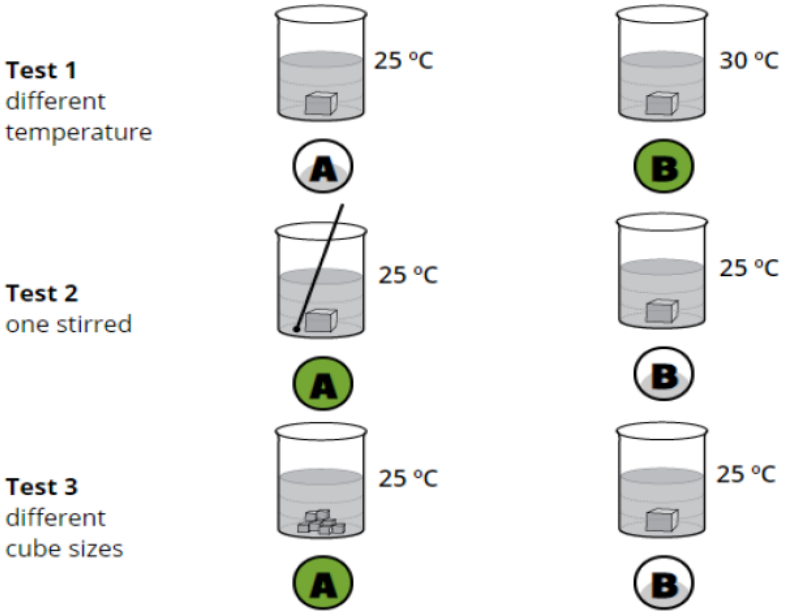
Cognitive Domain: Reasoning

Description: Part A - Recognizes set-ups that will more quickly dissolve a solid in water

Description: Part B - Explains the importance of controlling a variable in an experiment

Karl is investigating ways to make the same amount of sugar dissolve quickly in water. He sets up three tests.

A. For each of the tests, click the circle under the set-up that will dissolve the sugar faster.



B. Why is it important that the amount of water in each beaker is the same?

To make sure the amount of water did not change the test. Different amounts of water would not make the test fair.

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

Source: Exhibit 2.13.2, TIMSS 2019 International Results in Mathematics and Science

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 five per cent of pupils score lower, while the 95th percentile is the score at which five 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. Such a 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.

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

Country	Average scale score	Score 5th percentile	Score 95th percentile	Range[1]
Singapore	625	481	741	260
Hong Kong	602	479	710	231
Korea	600	477	710	233
Northern Ireland	**566**	**410**	**699**	**289**
England	556	411	693	282
Republic of Ireland	548	414	665	251
Finland	532	402	653	251
Poland	520	386	642	256
Canada	512	383	633	250

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

The score of pupils in Northern Ireland at the 5th percentile was 410, while the score of those at the 95th percentile was 699; a difference of 289 score points. This is a slightly wider score distribution than in 2015 (282 score points); a lower score of pupils at the 5th percentile (420 in 2015) appears to be largely responsible for the widening of the distribution. None of the comparator countries had a wider score distribution than Northern Ireland.

However, in a number of the comparator countries the distribution has widened since 2015, including in England and the Republic of Ireland. Singapore is the only comparator country where the distribution of performance has narrowed since 2015; the gap between the highest and lowest attaining pupils in 2019 was 30 score points less than in 2015. Of the comparator countries, Hong Kong and Korea had the narrowest gaps between the highest and lowest attainers at 231 and 233 respectively.

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.

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

Country	Average scale score	Score 5th percentile	Score 95th percentile	Range[1]
Singapore	595	454	708	254
Korea	588	474	693	219
Finland	555	429	662	233
England	537	413	649	236
Hong Kong	531	408	644	236
Poland	531	401	643	242
Republic of Ireland	528	393	643	250
Canada	523	401	636	235
Northern Ireland	**518**	**392**	**627**	**235**

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

The science score of pupils in Northern Ireland at the 5th percentile was 392, while the score of those at the 95th percentile was 627; a difference of 235 score points. This is a much narrower score distribution than that seen in mathematics. As was the case for mathematics, the score distribution for science is slightly wider than that seen in 2015 (230 score points), and again this widening of the gap is a result of a lower score for the lowest attaining pupils. Among the comparator countries England, Hong Kong Canada and Finland had score distributions that were very similar to the distribution in Northern Ireland (236, 236, 235 and 233 score points respectively). Notably the score distribution in the Republic of Ireland has widened with the gap between the highest and lowest

attaining pupils increasing to 250 score points, in 2015 it had the same score distribution as Northern Ireland. As with mathematics, Singapore was the only comparator country where the distribution of performance narrowed since 2015, the gap between the highest and lowest attaining pupils in 2019 was 28 score points less than in 2015.

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.

The tail of low performance (the percentage of pupils failing to reach the Low International Benchmark) for each subject was relatively small, but marginally greater in science than for mathematics.

Since 2015 the distribution of attainment for mathematics and science has remained relatively stable with similar percentages of pupils reaching each of the international benchmarks.

There is also a difference in the spread of score distributions (between the 95th and the 5th percentiles) 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. Notably, in Northern Ireland the gap between the highest and lowest attainers in both subjects has increased slightly since 2015. The only country that has seen a narrowing of the score distribution is Singapore the highest achieving country in both subjects.

4 Socio-economic disadvantage and achievement in TIMSS 2019

Chapter outline

This chapter summarises parent, pupil and principal reports to consider the relationship between socio-economic disadvantage, as measured by TIMSS 2019, and mathematics and science attainment amongst Year 6 pupils (Y6, ages 9-10) in Northern Ireland. Outcomes for Northern Ireland are compared with International Averages and with comparator countries of interest.

Key findings

- As in 2015 and 2011 there were differences in achievement between pupils categorised as having *Many resources* or *Some resources*, in both subjects. In 2019 pupils categorised as having *Many resources* had significantly[16] higher mathematics and science scores.
- In Northern Ireland there was a significant difference in mathematics and science achievement between pupils taught in schools categorised as *Most affluent* and those taught in schools categorised as *Most disadvantaged*. This was the case in all eight comparator countries.

There are many different ways of measuring socio-economic disadvantage, for example, the Multiple Deprivation Measure (NISRA, 2017) is used as the official measure of disadvantage in Northern Ireland. However in a large scale international survey such as TIMSS, the way in which disadvantage is measured has to be appropriate for a variety of national contexts in order for the findings to be comparable. Therefore it is important to recognise that when information from different sources is used to measure particular background characteristics, the findings may differ slightly – particularly if a more subjective measure is used. It is important to recognise that the TIMSS data provides a valuable source of information on the association between disadvantage and achievement and as such complements national data.

The TIMSS study collects important background information which can be used to inform the discussion of the impact of disadvantage on attainment. Bradshaw *et al,* (2018) used the 2015 TIMSS data to explore the connections between pupils' socio-economic background and their TIMSS performance. They found that socio-economic background had a strong association with TIMSS achievement in Northern Ireland. This was particularly evident in mathematics where, Northern Ireland achieves particularly well

[16] Throughout this report, the term 'significant' refers to statistical significance. When statistical significance is reported, it indicates that the compared mean scores are significantly different at the 5 per cent level.

internationally and although the scores of pupils in the highest socio-economic groups compared well with similarly advantaged pupils in other countries, the pupils in the most disadvantaged groups had much lower scores than pupils from more advantaged backgrounds. This additional analysis of the TIMSS 2015 results found that the gap between the highest and lowest socio-economic groups in mathematics was the largest among the comparator countries and had widened since the TIMSS study in 2011 (Bradshaw *et al*, 2018).

This chapter explores the two measures of socio-economic disadvantage used in TIMSS 2019 and examines whether the relationship between disadvantage and attainment is consistent with the findings from earlier research. It is important to recognise that the two scales discussed, *Home resources for learning* and *Socio-economic composition of schools*, are subjective measures completed by different groups of respondents. As a result, there may be some differences in the findings between the two scales, however the focus here is on general trends in disadvantage both in Northern Ireland and internationally.

4.1 Home resources for learning

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 2019 study collected information from both pupils and parents on background factors that have been found to show a relationship with attainment, such as books in the home, home study supports, parents' level of education and occupation. Therefore the findings from TIMSS 2019 will add to the growing body of evidence, including the research outlined above, which highlights the strong connection between pupils' socio-economic environment and their educational achievement.

The information from parents and pupils was used to construct the *Home resources for learning* scale which enables exploration of connections between pupils' background and their achievement in TIMSS. The *Early learning survey* asked the parents of pupils involved in TIMSS 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, pupils were asked about:

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

Interpreting the data: indices and scales

In order to summarise data from a questionnaire, responses to several related items can be 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 are often considered to be more reliable and valid than the responses to individual items.

Table 4.1 presents the results for the *Home resources for learning* scale, which was created using parents' and pupil'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 4.1).

In Northern Ireland, 35 per cent of pupils were in the *Many resources* category, 63 per cent were in the *Some resources* category and one per cent were in the *Few resources* category. Compared with the 2015 study similar percentages of pupils in Northern Ireland were in each category.

A higher proportion of pupils were reported to have *Many resources* in Northern Ireland than on average internationally, mirroring the findings from 2015 and 2011. In Table 4.1, the percentages of pupils in each category are the same for both subjects since they refer to the same pupils, but average achievement is different for mathematics and science.

In Northern Ireland, the results from 2019 showed that pupils who were in the *Many resources* category scored significantly higher in mathematics and science than those who were in the *Some resources* category. The same was true in the comparator countries[17] and on average internationally, and mirrors the findings from the previous two cycles of TIMSS. No comparisons could be made between achievement of pupils in the *Many resources* and *Few resources* categories (for both subjects) because only one per cent of pupils in Northern Ireland were categorised as having *Few resources*.

[17] Comparable data was not available for England as they did not administer the *Early Learning Survey.*

Table 4.1 Home resources for learning

Mathematics

Reported by Parents, except Number of Books and Home Study Supports Reported by Pupils

Students were scored according to their own and their parents' reports regarding the availability of five resources on the *Home Resources for Learning* scale. Cut scores divide the scale into three categories. Students with **Many Resources** had a score at or above the cut score corresponding to students reporting they had more than 100 books and both home study supports in their home and their parents reporting they had more than 25 children's books in their home, that at least one parent finished university, and that at least one parent had a professional occupation, on average. Students with **Few Resources** had a score at or below the cut score corresponding to students reporting they had 25 or fewer books and neither of the home study supports in their home and their parents reporting 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 worked in a clerical or professional occupation, on average. All other students had **Some Resources**.

Country	Many Resources		Some Resources		Few Resources		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland s	35 (1.8)	626 (4.5)	63 (1.7)	565 (3.6)	1 (0.3)	~ ~	11.1 (0.07)
International Average	**17 (0.1)**	**562 (0.7)**	**75 (0.2)**	**498 (0.5)**	**8 (0.1)**	**433 (1.5)**	

This TIMSS context 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 "s" indicates data are available for at least 50% but less than 70% of the students.

The term students is used in this table as this is the term used in the TIMSS international report from which the table was sourced.

Source: Exhibit 5.2, TIMSS 2019 International Results in Mathematics and Science

Science

Reported by Parents, except Number of Books and Home Study Supports Reported by Pupils

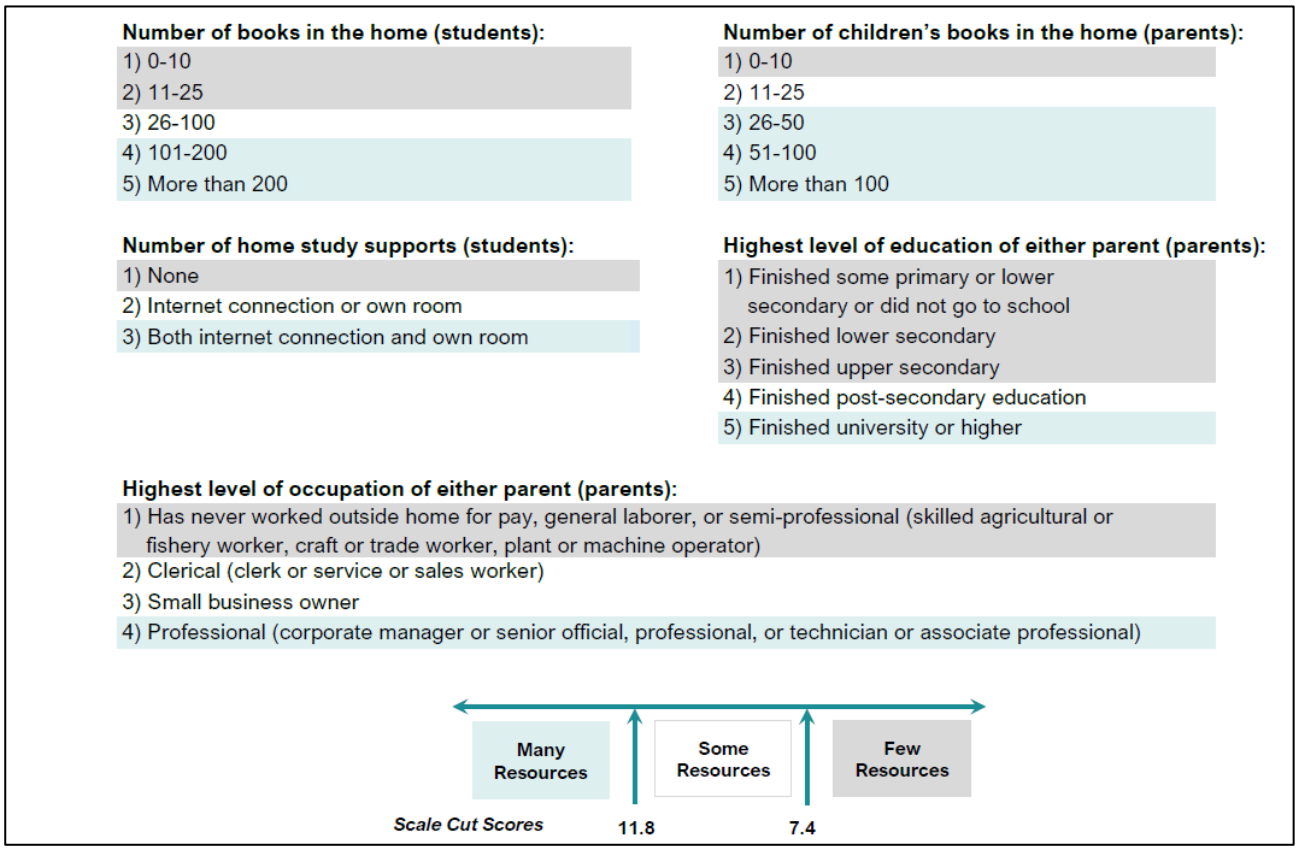
Country	Many Resources		Some Resources		Few Resources		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland s	35 (1.8)	565 (3.3)	63 (1.7)	515 (2.6)	1 (0.3)	~ ~	11.1 (0.07)
International Average	**17 (0.1)**	**557 (0.8)**	**75 (0.2)**	**488 (0.5)**	**8 (0.1)**	**414 (1.7)**	

This TIMSS context 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 "s" indicates data are available for at least 50% but less than 70% of the students.

The term students is used in this table as this is the term used in the TIMSS international report from which the table was sourced.

Source: Exhibit 5.3, TIMSS 2019 International Results in Mathematics and Science

Figure 4.1 The Home resources for learning scale



The term students is used in this figure as this is the term used in the TIMSS international report from which the figure was sourced.

Source: Exhibit 5.1, TIMSS 2019 International Results in Mathematics and Science

4.2 Socio-economic composition of schools

There is consistent evidence from large scale international surveys that there is a strong relationship between a school's socio-economic profile and the performance of pupils The findings from PISA indicates that schools that are categorised as socio-economically disadvantaged (i.e. schools whose socio-economic profile is in the bottom 25 per cent within their country or economy) usually have lower average performance than those with pupils who are more advantaged (OECD, 2018). TIMSS 2019 examined the relationship between socio-economic status and achievement through information collected from principals about the socio-economic background of the pupils within their school. Using this information schools are categorised based on principals' reports of the percentages of economically disadvantaged and economically affluent pupils in the school (details of how responses were categorised during analysis are given in Figure 4.2). Schools were categorised into three groups: *More affluent*, *Neither more affluent nor more disadvantaged* and *More disadvantaged*. *More affluent* schools were defined as having more than 25 per cent of pupils from economically affluent homes and not more than 25

per cent from economically disadvantaged homes, while *More disadvantaged* schools had more than 25 per cent of pupils from disadvantaged homes and not more than 25 per cent from affluent homes. All other combinations were considered to be *Neither more affluent nor more disadvantaged*.

In Northern Ireland, 39 per cent of pupils were taught in schools that were defined as *More affluent*, 30 per cent were in schools in the *Neither more affluent nor more disadvantaged* category and 30 per cent were in schools in the *More disadvantaged* category. Compared with the International Average, Northern Ireland had a similar proportion of pupils taught in schools defined as *More affluent* and a higher proportion of pupils in schools defined as *More disadvantaged*. In Table 4.2, the percentages of pupils in each category are the same for both subjects since they refer to the same pupils, but the achievement is different for mathematics and science.

In Northern Ireland, the results from 2019 showed that pupils who were in the *More affluent* category and pupils in the *Neither more affluent nor more disadvantaged* categories scored significantly higher in mathematics and science than those who were in the *More Disadvantaged* category.

In science there was also a significant difference between the scores of pupils in the *More affluent* category and pupils in the *Neither more affluent nor more disadvantaged* category, with pupils in the latter having significantly lower science scores. This was not true for mathematics where the difference of 10 score points was not statistically significant.

Among the comparator countries there was also a clear relationship between achievement and socio-economic background of pupils within schools. Figures 4.2 and 4.3 show that in every comparator country, apart from Finland, there was a significant difference between the achievement of pupils in the *More affluent* category and those who were in the *More disadvantaged* category. Those in the *More affluent* category scored significantly higher in mathematics and science, mirroring what was seen in Northern Ireland.

Table 4.2 School composition by socio-economic background of pupils as reported by the school's principal.

Mathematics

Country	More Affluent Schools where more than 25% of the student body comes from economically affluent homes and not more than 25% from economically disadvantaged homes		Neither More Affluent Nor More Disadvantaged		More Disadvantaged Schools where more than 25% of the student body comes from economically disadvantaged homes and not more than 25% from economically affluent homes	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Canada	43 (2.5)	530 (3.0)	35 (2.5)	505 (2.8)	22 (2.2)	486 (4.1)
England s	13 (3.5)	620 (13.7)	53 (5.6)	550 (4.0)	34 (5.3)	540 (5.6)
Finland	36 (4.0)	541 (3.1)	54 (4.1)	530 (3.4)	10 (2.3)	512 (7.1)
Hong Kong SAR	34 (3.6)	612 (5.1)	25 (4.0)	607 (6.3)	41 (4.3)	590 (5.8)
Ireland, Rep. of	49 (4.4)	557 (4.0)	27 (4.0)	555 (5.5)	24 (3.0)	522 (4.9)
Korea, Rep. of	26 (3.3)	620 (4.1)	57 (4.1)	594 (3.0)	17 (3.1)	583 (4.4)
Northern Ireland r	39 (4.3)	586 (5.9)	30 (4.9)	576 (4.6)	30 (3.9)	539 (5.1)
Poland	25 (4.0)	534 (5.7)	64 (4.3)	521 (3.3)	11 (3.1)	493 (7.9)
Singapore	53 (0.0)	635 (5.2)	37 (0.0)	623 (5.7)	10 (0.0)	584 (13.4)
International Average	**41 (0.5)**	**521 (1.3)**	**34 (0.5)**	**499 (0.9)**	**25 (0.4)**	**479 (1.1)**

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

The term students is used in this table as this is the term used in the TIMSS international report from which the table was sourced.

Source: Exhibit 6.2, TIMSS 2019 International Results in Mathematics and Science

Science

Country	More Affluent: Schools where more than 25% of the student body comes from economically affluent homes and not more than 25% from economically disadvantaged homes		Neither More Affluent Nor More Disadvantaged		More Disadvantaged: Schools where more than 25% of the student body comes from economically disadvantaged homes and not more than 25% from economically affluent homes	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Canada	43 (2.5)	534 (2.8)	35 (2.5)	523 (2.7)	22 (2.2)	502 (3.4)
England s	13 (3.5)	590 (11.4)	53 (5.6)	532 (4.0)	34 (5.3)	521 (5.9)
Finland	36 (4.0)	559 (3.6)	54 (4.1)	554 (3.6)	10 (2.3)	537 (8.6)
Hong Kong SAR	34 (3.6)	546 (4.6)	25 (4.0)	532 (5.7)	41 (4.3)	520 (6.1)
Ireland, Rep. of	49 (4.4)	536 (5.8)	27 (4.0)	533 (6.3)	24 (3.0)	505 (4.9)
Korea, Rep. of	26 (3.3)	606 (3.7)	57 (4.1)	583 (2.6)	17 (3.1)	571 (4.1)
Northern Ireland r	39 (4.3)	532 (4.3)	30 (4.9)	524 (4.1)	30 (3.9)	500 (4.2)
Poland	25 (4.0)	545 (5.6)	64 (4.3)	531 (3.1)	11 (3.1)	504 (7.0)
Singapore	53 (0.0)	605 (4.6)	37 (0.0)	590 (5.1)	10 (0.0)	553 (11.9)
International Average	**41 (0.5)**	**512 (1.3)**	**34 (0.5)**	**489 (1.0)**	**25 (0.4)**	**467 (1.1)**

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

The term students is used in this table as this is the term used in the TIMSS international report from which the table was sourced.

Source: Exhibit 6.3, TIMSS 2019 International Results in Mathematics and Science

Figure 4.2 TIMSS 2019 Mathematics achievement and school composition by socio-economic background of pupils

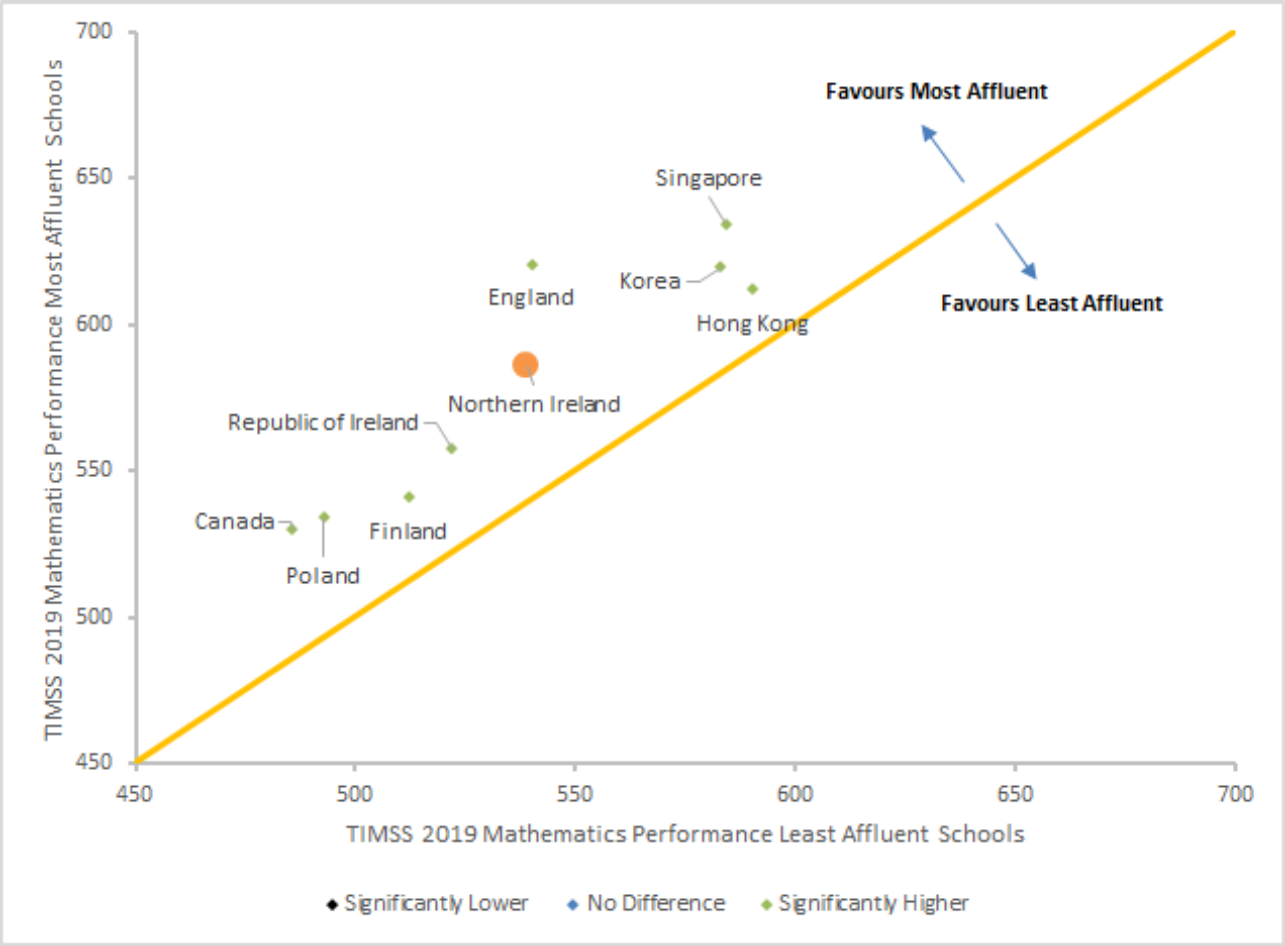


Figure 4.3 TIMSS 2019 Science achievement and school composition by socio-economic background of pupils

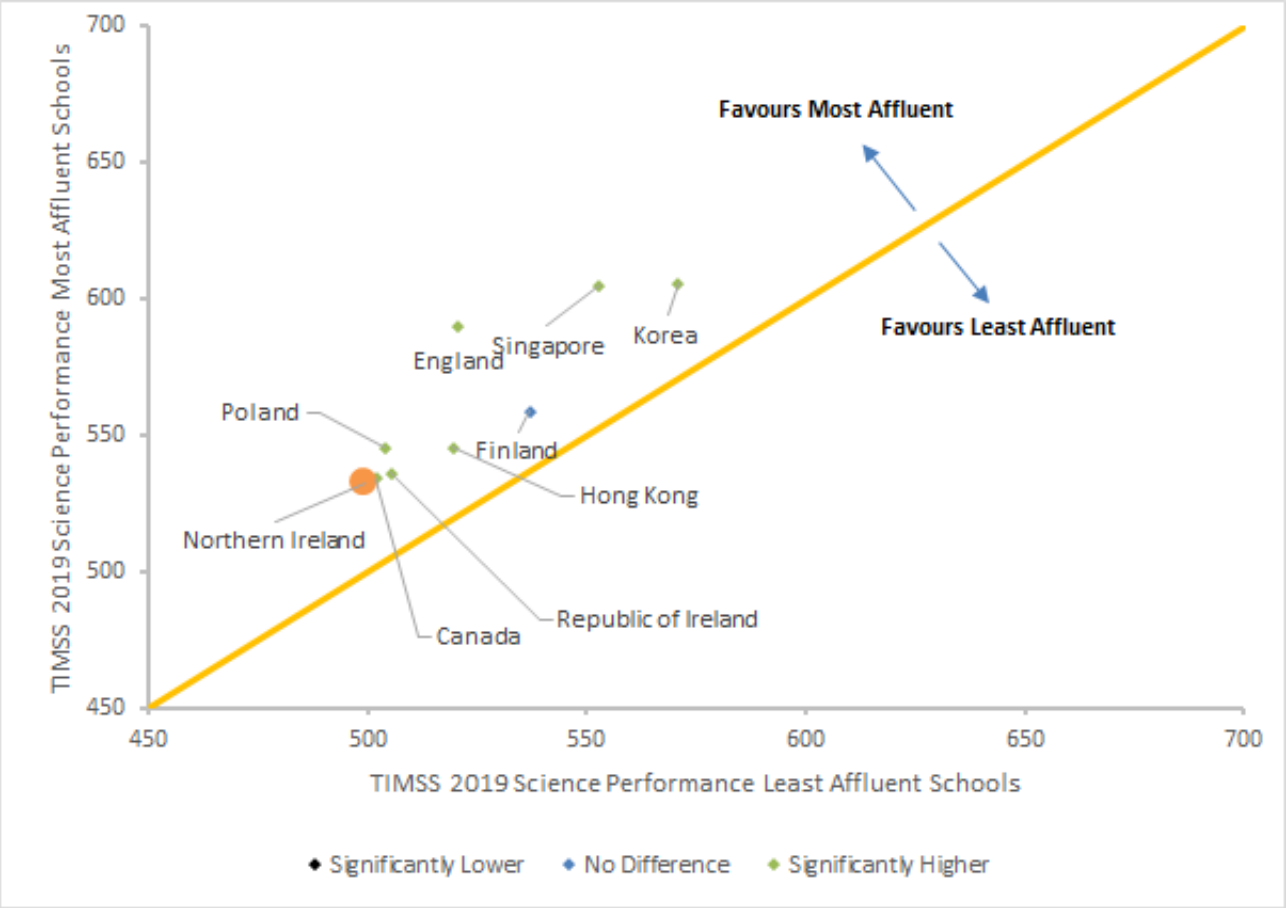
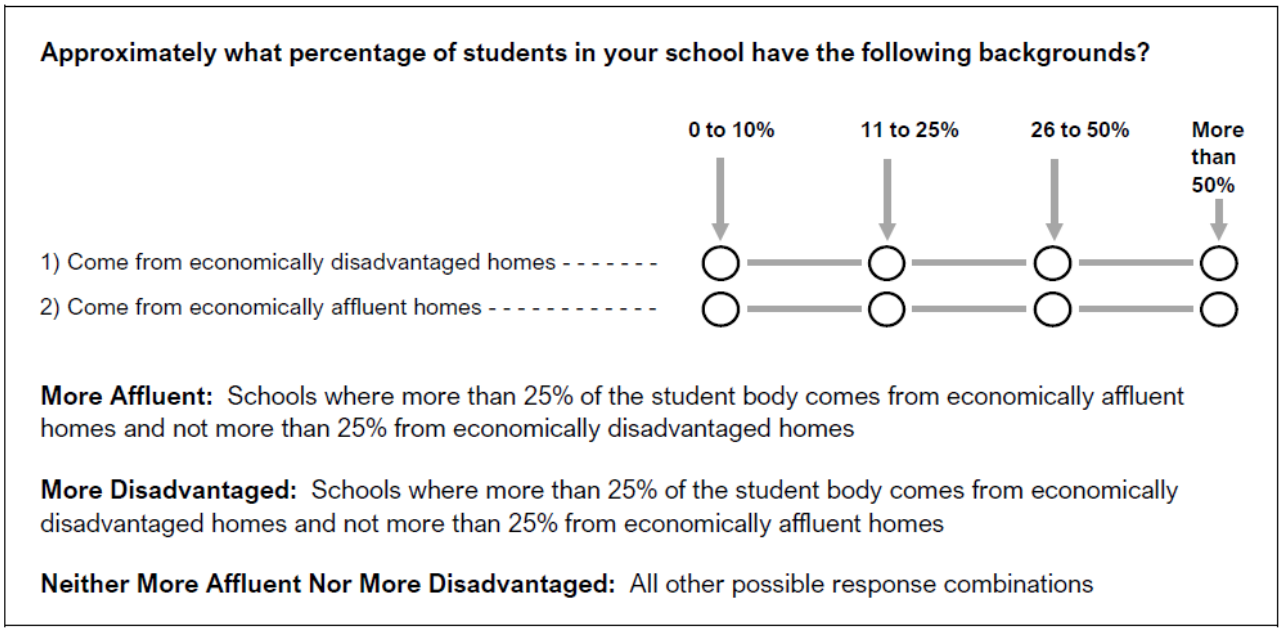


Figure 4.4 School composition by socio-economic background of pupils as reported by the school's principal.



The term students is used in this figure as this is the term used in the TIMSS international report from which the figure was sourced.

Source: Exhibit 6.1, TIMSS 2019 International Results in Mathematics and Science

4.3 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 pupils in Northern Ireland were categorised as having access to *Some* or *Many* resources, similar to 2015 and higher than the International Average. The TIMSS findings for Northern Ireland support what is seen in other international research; pupils with *Many resources* scored significantly higher than those with *Some resources* in mathematics and science. This mirrors the findings from 2011 and 2015.

TIMSS 2019 also looked at the relationship between socio-economic status and achievement based on principals' reports about the socio-economic background of pupils at their school. A clear pattern of achievement could be seen in Northern Ireland and in all but one of the comparator countries. That is, in both mathematics and science there was a significant difference in achievement between pupils taught in schools categorised as *Most affluent* and those taught in schools categorised as *Most disadvantaged,* with pupils in the former performing significantly better in the two subjects.

The findings presented in this chapter are consistent with the evidence provided by Bradshaw *et al*, (2018) on the connections between pupils' socio-economic background

and their TIMSS 2015 performance and also add to the growing body of evidence from other international surveys of the impact of disadvantage on achievement.

5 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). It summarises pupils' mathematics and science attainment across the TIMSS content and cognitive domains in 2019 and compares these to international trends, relevant comparator countries and previous cycles of TIMSS.

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

Key findings

- In the mathematics content domains, pupils in Northern Ireland did significantly[18] better on Number questions and less well on Measures and Geometry questions. In the mathematics cognitive domains, they did significantly better on questions assessing Knowing skills and less well on questions assessing Reasoning skills.
- Internationally for mathematics, pupils tended to perform better on questions assessing Number than on the other domains (relative to their overall mean performance), as seen in Northern Ireland.
- Northern Ireland was one of only nine countries that scored significantly better than their national mean scale score on the Knowing cognitive domain in mathematics.
- In the science content domains, pupils in Northern Ireland did significantly better on Earth Science and less well on Physical Science. In the science cognitive domains, they performed significantly less well in the Applying domain.
- In Northern Ireland, the only significant gender difference in attainment across the content and cognitive domains was for science Reasoning tasks, where girls scored higher than boys. Internationally, for both mathematics and science, most countries had gender differences on the content and cognitive domains.

[18] Throughout this report, the term 'significant' refers to statistical significance. When statistical significance is reported, it indicates that the compared mean scores are significantly different at the 5 per cent level.

- Performance on the content and cognitive domains can be compared to the results from TIMSS 2015 to identify any statistically significant changes over the four-year cycle:
    - In mathematics, performance on Reasoning tasks has increased significantly while performance on Measurement and Geometry and Applying tasks has decreased significantly.
    - In science, there were no significant changes in performance in the content and cognitive domains.
- Since Northern Ireland first participated in TIMSS in 2011, some significant longer-term trends have emerged:
    - In mathematics, there have been significant improvements in the Data domain and in Reasoning skills.
    - In science, there have been significant improvements in performance on the Earth Science domain and Reasoning skills and a significant decrease on Applying skills

5.1 The content and cognitive domains in TIMSS 2019

TIMSS assesses pupils' subject performance using a wide range of questions (items) that are classified by the broad subject content that they cover and the cognitive skill that pupils require to answer them correctly by analysing the relative performance of pupils on the subsets of items for each of these content and cognitive domains compared to the overall performance, a picture of national strengths and weaknesses in mathematics and science can be developed. Further information about international performance on these domains is available in the international report (Mullis *et al*, 2020).

Mathematics: what TIMSS assesses at ages 9-10

The content domains and subdomains assessed for Y6 mathematics are:

- **Number** – Whole Number; Expressions; Simple Equations and Relationships; Fractions and Decimals
- **Measurement and Geometry** – Measurement; Geometry
- **Data** – Reading, Interpreting and Representing Data; Using Data to Solve Problems.

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 Frameworks (Mullis and Martin, 2017).

Science: what TIMSS assesses at ages 9-10

The content domains and subdomains assessed for 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 Physical Characteristics, Resources and History; Earth's Weather and Climates; 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 Frameworks (Mullis and Martin, 2017). Although the curriculum in Northern Ireland does not include science as a discrete subject, it is covered as part of 'The World Around Us'(CCEA, 2007). While there are some differences between the Key Stage 2 curriculum in Northern Ireland and the fourth grade TIMSS Assessment Framework for science, 23 of the 26 TIMSS science topics are included in Northern Ireland's curriculum (Kelly *et al*, 2020).

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 with each other since they represent different constructs. However, each subscale 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.

5.2 Attainment by content domain

5.2.1 Attainment in the mathematics content domains

In 2019, Northern Ireland's overall mean scale score for TIMSS mathematics was 566.

Pupils in Northern Ireland scored significantly above the overall mean scale score on questions from the content domain of Number (a mean scale score of 572) and significantly below it in the Measurement and Geometry domain (556). The scale score for Data (564) was similar to the score for mathematics overall (see Table 5.1). This pattern of relative performance across the content domains mirrored that seen in 2015.

Table 5.1 Y6 attainment in the Mathematics content domains

Country	Overall Mathematics Average Scale Score	Number (83 Items)		Measurement and Geometry (52 Items)		Data (36 Items)	
		Average Scale Score 2019	Difference from Overall Mathematics Score	Average Scale Score 2019	Difference from Overall Mathematics Score	Average Scale Score 2019	Difference from Overall Mathematics Score
† Northern Ireland	566 (2.7)	572 (3.1)	7 (1.9) ▲	556 (3.0)	-10 (2.0) ▽	564 (2.5)	-2 (1.3)

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

See Appendix B.5 for sampling guidelines and sampling participation notes †.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.14, International Results in Mathematics and Science

For TIMSS 2019, the general pattern internationally was for countries to perform better on questions assessing Number than on the other content domains, relative to their overall mean performance. Of the 55[19] countries in the analysis, 27 showed higher performance on Number, compared to 19 for Measurement and Geometry and 11 for

[19] Data from 55 of the 58 participating countries is included in the international analysis of the mathematics content domains.

Data. The majority of countries performed less well on Data relative to their overall performance: 33 of 55 compared to 23 for Measurement and Geometry and 17 for Number.

Among the comparator countries, England, the Republic of Ireland and Singapore all mirrored Northern Ireland in performing significantly better on Number questions and significantly less well on Measurement and Geometry questions. Northern Ireland's performance on the Data domain was similar to that of Finland, Hong Kong and Korea in showing no significant difference to the overall national average.

Table 5.2 Difference in attainment in the Mathematics content domains between 2011, 2015 and 2019

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			Measurement and Geometry			Data		
	Average Scale Score	Differences Between Years		Average Scale Score	Differences Between Years		Average Scale Score	Differences Between Years	
		2015	2011		2015	2011		2015	2011
Northern Ireland									
† 2019	572 (3.1)	-2	6	556 (3.0)	-10 ▽	-4	564 (2.5)	-3	9 ▲
‡ 2015	574 (3.1)		8	566 (3.3)		6	567 (3.8)		12 ▲
† 2011	566 (2.9)			560 (3.2)			555 (2.9)		

▲ Average from more recent year significantly higher

▽ Average from more recent year significantly lower

See Appendix B.5 for sampling guidelines and sampling participation notes † and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.15, International Results in Mathematics and Science

In terms of trends, the only notable change from the 2015 scores was a significant drop in performance on the Measurement and Geometry domain of ten scale points from 2015 to 2019 (see Table 5.2). However, this domain had shown previous variability. Performance on the Data domain did not change significantly from 2015, but had improved significantly from 2011 to 2015. Performance on the Number domain has not changed significantly between any of the TIMSS cycles.

5.2.2 Attainment in the science content domains

In 2019, Northern Ireland's overall mean scale score for TIMSS science was 518.

Pupils in Northern Ireland (see Table 5.3) scored similarly to this mean in the science content domains of Life Science (a mean scale score of 520). They scored significantly higher than the mean scale score in Earth Science (525), but significantly lower in Physical Science (511).

Table 5.3 Y6 attainment in the Science content domains

Country	Overall Science Average Scale Score	Life Science (73 Items)		Physical Science (61 Items)		Earth Science (35 Items)	
		Average Scale Score 2019	Difference from Overall Science Score	Average Scale Score 2019	Difference from Overall Science Score	Average Scale Score 2019	Difference from Overall Science Score
† Northern Ireland	518 (2.3)	520 (2.8)	2 (2.1)	511 (2.2)	-8 (1.4) ▽	525 (2.6)	6 (2.5) ▲

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

See Appendix B.5 for sampling guidelines and sampling participation notes †.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 2.14, International Results in Mathematics and Science

For TIMSS 2019, the general pattern internationally was for countries to perform less well on Earth Science, relative to their overall mean performance[20]. Approximately half of the TIMSS countries had lower relative scores on Earth Science (with only ten countries, including Northern Ireland, performing better). However, there was more variability with no clear pattern in performance on Life Science and Physical Science. Just over a third of countries performed better on Life Science than their mean scale score (21 compared to 13 that performed less well). In Physical Science, some countries significantly exceeded their mean score on this domain while others did less well (17 countries performed better compared to 21 that performed less well).

In the comparator countries, the pattern in performance seen in Northern Ireland mirrored that of the Republic of Ireland in all three domains. Canada, Finland and Poland also performed lower on Physical Science, while Finland and Hong Kong also performed higher on Earth Science. In contrast England performed at a similar level in the science domains, except less well on Earth Science.

[20] Data from 53 of the 58 participating countries is included in the international analysis of the science content domains.

Table 5.4 Difference in attainment in the Science content domains between 2011, 2015 and 2019

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			Physical Science			Earth Science		
	Average Scale Score	Differences Between Years		Average Scale Score	Differences Between Years		Average Scale Score	Differences Between Years	
		2015	2011		2015	2011		2015	2011
Northern Ireland									
† 2019	520 (2.8)	-1	1	511 (2.2)	-3	-9 ▽	525 (2.6)	3	17 ▲
‡ 2015	521 (2.7)		3	514 (2.6)		-6	522 (3.0)		15 ▲
† 2011	519 (2.9)			520 (3.2)			507 (2.7)		

▲ Average from more recent year significantly higher

▽ Average from more recent year significantly lower

See Appendix B.5 for sampling guidelines and sampling participation notes † and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 2.15, International Results in Mathematics and Science

There were no significant changes in the performance on any of the science content domains from 2015 to 2019 (see Table 5.4). However, the mean score for Earth Science in 2019 is significantly higher than the score in 2011, by 17 scale points, while performance on Physical Science has fallen significantly from 2011, by nine scale points.

5.3 Attainment by cognitive domain

5.3.1 Attainment in the mathematics cognitive domains

The cognitive domains define the different skills required for performance in mathematics. Relative to their overall mathematics scale score of 566, pupils did significantly better on Knowing (a mean scale score of 574), neither significantly better nor less well on Applying (565) and significantly less well on Reasoning (558).

Table 5.5 Y6 attainment in the Mathematics cognitive domains

Country	Overall Mathematics Average Scale Score	Knowing (59 Items)		Applying (74 Items)		Reasoning (38 Items)	
		Average Scale Score 2019	Difference from Overall Mathematics Score	Average Scale Score 2019	Difference from Overall Mathematics Score	Average Scale Score 2019	Difference from Overall Mathematics Score
† Northern Ireland	566 (2.7)	574 (3.3)	9 (1.5) ▲	565 (2.8)	-1 (1.4)	558 (2.9)	-7 (1.7) ▽

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

See Appendix B.5 for sampling guidelines and sampling participation notes †.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.17, International Results in Mathematics and Science

Northern Ireland was one of only nine countries that scored significantly better than their national mean scale score on Knowing items, compared to 25 countries that performed significantly less well[21]. Note also that six of the nine countries that performed better on Knowing items were in the top eight countries ranked by overall mean scale score. Reasoning and Applying require higher order thinking skills. Northern Ireland was one of 28 countries that performed less well in the Reasoning domain, compared to 17 countries that performed significantly better. For the Applying domain, 24 countries performed significantly better than their mean scale score, while ten countries performed less well.

The comparator countries had different patterns of relative strength and weakness. Some of the comparator countries shared aspects of their pattern of performance with Northern Ireland. Singapore showed the same relative performance across all three mathematics cognitive domains. England and Korea also showed higher performance on the Knowing domain, while the Republic of Ireland also showed lower performance on the Reasoning domain.

[21] Data from 56 of the 58 participating countries is included in the international analysis of the mathematics cognitive domains.

Table 5.6 Difference in attainment in the Mathematics cognitive domains between 2011, 2015 and 2019

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			Applying			Reasoning		
	Average Scale Score	Differences Between Years		Average Scale Score	Differences Between Years		Average Scale Score	Differences Between Years	
		2015	2011		2015	2011		2015	2011
Northern Ireland									
† 2019	574 (3.3)	-7	-5	565 (2.8)	-11 ▽	0	558 (2.9)	9 ▲	20 ▲
‡ 2015	582 (3.9)		2	575 (3.2)		11 ▲	550 (3.3)		12 ▲
† 2011	580 (3.4)			565 (2.9)			538 (3.4)		

▲ Average from more recent year significantly higher

▽ Average from more recent year significantly lower

See Appendix B.5 for sampling guidelines and sampling participation notes † and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.18, International Results in Mathematics and Science

Looking at trends over time, the performance score on the Knowing domain has varied between the different TIMSS cycles, but there has been no significant change in the performance on this domain (see Table 5.6). For the Applying domain, there have been significant changes, but with no clear trend over time. Indeed, the average scale score for Applying in 2019 was the same as in 2011. In contrast, the Reasoning domain for mathematics has demonstrated a clear performance trend since 2011. The scale score for Reasoning items increased from 538 in 2011 to 558 in 2019, with significant increases between each of the TIMSS cycles. Note that despite this, pupils in Northern Ireland still performed less well on Reasoning items relative to their overall mean score, but the significant upward trend in performance on this domain suggests pupils' use of reasoning skills to answer mathematics questions continues to improve.

5.3.2 Attainment in the science cognitive domains

In comparison to mathematics, the performance on the science cognitive domains relative to the mean scale score varied less. The performance on each of the three domains was no more than five scale points different from the mean scale score of 518 (see Table 5.7). Performance on the Knowing and Reasoning domains was not significantly different from the overall mean (523 and 519, respectively), while performance on the Applying domain was significantly lower, with a score of 514.

Table 5.7 Y6 attainment in the Science cognitive domains

Country	Overall Science Average Scale Score	Knowing (69 Items)		Applying (64 Items)		Reasoning (36 Items)	
		Average Scale Score 2019	Difference from Overall Science Score	Average Scale Score 2019	Difference from Overall Science Score	Average Scale Score 2019	Difference from Overall Science Score
† Northern Ireland	518 (2.3)	523 (2.9)	4 (2.7)	514 (2.3)	-4 (1.2) ▽	519 (3.2)	1 (2.1)

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

See Appendix B.5 for sampling guidelines and sampling participation notes † and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 2.17, International Results in Mathematics and Science

Internationally, the only clear pattern to emerge was lower relative performance on the Applying domain. Northern Ireland was one of 22 participating countries to perform less well on the Applying domain, compared to only nine countries that performed significantly better[22]. Among the comparators, Canada demonstrated the same pattern as Northern Ireland across all three cognitive domains, while England, Finland and Hong Kong also performed significantly less well in the Applying domain.

Table 5.8 Difference in attainment in the Science cognitive domains between 2011, 2015 and 2019

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			Applying			Reasoning		
	Average Scale Score	Differences Between Years		Average Scale Score	Differences Between Years		Average Scale Score	Differences Between Years	
		2015	2011		2015	2011		2015	2011
Northern Ireland									
† 2019	523 (2.9)	5	6	514 (2.3)	-5	-7 ▽	519 (3.2)	-1	16 ▲
‡ 2015	518 (2.9)		1	519 (2.9)		-3	520 (2.6)		17 ▲
† 2011	517 (3.1)			521 (2.8)			503 (3.2)		

▲ Average from more recent year significantly higher
▽ Average from more recent year significantly lower

See Appendix B.5 for sampling guidelines and sampling participation notes † and ‡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 2.18, International Results in Mathematics and Science

The average scale score for all of these science domains for Northern Ireland has not changed significantly since the 2015 TIMSS cycle (see Table 5.8), when there was a 'flat' profile (only two scale points difference between all of the domains and the overall average). However, there is some evidence of longer-term trends when comparing the three TIMSS cycles in which Northern Ireland has participated. Performance on the science Reasoning domain has increased significantly, by 16 points, from 2011 to 2019,

[22] Data from 51 of the 58 participating countries is included in the international analysis of the science cognitive domains.

while performance on the Applying domain has fallen significantly, by seven points, over the same time period.

5.4 Attainment by gender

5.4.1 Attainment by gender in mathematics content and cognitive domains

As was the case in 2011 and 2015, Northern Ireland has no significant gender differences in the Y6 mathematics content domains (Table 5.9) or cognitive domains (Table 5.10). This equality of attainment between boys and girls is unusual internationally and the International Average performance for boys is significantly higher than for girls on all content and cognitive domains for mathematics, except for the Data domain.

Table 5.9 Gender differences in the Y6 Mathematics content domains

Country	Number (83 Items)		Measurement and Geometry (52 Items)		Data (36 Items)	
	Girls	Boys	Girls	Boys	Girls	Boys
† Northern Ireland	571 (3.6)	574 (3.8)	551 (3.8)	560 (3.7)	564 (3.1)	564 (4.0)
International Average	**506 (0.5)**	**510 (0.5) ▲**	**501 (0.6)**	**508 (0.6) ▲**	**499 (0.7)**	**500 (0.6)**

▲ Average significantly higher than other gender

Numbers of items are based on the TIMSS 2019 fourth grade mathematics eAssessment items included in scaling.
See Appendix B.5 for sampling guidelines and sampling participation notes †.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.16, International Results in Mathematics and Science

Table 5.10 Gender differences in the Y6 Mathematics cognitive domains

Country	Knowing (59 Items)		Applying (74 Items)		Reasoning (38 Items)	
	Girls	Boys	Girls	Boys	Girls	Boys
† Northern Ireland	570 (4.0)	579 (4.2)	565 (3.4)	564 (3.7)	556 (3.2)	561 (3.9)
International Average	**500 (0.6)**	**507 (0.5) ▲**	**505 (0.6)**	**506 (0.5) ▲**	**500 (0.6)**	**507 (0.6) ▲**

▲ Average significantly higher than other gender

Numbers of items are based on the TIMSS 2019 fourth grade mathematics eAssessment items included in scaling.
See Appendix B.5 for sampling guidelines and sampling participation notes †.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 1.19, International Results in Mathematics and Science

Among the comparator countries, Finland and the Republic of Ireland also had no significant gender difference on any of the mathematics content or cognitive domains. In contrast, Canada had significant gender differences in all content and cognitive domains, with boys performing better. For the remaining five comparator countries, the picture was more varied: each one demonstrated significant gender differences in one or more of the mathematics content and cognitive domains, again favouring the performance of boys.

5.4.2 Attainment by gender in science content and cognitive domains

There were no significant gender differences in the performance of pupils in Northern Ireland in 2019 across the science content domains (see Table 5.11). However, in the cognitive domains girls performed significantly better on Reasoning items (Table 5.12). This is similar to the pattern of performance between boys and girls that was seen in 2015.

Table 5.11 Gender differences in the Y6 Science content domains

Country	Life Science (73 Items)		Physical Science (61 Items)		Earth Science (35 Items)	
	Girls	Boys	Girls	Boys	Girls	Boys
† Northern Ireland	523 (3.9)	517 (4.2)	510 (2.7)	512 (2.9)	521 (3.2)	528 (3.9)
International Average	**510 (0.5)** ▲	**503 (0.5)**	**504 (0.6)**	**506 (0.6)** ▲	**499 (0.6)**	**503 (0.6)** ▲

▲ Average significantly higher than other gender

Numbers of items are based on the TIMSS 2019 fourth grade science eAssessment items included in scaling.
See Appendix B.5 for sampling guidelines and sampling participation notes †.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 2.16, International Results in Mathematics and Science

Table 5.12 Gender differences in the Y6 Science cognitive domains

Country	Knowing (69 Items)		Applying (64 Items)		Reasoning (36 Items)	
	Girls	Boys	Girls	Boys	Girls	Boys
† Northern Ireland	521 (3.7)	525 (3.7)	514 (3.6)	514 (3.3)	525 (3.9) ▲	514 (4.0)
International Average	**507 (0.6)**	**510 (0.5)** ▲	**509 (0.5)** ▲	**506 (0.5)**	**512 (0.6)** ▲	**506 (0.6)**

▲ Average significantly higher than other gender

Numbers of items are based on the TIMSS 2019 fourth grade science eAssessment items included in scaling.
See Appendix B.5 for sampling guidelines and sampling participation notes †.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Source: Exhibit 2.19, International Results in Mathematics and Science

As with mathematics, this equality does not reflect the picture internationally. The International Average indicates that girls performed significantly better than boys in Life Science, whereas boys scored significantly higher in Physical Science and Earth Science. Internationally, in the cognitive domains, boys scored significantly higher in the Knowing domain, while girls scored significantly higher in both the Applying and Reasoning domains.

Among the comparator countries, only England showed the same pattern as Northern Ireland in science, with no significant gender differences except for better performance by girls on Reasoning items. There was a mixed pattern across the other comparator countries, with the only clear trend being that boys performed significantly higher on Earth Science in all of the comparator countries, apart from England and Finland.

5.5 Conclusion

Chapter 1 indicated that Northern Ireland's pupils have scored consistently above the International Average in both mathematics and science, performing particularly well in mathematics. Even so, within this overall high achievement, areas of relative strength and weakness within these subjects can be identified.

In terms of content domains, the analysis allows us to identify areas of relative strength and areas that may need development. In mathematics, pupils did significantly better on Number and less well on Measurement and Geometry. In science, they did better in Earth Science and less well in Physical Science.

For the mathematics cognitive domains, which define the skills demonstrated in each subject, pupils performed better on the Knowing domain compared to their overall mean performance and less well on the Reasoning domain. Only a small number of mainly high-performing countries (including the comparators England, Korea and Singapore) performed better in the Knowing domain, while nearly half of countries performed less well in Reasoning (including the comparators Republic of Ireland and Singapore), reflecting the higher cognitive demand of these items. In science, pupils in Northern Ireland performed less well in the Applying skills, as did pupils in over a third of the other countries, including the comparators Canada, England, Finland and Hong Kong.

Since the previous TIMSS cycle in 2015, there have been some statistically significant changes in Northern Ireland's performance across the content and cognitive domains. In mathematics, performance on Measurement and Geometry has decreased. For the cognitive domains, performance on Reasoning has increased and performance on Applying has decreased. In science, there was a more stable picture, with no significant changes in performance in the content and cognitive domains.

TIMSS 2019 was the third time that Y6 pupils in Northern Ireland have participated in the study and this allows us to identify some longer-term trends.

- In mathematics, there have been significant improvements in performance on the Data domain and on Reasoning skills over this time period.
- In science, there have been significant improvements in performance on Earth Science and, as was the case in mathematics, an improvement to the scores in Reasoning. There has also been a less pronounced, but still significant decline in Applying skills.

Northern Ireland deviated from to the international pattern in terms of gender differences for mathematics and science – there was only one case of significant gender difference (girls performed better at Reasoning tasks in science), indicating that there is gender equality in attainment in mathematics and science for pupils in Northern Ireland.

6 Pupil attitudes to mathematics and science learning

Chapter outline

This chapter summarises Year 6 (Y6, ages 9-10) pupils' attitudes towards mathematics and science, and their confidence in these subjects. This chapter also explores the clarity with which teachers convey the mathematics and science curriculum to pupils, and teachers' 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 countries where relevant.

Key findings

- In Northern Ireland and within countries internationally, the pupils who most liked mathematics and science had higher average achievement scores.
- There was a higher proportion of pupils in Northern Ireland (and internationally) who *Very much like learning science* than *Very much like learning mathematics.*
- The proportion of pupils internationally who *Very much like learning mathematics* was higher than in Northern Ireland. The proportions who *Very much like learning science* were more similar.
- In Northern Ireland and internationally, pupils who were categorised as *Very confident* in mathematics and science also had higher achievement scores.
- Countries with the highest performing pupils overall in mathematics had a low proportion of pupils categorised as *Very confident*. This is evident in the data from four of the five highest-performing countries: Korea, Chinese Taipei, Japan and Hong Kong.
- In Northern Ireland, pupils' attitudes towards mathematics and science were similar to those seen in 2015.

- Northern Ireland had the highest proportion of pupils reporting *High clarity of instruction* in their mathematics and science lessons across the comparator countries except the Republic of Ireland which had a similar proportion.
- In Northern Ireland, in mathematics, there was an association between clarity in lessons and pupils' achievement; this pattern was not seen for science.
- In Northern Ireland, both in mathematics and science, the most common instructional practices used *Every or almost every lesson* by teachers were asking pupils to explain their answers and linking new content to pupils' prior knowledge.
- Compared to the International Average, more pupils in Northern Ireland had teachers encouraging classroom discussions among pupils *Every or almost every lesson* but fewer pupils had teachers relating the lesson to the pupils' daily lives and bringing interesting materials to class regularly; this was the case for both mathematics and science.

6.1 Pupils' attitudes to mathematics and science

Interpreting the data: indices and scales

In order to summarise data from a questionnaire, responses to several related items can be 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 are often considered to be more reliable and valid than the responses to individual items.

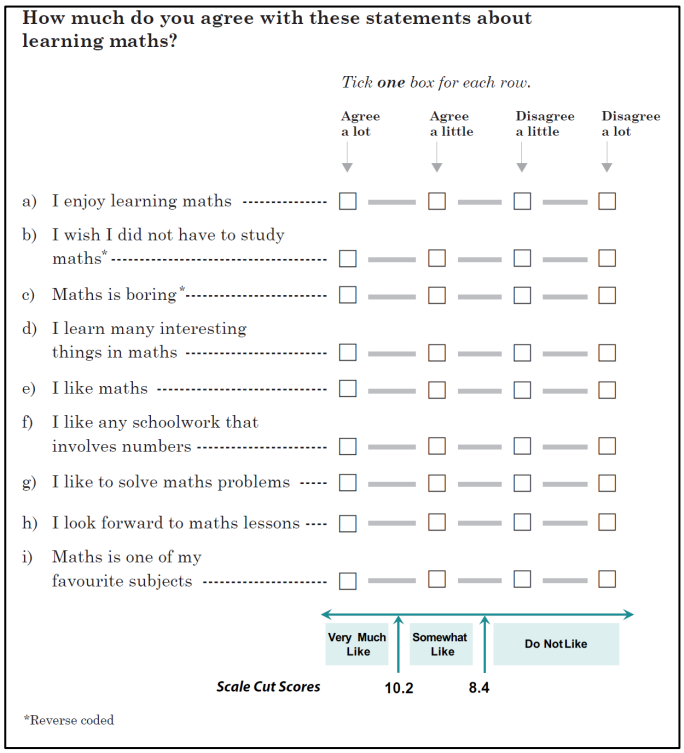
Interpreting the data: differences

In this section, we do not report whether differences are statistically significant as, due to the large sample sizes, small differences can be statistically significant but not meaningful from a policy or practice perspective. Instead, we report on the size of differences. Throughout the remainder of the chapter, differences of three percentage points or less may be described as similar, differences of four to six percentage points as small, differences of seven to nine percentage points as moderate, and differences of 10 or more percentage points as large.

6.1.1 Pupils' attitudes: liking the subject, mathematics

Pupils' attitudes to mathematics were measured by their responses to nine statements about learning the subject (these statements can be seen in Figure 6.1). The international analysis uses responses to these statements to create the *Students like learning mathematics scale*. Pupils were categorised into three bands: *Very much like learning mathematics*, *Somewhat like learning mathematics* and *Do not like learning mathematics* (details of how pupils were assigned to each band are provided in Figure 6.1).

Figure 6.1 Pupils like learning Mathematics scale



Source: Exhibit 11.1, TIMSS 2019 International Results in Mathematics and Science and adapted from the international version of the TIMSS 2019 Pupil Questionnaire.

Table 6.1 shows the proportions of pupils categorised as *Very much liking*, *Somewhat liking* and *Not liking* mathematics, together with the mean achievement score of pupils in each of these categories. Data is provided for Northern Ireland and for comparator countries, and countries are listed in descending order of the proportion of pupils expressing the most positive attitude. It is worth noting that there have been some small

changes to the categories and cut scores (defined in Table 6.1) since 2015 and therefore some caution should be taken when interpreting trends over time[23].

Table 6.1 Pupils like learning Mathematics

Reported by pupils

Students were scored according to their responses to nine statements on the *Students Like Learning Mathematics scale*. Cut scores divide the scale into three categories. Students who **Very Much Like Learning Mathematics** had a score at or above the cut score corresponding to "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 at or below the cut score corresponding to "disagreeing a little" with five of the nine statements and "agreeing a little" with the other four, on average. All other students **Somewhat Like Learning Mathematics**.

Country	Very Much Like Learning Mathematics		Somewhat Like Learning Mathematics		Do Not Like Learning Mathematics		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
England	44 (1.6)	576 (4.4)	34 (1.1)	549 (4.4)	23 (1.1)	530 (3.8)	9.9 (0.07)
Canada	38 (0.9)	531 (2.9)	38 (0.8)	508 (2.1)	25 (0.6)	485 (2.5)	9.7 (0.04)
Singapore	37 (0.9)	654 (3.5)	40 (0.7)	618 (4.4)	23 (0.8)	594 (4.1)	9.7 (0.04)
Ireland, Rep. of	35 (1.1)	566 (2.9)	37 (1.0)	549 (3.2)	28 (1.1)	529 (3.3)	9.5 (0.05)
Northern Ireland	31 (1.2)	589 (4.0)	39 (1.1)	572 (3.6)	30 (1.2)	535 (3.8)	9.4 (0.05)
Hong Kong SAR	30 (1.3)	626 (4.9)	38 (1.2)	596 (3.9)	32 (1.4)	585 (3.9)	9.3 (0.06)
Poland	28 (1.0)	544 (3.4)	41 (0.8)	517 (3.1)	31 (1.2)	505 (3.4)	9.2 (0.05)
Finland	28 (0.9)	546 (3.8)	41 (0.7)	535 (2.8)	31 (0.9)	518 (3.2)	9.2 (0.04)
Korea, Rep. of	22 (0.9)	631 (3.2)	38 (1.1)	607 (3.0)	40 (1.1)	576 (2.9)	8.9 (0.04)
International Average	**45 (0.2)**	**520 (0.5)**	**35 (0.1)**	**491 (0.6)**	**20 (0.1)**	**479 (0.7)**	

This TIMSS context 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.

Source: Exhibit 11.2, TIMSS 2019 International Results in Mathematics and Science

In Northern Ireland, 31 per cent of Y6 pupils were in the highest category of *Very much like learning mathematics,* compared to the International Average of 45 per cent of pupils; a large difference. Comparing the findings from 2019 and 2015, there was a small decrease in the percentage of pupils in the highest category on this scale, the equivalent figure in 2015 was 35 per cent.

In 2019, the percentage of pupils in Northern Ireland who *Very much like learning mathematics* was similar to Hong Kong (30 per cent), Poland (28 per cent) and Finland (28 per cent). There was a small difference in the percentage of pupils in this highest category between Northern Ireland and the Republic of Ireland (35 per cent) and Singapore (37 per cent). Notably in England, pupils had a more positive attitude to mathematics than pupils in Northern Ireland. Forty-four per cent of pupils in England reported *Very much like learning mathematics* compared to 31 per cent of pupils in Northern Ireland, a large difference of 13 percentage points.

[23] In 2015 pupils answered the same nine statements as in 2019 but their responses were spilt into three categories: *Very much like learning mathematics, Like learning mathematics and Do not like learning mathematics*. Pupils who *Very much like learning mathematics* had a score on the scale of at least 10.1 and pupils who *Do not like learning mathematics* had a score no higher than 8.3.

In Northern Ireland, the average achievement score for the 31 per cent of pupils categorised in the *Very much like learning mathematics* band was 589. Thirty per cent of Y6 pupils were in the *Do not like learning mathematics* category, and, at 535, the average achievement score for these pupils was 54 score points lower than those in the *Very much like learning mathematics* category. Both for Northern Ireland and within countries internationally, the data mirrors what was seen in 2015 and 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 standard errors, the differences in achievement scores for Northern Ireland are likely to be statistically significant. The direction of causality cannot be inferred from this data. Pupils may perform better in mathematics because they like learning the subject, but this relationship could also work in the opposite direction; pupils who perform better in mathematics may have a more positive attitude to their lessons, and may respond to the statements about whether they like learning the subject more positively than other pupils.

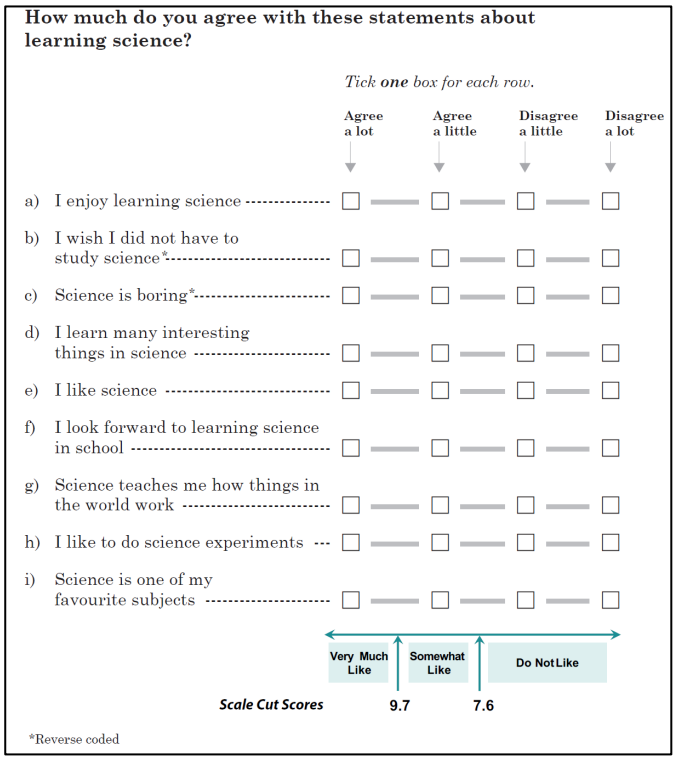
6.1.2 Pupils' attitudes: liking the subject, science

In Northern Ireland, over half of pupils (56 per cent) were in the highest category of the *Students like learning science* scale, as shown in Table 6.2. This was a much higher percentage than for mathematics in Northern Ireland and similar to that seen in 2015 (59 per cent).

For this scale, pupils were scored according to their responses to nine statements about learning science. Based on their responses, pupils were categorised into three bands: *Very much like learning science, Somewhat like learning science* and *Do not like learning science*. The statements and details on how pupils were assigned to bands are provided in Figure 6.2. It is worth noting that there have been a few changes to the categories and cut scores (defined in Table 6.2) since 2015 and therefore some caution should be taken when interpreting trends over time[24].

[24] In 2015 pupils answered the same nine statements as in 2019 but their responses were split into three categories: *Very much like learning science, Like learning science and Do not like learning science*. Pupils who *Very much like learning science* had a score on the scale of at least 9.6 and pupils who *Do not like learning mathematics* had a score no higher than 7.6.

Figure 6.2 Pupils like learning Science scale



Source: Exhibit 11.4, TIMSS 2019 International Results in Mathematics and Science and adapted from the international version of the TIMSS 2019 Pupil Questionnaire.

Among the comparator group of countries, Northern Ireland had the joint-highest percentage of pupils in the *Very much like learning science* band with the Republic of Ireland. This was followed by Singapore, Hong Kong and Canada (all with 49 per cent) and England (46 per cent). Finland had the lowest percentage of pupils classified in the highest band, with just over a quarter of pupils having a very positive attitude to science. This mirrors what was seen in 2015, where Northern Ireland had the highest percentage of pupils in the highest band of the *Students like learning science* scale.

Table 6.2 Pupils like learning Science

Reported by pupils

Students were scored according to their responses to nine statements on the *Students Like Learning Science scale*. Cut scores divide the scale into three categories. Students who **Very Much Like Learning Science** had a score at or above the cut score corresponding to "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 at or below the cut score corresponding to "disagreeing a little" with five of the nine statements and "agreeing a little" with the other four, on average. All other students **Somewhat Like Learning Science**.

Country	Very Much Like Learning Science		Somewhat Like Learning Science		Do Not Like Learning Science		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Ireland, Rep. of	56 (1.3)	537 (3.3)	33 (1.0)	523 (4.0)	12 (0.7)	507 (5.2)	10.2 (0.06)
Northern Ireland	56 (1.1)	530 (2.4)	33 (1.0)	510 (3.4)	11 (0.7)	487 (4.5)	10.2 (0.05)
Singapore	49 (1.0)	605 (3.6)	39 (0.7)	588 (3.9)	12 (0.5)	574 (4.7)	10.0 (0.04)
Hong Kong SAR	49 (1.5)	547 (3.5)	37 (1.2)	519 (4.8)	15 (1.0)	509 (6.7)	10.0 (0.08)
Canada	49 (1.0)	528 (2.2)	36 (0.8)	524 (2.2)	15 (0.6)	511 (2.8)	9.9 (0.05)
England	46 (1.6)	542 (3.7)	37 (1.2)	540 (3.6)	16 (1.1)	528 (4.8)	9.8 (0.09)
Poland	38 (1.3)	541 (3.3)	44 (1.0)	527 (2.8)	18 (0.9)	528 (3.7)	9.3 (0.06)
Korea, Rep. of	37 (1.3)	602 (2.7)	47 (0.9)	581 (2.8)	16 (1.0)	572 (3.6)	9.5 (0.06)
Finland	26 (1.0)	554 (3.2)	45 (0.9)	556 (3.1)	29 (1.1)	554 (3.1)	8.7 (0.05)
International Average	**52 (0.2)**	**506 (0.5)**	**36 (0.1)**	**478 (0.6)**	**12 (0.1)**	**467 (0.9)**	

This TIMSS context 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.

Source: Exhibit 11.5, TIMSS 2019 International Results in Mathematics and Science

In Northern Ireland, the average achievement score for the 56 per cent of pupils in the *Very much like learning science* category was 530, whereas the average achievement score for the 11 per cent of pupils in the *Do not like learning science* category was lower at 487 (see Table 6.2). As with mathematics, in Northern Ireland the lower the level of liking science, the lower the achievement scores. This is also the pattern seen internationally, and mirrors what was seen in 2015 and 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.

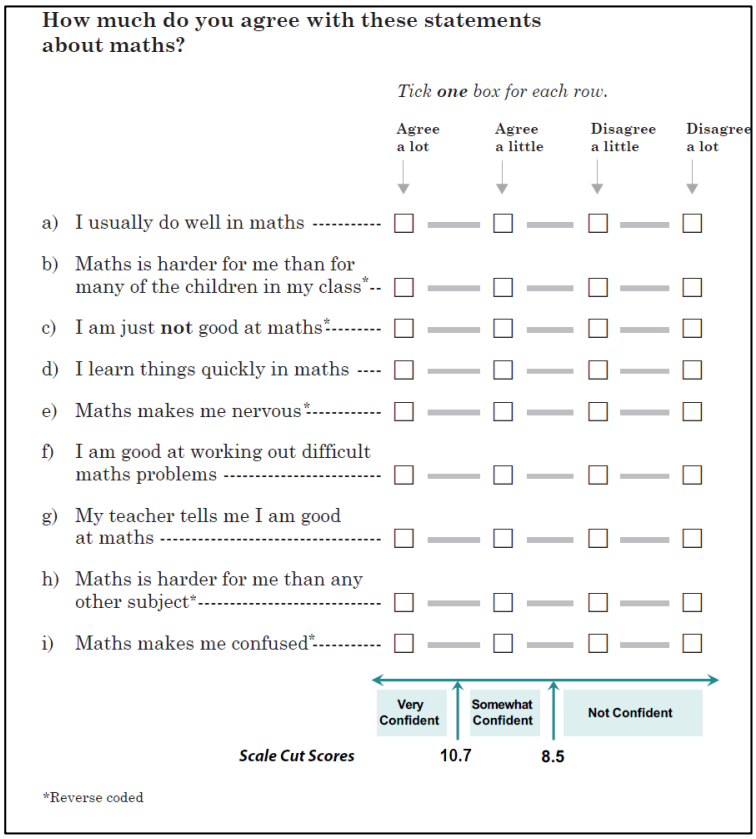
6.2 Pupils' confidence in mathematics and science

6.2.1 Pupils' confidence in mathematics

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 split into one of the three categories (details of the statements used and how pupils were assigned to each category are provided in Figure 6.3). It is worth noting that there have been small changes to the categories and cut scores since 2015 and therefore some caution should be taken when interpreting trends over time[25].

[25] In 2015 pupils answered the same nine statements as in 2019. Their responses were split into three categories: *Very Confident in Mathematics, Confident in Mathematics* and *Not Confident in Mathematics*. Pupils who were *Very Confident in Mathematics* had a score on the scale of at least 10.6 and pupils who were *Not confident in Mathematics* had a score no higher than 8.5

Figure 6.3 Pupils confident in Mathematics scale



Source: Exhibit 11.7, TIMSS 2019 International Results in Mathematics and Science and adapted from the international version of the TIMSS 2019 Pupil Questionnaire.

Table 6.3 shows the percentages of pupils in Northern Ireland and across comparator countries in each category on the *Students confident in mathematics scale*. In this table, countries are listed in descending order of the proportion of pupils expressing more confidence in the subject. In Northern Ireland, 29 per cent of pupils were in the highest category of being *Very confident in mathematics*, with 45 per cent in the *Somewhat confident* category and 26 per cent categorised as *Not confident in mathematics*. The percentage of pupils in the highest band of the scale was similar to 2015 (31 per cent).

Table 6.3 Pupils confident in Mathematics

Reported by pupils

Students were scored according to their responses to nine statements on the *Students Confident in Mathematics scale*. Cut scores divide the scale into three categories. **Students Very Confident in Mathematics** had a score at or above the cut score corresponding to "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 at or below the cut score corresponding to "disagreeing a little" with five of the nine statements and "agreeing a little" with the other four, on average. All other students were **Somewhat Confident in Mathematics**.

Country	Very Confident in Mathematics		Somewhat Confident in Mathematics		Not Confident in Mathematics		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Ireland, Rep. of	33 (0.7)	585 (3.0)	45 (1.0)	545 (3.0)	22 (0.9)	503 (3.3)	10.0 (0.03)
Finland	32 (0.9)	573 (2.5)	50 (0.9)	524 (2.7)	17 (0.7)	481 (3.4)	10.1 (0.03)
Canada	32 (0.5)	555 (2.4)	45 (0.6)	506 (2.3)	24 (0.6)	464 (2.2)	10.0 (0.03)
England	31 (1.2)	607 (4.5)	45 (1.0)	549 (3.7)	24 (1.0)	506 (4.2)	9.9 (0.05)
Northern Ireland	29 (1.0)	613 (3.8)	45 (1.0)	569 (3.2)	26 (0.8)	510 (3.8)	9.8 (0.04)
Poland	23 (0.8)	571 (3.5)	47 (0.9)	526 (2.7)	30 (1.0)	476 (2.8)	9.5 (0.04)
Singapore	21 (0.9)	683 (2.9)	42 (0.8)	637 (3.9)	37 (1.2)	579 (3.4)	9.3 (0.05)
Hong Kong SAR	18 (0.8)	652 (4.2)	43 (1.1)	606 (3.6)	39 (1.2)	573 (3.7)	9.2 (0.05)
Korea, Rep. of	15 (0.7)	651 (2.6)	49 (1.1)	614 (2.5)	36 (0.9)	559 (2.7)	9.2 (0.03)
International Average	**32 (0.1)**	**545 (0.6)**	**44 (0.1)**	**497 (0.5)**	**23 (0.1)**	**456 (0.6)**	

This TIMSS context 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.

Source: Exhibit 11.8, TIMSS 2019 International Results in Mathematics and Science

Among the group of comparator countries, Northern Ireland had a similar percentage of pupils categorised as *Very confident in mathematics* as England (31 per cent), Canada and Finland (both 32 per cent). The Republic of Ireland had the largest percentage of pupils in this category (33 per cent), a small increase on the equivalent percentage in Northern Ireland.

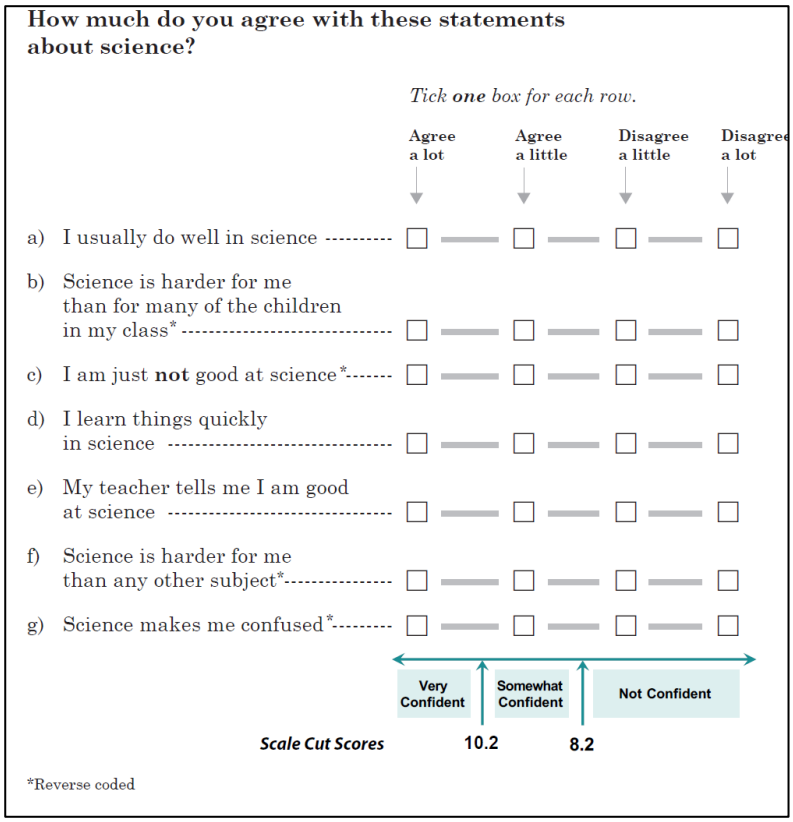
Among the highest performing countries in mathematics at this age group, the overall levels of pupils' confidence are fairly low. Four of the five countries with the highest mathematics achievement (Korea, Chinese Taipei, Japan and Hong Kong) were among the five countries with the lowest percentage (below 20 per cent) of pupils categorised as *Very confident in mathematics*. The data from 2015 and 2011 showed a similar relationship between pupil confidence and national performance.

As with pupil attitudes, the findings show that, within each country, as pupil confidence increases, 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* the average achievement was 613 and among the pupils who were classified as *Not confident in mathematics* the average achievement was lower at 510. This reflects what was seen in 2015 and 2011. The differences in achievement data are likely to be statistically significant across the three categories. As with 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 that pupils who are better at mathematics are more confident in the subject.

6.2.2 Pupils' confidence in science

Pupil confidence was measured by responses to eight statements on the *Students confident in science* scale. Based on their responses, pupils were categorised into three bands (See Figure 6.4 for details of the statements and how the scale was derived). It is worth noting that there have been a few changes to the categories since 2015 and therefore some caution should be taken when interpreting trends over time[26].

Figure 6.4 Pupils' confident in Science scale



Source: Exhibit 11.10, TIMSS 2019 International Results in Mathematics and Science and adapted from the international version of the TIMSS 2019 Pupil Questionnaire.

In Northern Ireland, 29 per cent of pupils were categorised as being *Very confident in science*, with 49 per cent categorised as *Somewhat confident in science*, and 22 per cent categorised as *Not confident in science* (see Table 6.4). The percentage of pupils in the highest category was moderately lower than in 2015 (36 per cent).

[26] In 2015 pupils answered the same statements as in 2019. Their responses were split into three categories: *Very confident in science, Confident in science* and *Not confident in science*. As in 2019, pupils who were *Very confident in science* had a score on the scale of at least 10.2 and pupils who were *Not confident in science* had a score no higher than 8.2.

Table 6.4 Pupils confident in Science

Reported by pupils

Students were scored according to their responses to eight statements on the *Students Confident in Science scale*. Cut scores divide the scale into three categories. Students **Very Confident in Science** had a score at or above the cut score corresponding to "agreeing a lot" with four of the eight statements and "agreeing a little" with the other four, on average. Students who were **Not Confident in Science** had a score at or below the cut score corresponding to "disagreeing a little" with four of the eight statements and "agreeing a little" with the other four, on average. All other students were **Somewhat Confident in Science**.

Country	Very Confident in Science		Somewhat Confident in Science		Not Confident in Science		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Canada	35 (0.7)	540 (2.4)	46 (0.7)	523 (2.1)	19 (0.7)	498 (2.5)	9.7 (0.03)
Ireland, Rep. of	35 (0.9)	542 (4.0)	48 (0.9)	529 (3.9)	18 (0.9)	502 (4.4)	9.7 (0.04)
Poland	32 (1.2)	553 (3.3)	49 (0.9)	531 (2.8)	19 (0.8)	503 (3.6)	9.6 (0.05)
Northern Ireland	29 (1.0)	536 (3.1)	49 (0.9)	523 (2.9)	22 (0.8)	487 (4.1)	9.4 (0.04)
England	28 (1.0)	559 (4.2)	47 (1.0)	538 (3.2)	25 (1.2)	516 (3.9)	9.4 (0.05)
Finland	27 (0.8)	573 (3.4)	57 (0.9)	555 (2.6)	16 (0.7)	525 (4.0)	9.5 (0.03)
Singapore	23 (0.6)	626 (3.6)	44 (0.7)	599 (3.6)	33 (0.7)	567 (3.9)	9.1 (0.03)
Hong Kong SAR	23 (0.9)	562 (3.9)	49 (1.1)	532 (3.5)	29 (1.2)	506 (4.9)	9.2 (0.05)
Korea, Rep. of	17 (0.8)	620 (3.1)	59 (1.1)	587 (2.6)	23 (1.0)	564 (3.2)	9.1 (0.03)
International Average	**38 (0.2)**	**520 (0.6)**	**43 (0.1)**	**486 (0.6)**	**19 (0.1)**	**453 (0.7)**	

This TIMSS context 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.

Source: Exhibit 11.11, TIMSS 2019 International Results in Mathematics and Science

Among the comparator countries Poland, England and Finland had similar percentages of pupils categorised as *Very confident in science* (32 per cent, 28 per cent and 27 per cent respectively) as was found in Northern Ireland. Canada and the Republic of Ireland had the highest percentage of pupils in the highest category on this scale (35 per cent). Despite being one of the top-performing countries in science, a third of pupils in Singapore were *Not confident in science,* the highest percentage across the comparator countries in this category.

As was the case in 2015 and 2011, within each participating country, pupil achievement was higher among those pupils with a higher level of confidence. In Northern Ireland, among the pupils who were found to be *Very confident in science,* the average achievement was 536, and among the pupils who were found to be *Not confident in science* the average achievement was lower at 487. The differences in achievement data are likely to be statistically significant across the three categories. This pattern is also true internationally: as the level of pupils' confidence decreases, so do the average achievement scores.

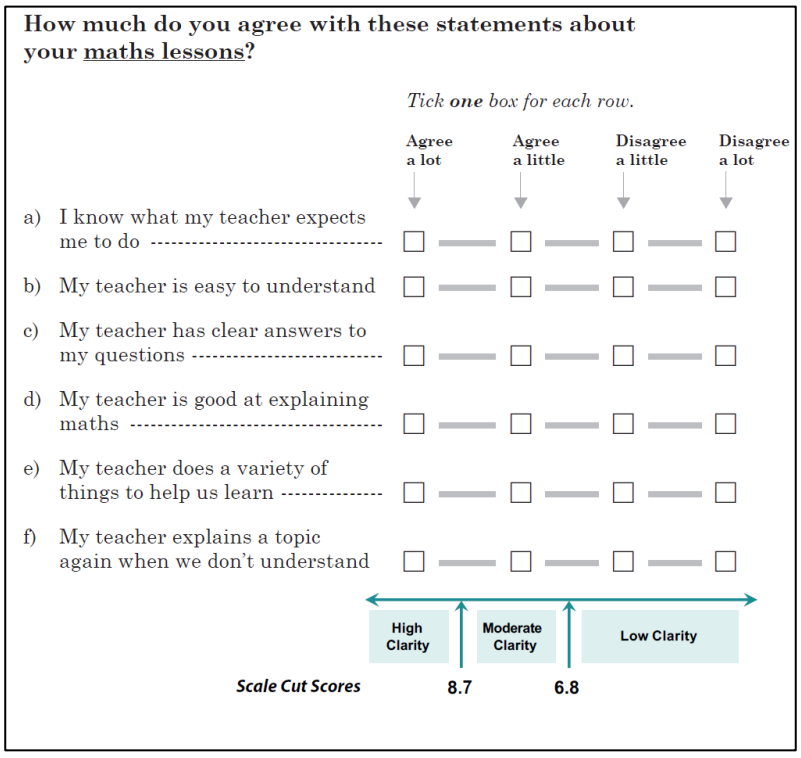
6.3 Instructional clarity in mathematics and science lessons

The *Instructional clarity in mathematics and science lessons* scales are new to 2019, but the statements comprising the scale may look familiar. Five of the statements appeared as part of the TIMSS 2015 *Students' views on engaging teaching* scales, which indicated pupils' engagement in mathematics and science lessons. For 2019 the focus has shifted to instructional clarity (Mullis and Martin, 2017) and is, therefore, not directly comparable.

6.3.1 Instructional clarity in mathematics lessons

Whether a teacher is able to clearly convey the curriculum to their pupils can have a significant impact on their learning. TIMSS 2019 explores the relationship between instructional clarity and learning by asking pupils about particular aspects of teaching during their mathematics lessons: whether they know what their teacher expects them to do; whether their teacher is easy to understand; has clear answers to their questions; is good at explaining mathematics; does a variety of things to help them learn; and explains a topic again when the pupils do not understand. Instructional clarity was measured by pupils' responses to these six statements about their mathematics lessons. The international analysis used responses to these statements to create the *Instructional clarity in mathematics lessons* scale. Pupils were then categorised into three bands *High clarity of instruction, Moderate clarity of instruction* and *Low clarity of instruction* (further details of these statements and how pupils were assigned to each band are provided in Figure 6.5).

Figure 6.5 Instructional clarity in Mathematics lessons scale



Source: Exhibit 12.8, TIMSS 2019 International Results in Mathematics and Science and adapted from the international version of the TIMSS 2019 Pupil Questionnaire.

As shown in Table 6.5, 80 per cent of pupils in Northern Ireland reported *High clarity of instruction*, 17 per cent reported *Moderate clarity of instruction* and only three per cent reported *Low clarity of instruction.* Compared with the comparator countries, Northern Ireland had the highest percentage of pupils in the highest band for this scale, with only the Republic of Ireland having a similar percentage (77 per cent).

Table 6.5 Instructional clarity in Mathematics lessons

Reported by pupils

Students were scored according to their responses to seven statements on the *Instructional Clarity in Mathematics Lessons scale*. Cut scores divide the scale into three categories. Students who reported **High Clarity of Instruction** in their mathematics lessons had a score at or above the cut score corresponding to "agreeing a lot" with four of the seven statements and "agreeing a little" with the other three, on average. Students who reported **Low Clarity of Instruction** in their mathematics lessons had a score at or below the cut score corresponding to "disagreeing a little" with four of the seven statements and "agreeing a little" with the other three, on average. All other students reported **Moderate Clarity of Instruction** in their mathematics lessons.

Country	High Clarity of Instruction		Moderate Clarity of Instruction		Low Clarity of Instruction		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland	80 (1.2)	571 (2.9)	17 (1.0)	552 (5.3)	3 (0.4)	527 (9.8)	10.2 (0.05)
Ireland, Rep. of	77 (1.2)	551 (2.5)	20 (0.9)	544 (3.9)	3 (0.5)	528 (8.9)	10.1 (0.06)
England	76 (1.1)	561 (3.6)	21 (0.9)	548 (4.5)	4 (0.5)	524 (9.4)	10.0 (0.05)
Canada	75 (0.8)	514 (2.1)	21 (0.7)	505 (3.0)	4 (0.3)	481 (4.8)	10.0 (0.04)
Singapore	66 (1.0)	637 (3.7)	28 (0.8)	608 (4.6)	6 (0.4)	582 (6.4)	9.6 (0.05)
Finland	65 (1.1)	538 (2.4)	30 (1.0)	526 (3.6)	5 (0.4)	506 (5.8)	9.5 (0.05)
Poland	60 (1.1)	527 (3.0)	32 (0.9)	517 (3.1)	8 (0.5)	498 (4.9)	9.2 (0.05)
Hong Kong SAR	55 (1.5)	613 (3.9)	33 (1.0)	592 (3.5)	12 (1.0)	573 (7.6)	9.2 (0.07)
Korea, Rep. of	43 (1.4)	614 (2.5)	50 (1.1)	592 (2.6)	7 (0.7)	570 (5.8)	8.5 (0.05)
International Average	**74 (0.2)**	**508 (0.5)**	**21 (0.1)**	**488 (0.7)**	**5 (0.1)**	**466 (1.2)**	

This TIMSS context questionnaire scale was established in 2019 based on the combined response distribution of all countries that participated in TIMSS 2019. 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.

Source: Exhibit 12.9, TIMSS 2019 International Results in Mathematics and Science

Among the highest performing countries in mathematics at this age group, the overall levels of pupils' reporting *High clarity of instruction in mathematics* were relatively low. Japan and Korea both had high mathematics achievement among 9-10 year olds but less than half of pupils reported *High clarity of instruction in mathematics*.

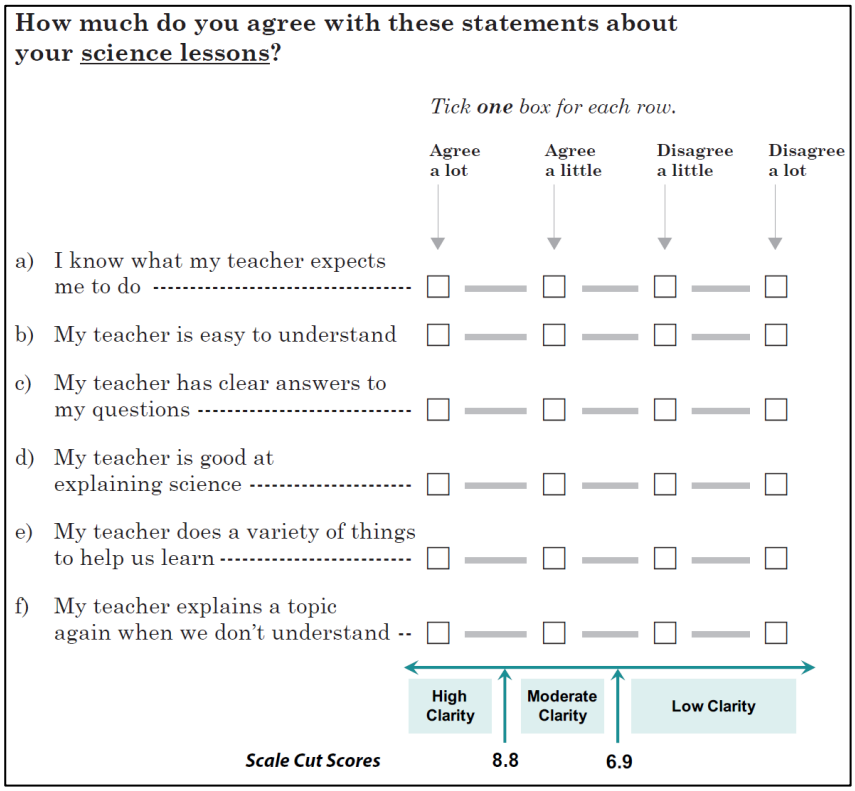
In Northern Ireland, pupils who reported *High clarity of instruction* had a higher average achievement (571) than those who reported *Moderate clarity of instruction* (552) and *Low clarity of instruction* (527). This pattern was seen across comparator countries and in general internationally. Although significance tests have not been conducted in the international analysis, based on the size of the standard errors, the differences in achievement scores for Northern Ireland are likely to be statistically significant. As noted with liking mathematics and confidence, the data cannot identify the direction of causality. It could be that pupils who perform better in mathematics are more positive about the clarity of their lessons because they understand what the teacher is trying to convey without requiring additional support or explanation, or perhaps pupils who are good at mathematics may have a stronger foundation in order to better access and understand their lessons.

6.3.2 Instructional clarity in science lessons

As in mathematics, instructional clarity was measured by pupils' responses to six statements about their science lessons. The international analysis used responses to these statements to create the *Instructional clarity in science lessons scale*. Pupils were then categorised into three bands *High clarity of instruction, Moderate clarity of*

instruction and *Low clarity of instruction* (further details of these statements and how pupils were assigned to each band are provided in Figure 6.6).

Figure 6.6 Instructional clarity in Science lessons scale



Source: Exhibit 13.8, TIMSS 2019 International Results in Mathematics and Science and adapted from the international version of the TIMSS 2019 Pupil Questionnaire.

In Northern Ireland, nearly three-quarters of pupils (73 per cent) reported *High clarity in science instruction,* 22 per cent reported *Moderate clarity* and five per cent reported *Low clarity.* Northern Ireland had the highest percentage of pupils in the highest category among comparator countries, with the exception of the Republic of Ireland where the percentage was the same.

Table 6.6 Instructional clarity in Science lessons

Reported by pupils

Students were scored according to their responses to seven statements on the *Instructional Clarity in Science Lessons scale*. Cut scores divide the scale into three categories. Students who reported **High Clarity of Instruction** in their science lessons had a score at or above the cut score corresponding to "agreeing a lot" with four of the seven statements and "agreeing a little" with the other three, on average. Students who reported **Low Clarity of Instruction** in their science lessons had a score at or below the cut score corresponding to "disagreeing a little" with four of the seven statements and "agreeing a little" with the other three, on average. All other students reported **Moderate Clarity of Instruction** in their science lessons.

Country	High Clarity of Instruction		Moderate Clarity of Instruction		Low Clarity of Instruction		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland	73 (1.2)	519 (2.4)	22 (1.0)	521 (4.2)	5 (0.5)	511 (6.9)	9.9 (0.05)
Ireland, Rep. of	73 (1.3)	530 (3.3)	21 (1.0)	525 (4.4)	6 (0.5)	529 (5.7)	9.9 (0.06)
Canada	72 (0.9)	526 (2.0)	23 (0.8)	521 (2.5)	5 (0.3)	512 (5.0)	10.0 (0.04)
England	70 (1.4)	539 (3.2)	25 (1.1)	538 (3.9)	6 (0.6)	540 (6.6)	9.9 (0.06)
Singapore	63 (1.0)	601 (3.3)	29 (0.7)	587 (4.1)	8 (0.5)	569 (6.6)	9.6 (0.04)
Finland	61 (1.2)	559 (2.7)	32 (1.1)	552 (3.3)	7 (0.6)	539 (5.5)	9.4 (0.05)
Poland	60 (1.3)	535 (2.8)	31 (0.9)	533 (3.1)	9 (0.7)	517 (6.0)	9.5 (0.06)
Hong Kong SAR	55 (1.4)	543 (3.3)	30 (1.0)	523 (3.6)	15 (1.0)	505 (7.3)	9.2 (0.07)
Korea, Rep. of	42 (1.4)	596 (2.8)	48 (1.3)	584 (2.3)	11 (1.0)	573 (5.5)	8.5 (0.05)
International Average	**72 (0.2)**	**498 (0.5)**	**22 (0.1)**	**480 (0.8)**	**6 (0.1)**	**466 (1.3)**	

This TIMSS context questionnaire scale was established in 2019 based on the combined response distribution of all countries that participated in TIMSS 2019. 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.

Source: Exhibit 13.9, TIMSS 2019 International Results in Mathematics and Science

As with mathematics, among the highest performing countries in science at this age group, the overall levels of pupils' reporting *High clarity of instruction in science* were relatively low. Japan and Korea both had high science achievement among 9-10 year olds but less than half of pupils reported *High clarity of instruction in science*.

In contrast to mathematics, there was no clear pattern in Northern Ireland or internationally between average achievement and the *Instructional clarity in science lessons* scale. In Northern Ireland, pupils who reported *High clarity of instruction* had a mean score of 519, those who reported *Moderate clarity of instruction* had a mean score of 521 and those who reported *Low clarity of instruction* had a mean score of 511. The differences in mean scores are unlikely to be significant based on the size of the standard errors.

6.4 Teachers' reported approaches to engaging pupils in mathematics and science lessons

Interpreting the data: percentages in tables

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

Y6 pupils were sampled by class. The Y6 teacher questionnaire would, in most cases therefore, 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 was not necessarily the same or the distribution of pupils within the sample of teachers may differ by subject.

In TIMSS 2019 teachers were asked how they engage pupils in lessons. They were asked how often they used eight particular instructional practices in their teaching. Table 6.7 and Table 6.8 show the percentages of pupils whose mathematics and science teachers reported using these approaches *Every or almost every lesson* in Northern Ireland and internationally for 2015 and 2019[27].

In 2019, and in 2015, the most common instructional practices used *Every or almost every lesson* by teachers in Northern Ireland were: asking pupils to explain their answers (80 per cent for both mathematics and science) and linking new content to pupils' prior knowledge (81 per cent for both mathematics and science). These practices were also common internationally. The least common instructional practice used *Every or almost every lesson* by teachers in Northern Ireland was bringing interesting materials to class, only 11 per cent of pupils had teachers who reported doing this in 2019, a smaller proportion than in 2015 (16 per cent) and a much smaller proportion than on average internationally (28 per cent for mathematics and 32 per cent for science).

For mathematics, there was a large difference between Northern Ireland and the International Average for four of the instructional practices. Internationally there was a

[27] Only two of the approaches listed in the 2019 questionnaire were presented to teachers in 2011 and therefore comparisons can only be drawn between 2019 and 2015.

larger proportion of pupils whose mathematics teachers reported relating the lesson to pupils' daily lives, bringing interesting materials to class and asking pupils to decide their own problem solving procedures *Every or almost every lesson* than in Northern Ireland, but a smaller proportion of pupils whose teachers reported encouraging classroom discussions among pupils regularly.

Table 6.7 Teaching to engage pupils in learning Mathematics

The percentage of pupils whose teachers report using this approach *Every or almost every lesson*

-	2015 Northern Ireland (%)	2015 International Avg. (%)	2019 Northern Ireland (%)	2019 International Avg. (%)	2019 Percentage points difference (NI – Int. Avg.)
Relate the lesson to children's daily lives	41	56	35	58	-23
Ask pupils to explain their answers	84	70	80	71	9
Bring interesting materials to class	16	23	11	28	-17
Ask pupils to complete challenging exercises that require them to go beyond the teaching	21	17	24	20	4
Encourage classroom discussions among pupils	59	43	64	50	14
Link new content to pupils' prior knowledge	86	72	81	76	5
Ask pupils to decide their own problem solving procedures	37	40	33	43	-10
Encourage pupils to express their ideas in class	81	70	71	73	-2

Sources: 2015 Mathematics Teacher Context Data Almanac by Mathematics Achievement questions ATBG14A to ATBG14H and 2019 Mathematics Teacher Context Data Almanac by Mathematics Achievement questions ATBG12A to ATBG12H

Between 2015 and 2019, there were small differences in the percentages of pupils in Northern Ireland whose mathematics teachers reported using each approach *Every or almost every lesson*, with the exception of encouraging pupils to express their ideas in class where there was a large decrease in percentages between cycles.

In science, there was a large difference between Northern Ireland and the International Average for four of the instructional practices, as shown in Table 6.8. Internationally, science teachers were more likely to relate the lesson to children's daily lives and bring interesting materials to class *Every or almost every lesson* than in Northern Ireland, but internationally there was a lower percentage of pupils who had a teacher who encouraged classroom discussions among pupils and teachers who ask pupils to explain their answers in *Every or almost every lesson*.

Table 6.8 Teaching to engage pupils in learning Science

The percentage of pupils whose teachers report using this approach *Every or almost every lesson*

-	2015 Northern Ireland (%)	2015 International Avg. (%)	2019 Northern Ireland (%)	2019 International Avg. (%)	2019 Percentage points difference (NI – Int. Avg.)
Relate the lesson to children's daily lives	41	60	35	62	-27
Ask pupils to explain their answers	84	70	80	70	10
Bring interesting materials to class	16	28	11	32	-21
Ask pupils to complete challenging exercises that require them to go beyond the teaching	21	17	24	20	4
Encourage classroom discussions among pupils	59	44	64	51	13
Link new content to pupils' prior knowledge	86	73	81	75	6
Ask pupils to decide their own problem solving procedures	37	40	33	43	-10
Encourage pupils to express their ideas in class	81	70	71	73	-2

Sources: 2015 Science Teacher Context Data Almanac by Science Achievement questions ATBG14A to ATBG14H and 2019 Science Teacher Context Data Almanac by Science Achievement questions ATBG12A to ATBG12H

As in mathematics between 2015 and 2019, there were small differences in the percentages of pupils in Northern Ireland whose science teachers reported using each

approach *Every or almost every lesson*, with the exception of encouraging pupils to express their ideas in class where there was a large decrease in percentages between cycles (from 81 per cent in 2015 to 71 per cent in 2019).

6.5 Conclusion

Overall in Northern Ireland, pupils' attitudes towards mathematics and science were similar to those seen in 2015. Northern Ireland had similar proportions of pupils in the highest band of the *Students like learning mathematics scale* and *Students like learning science scale* in 2015 and 2019. In 2019, more pupils in Northern Ireland were categorised as *Very much like learning science* than in the majority of the comparator countries, with the exception of the Republic of Ireland which had the same percentage of pupils in this category, mirroring the 2015 findings.

Overall, pupils in Northern Ireland who were categorised in the *Very much like learning mathematics* / *Very much like learning science* bands had the highest scale scores. This association between liking the subject and achievement was seen in most countries participating in 2015 and 2019. However, the direction of causality cannot be inferred from this data.

In Northern Ireland, pupils' confidence in science decreased moderately between 2015 and 2019. In both subjects there was also an association between pupil confidence and achievement. Pupils who were categorised as *Very confident in mathematics* / *very confident in science* had higher average achievement in mathematics / science. This mirrors what was seen in 2015 in Northern Ireland and internationally.

Countries with the highest performing pupils overall in mathematics had a low percentage of pupils categorised as *Very confident*. This is evident in the data from four of the five highest-performing countries: Korea, Chinese Taipei, Japan and Hong Kong.

Northern Ireland had the highest proportion of pupils reporting *High clarity of instruction* in their mathematics and science lessons compared to the comparator countries. Among the highest performing countries in mathematics at this age group (such as Japan and Korea), the overall levels of pupils' reporting *High clarity of instruction in mathematics* and *science* were relatively low. Whilst in mathematics there was an apparent association between clarity in lessons and achievement, this pattern was not seen for science.

The most popular instructional practices used *Every or almost every lesson* by teachers in Northern Ireland were asking pupils to explain their answers and linking new content to pupils' prior knowledge. Bringing interesting materials to class was least likely to be used *Every or almost every lesson* in Northern Ireland. Internationally, mathematics and science teachers were more likely to relate the lesson to children's daily lives and bring

interesting materials to class *Every or almost every lesson* than in Northern Ireland, but internationally there was a lower percentage of pupils who had a mathematics and science teacher who encouraged classroom discussions among pupils and science teachers who ask pupils to explain their answers in *Every or almost every lesson*.

7 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 a section on 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, three-quarters of pupils attended schools where the principal had completed a postgraduate degree, considerably higher than the International Average which was just over one-half of pupils.
- In Northern Ireland most pupils were taught science and mathematics by teachers with a degree, a larger proportion than what was seen internationally.
- Fifteen per cent of pupils were taught science and mathematics by teachers with a postgraduate degree. This was lower that than the International Averages for both subjects.
- Across comparator countries, pupils in Finland and Poland were most likely to be taught by teachers with a postgraduate degree and pupils in England were least likely to be taught by a teacher with that level of qualification.
- In Northern Ireland, for both mathematics and science, around two-thirds of pupils were taught by teachers whose main area of study was primary education without a subject specialisation. In Poland, all pupils were taught mathematics and science by teachers with the relevant subject specialism.
- There was no clear association in Northern Ireland and across individual countries between teacher specialisation during training and average achievement in mathematics and science.

- In Northern Ireland over the cycles of TIMSS in 2019, 2015 and 2011 there does not appear to be a stable association between teachers with a subject specialism and pupil attainment in mathematics and science.
- Overall the levels of participation in Northern Ireland in professional development activities were positive. Across most of the activities, more pupils in Northern Ireland had teachers who had engaged in professional development in the last two years than was the case, on average, internationally. Levels of participation in activities such as assessment were much lower for science than for mathematics in Northern Ireland and internationally.
- The most common topics for mathematics teachers in Northern Ireland to participate in professional development were pedagogy and teaching, and improving pupils' critical thinking or problem solving skills. The latter was also the most common professional development area for science teachers.
- Participation in two mathematics professional development topics decreased since 2015, namely mathematics curriculum and mathematics assessment. However, the amount of time teachers spent on professional development remained stable across the two cycles, possibly indicating a change in the emphasis of professional development activities.
- There was a moderate increase in the percentage of pupils whose teachers reported participating in no science professional development between 2015 and 2019.
- For the first time in TIMSS teachers were asked which areas of professional development they may need in the future. Nearly three-quarters of pupils were taught by teachers who reported needing future professional development on integrating technology into mathematics and science teaching.
- Half of pupils in Northern Ireland in 2019 were taught mathematics and science by teachers who were *Very satisfied* with their job. This was lower than in 2015 and the 2019 International Average.
- In Northern Ireland, job satisfaction did not appear to be linked with achievement as there were only small differences in the means scores between pupils in the highest and lowest categories on this scale for both mathematics and science.
- Among the comparator countries, Canada had the largest percentage of pupils taught by *Very satisfied* teachers.

Interpreting the data: percentages in tables

The data in this chapter were derived from teacher and principal responses and the achievement data sourced from the pupils' test scores. Reported percentages refer to pupils and can be interpreted as the percentage of pupils whose teachers or principals reported a particular practice or circumstance.

Year 6 (Y6, ages 9-10) pupils were sampled by class. The Y6 teacher questionnaire would, in most cases therefore, 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 was not necessarily the same or 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 can be 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 are often considered to be more reliable and valid than the responses to individual items.

Interpreting the data: differences

In this section, we do not report whether differences are statistically significant as, due to the large sample sizes, small differences can be statistically significant but not meaningful from a policy or practice perspective. Instead, we report on the size of differences. Throughout the remainder of the chapter, differences of three percentage points or less may be described as similar, differences of four to six percentage points as small, differences of seven to nine percentage points as moderate, and differences of ten or more percentage points as large.

7.1 Principals' and teachers' formal education

The inclusion of principal and teacher questionnaires in TIMSS helps to provide important background information on pupils' performance. The questions to principals and teachers address areas such as their preparedness for managing schools and teaching

mathematics and science. This data was then used to quantify the percentage of pupils attending schools run by principals, and taught by teachers, with various levels of educational qualifications (the findings are shown in Tables 7.1 to 7.3).

In Northern Ireland a large proportion of pupils (75 per cent) attended schools where the principal had a postgraduate degree (for example a doctorate or master's), higher than the International Average (54 per cent). However, there has been a moderate decrease since 2015 when 83 per cent of pupils went to schools where the principal had a postgraduate degree. Among the comparator countries only Korea, Finland and Poland had a higher percentage of pupils attending schools where the principal was qualified to this level (91, 98 and 99 per cent respectively).

Principals were also asked which qualifications or credentials they held in educational leadership. Three quarters of pupils attended schools where the principal had a certificate or license in educational leadership, known as a Professional Qualification for Headship in Northern Ireland, and 59 per cent of pupils attended schools where principals had a postgraduate degree in educational leadership.

Table 7.1 Principals' formal education

Reported by principals

Country	Percent of Students by Principals' Education Level			Percent of Students by Principals' Educational Leadership Qualification or Credential***	
	Completed Postgraduate University Degree**	Completed Bachelor's Degree or Equivalent but Not a Postgraduate Degree	Did Not Complete Bachelor's Degree	Certificate or License	Postgraduate Degree
Canada	64 (2.1)	36 (2.1)	0 (0.0)	60 (2.9)	45 (2.6)
England	s 22 (4.2)	78 (4.2)	0 (0.0)	s 61 (5.5)	s 17 (3.5)
Finland	98 (1.2)	2 (1.2)	0 (0.0)	89 (2.2)	35 (3.8)
Hong Kong SAR	66 (4.7)	33 (4.7)	1 (0.6)	82 (4.4)	57 (4.4)
Ireland, Rep. of	53 (4.2)	45 (4.2)	2 (1.3)	31 (4.1)	25 (3.7)
Korea, Rep. of	91 (2.4)	9 (2.4)	1 (0.6)	79 (3.4)	88 (2.8)
Northern Ireland	r 75 (4.7)	25 (4.7)	0 (0.0)	r 75 (4.4)	r 59 (4.8)
Poland	99 (0.8)	0 (0.0)	1 (0.8)	46 (4.6)	63 (4.4)
Singapore	63 (0.0)	36 (0.0)	1 (0.0)	97 (0.0)	44 (0.0)
International Average	**54 (0.4)**	**42 (0.4)**	**5 (0.2)**	**68 (0.5)**	**36 (0.5)**

* 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.
*** Principals could indicate holding more than one qualification or credential.
( ) 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. An "s" indicates data are available for at least 50% but less than 70% of the students.

Source: Exhibit 6.19, TIMSS 2019 International Results in Mathematics and Science
Principal reports are the same for mathematics and science.

In Northern Ireland, 78 per cent of pupils were taught by teachers with a bachelor's degree or equivalent. Fifteen per cent of pupils were taught by teachers with a postgraduate degree, this is lower than the International Average where 28 per cent to 29 per cent (for mathematics and science respectively) of pupils were taught by a teacher with a postgraduate degree. Among the comparator countries, pupils in England are least likely to be taught by a teacher with a postgraduate university degree (six per cent) whereas pupils in Finland and Poland were most likely to be taught by a teacher with that

level of qualification. In Finland this was 93 per cent of pupils for mathematics and science; and in Poland 96 per cent for mathematics and 99 per cent for science.

Table 7.2 Mathematics teachers' formal education

Reported by teachers

Country	Percent of Students by Teacher Education 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
Canada	19 (2.0)	80 (2.0)	0 (0.4)	0 (0.0)
England s	6 (2.7)	94 (2.7)	0 (0.0)	0 (0.0)
Finland	93 (1.8)	6 (1.6)	1 (0.6)	0 (0.4)
Hong Kong SAR	25 (4.4)	71 (4.6)	4 (1.8)	0 (0.0)
Ireland, Rep. of	31 (3.5)	69 (3.5)	0 (0.4)	0 (0.2)
Korea, Rep. of	25 (3.3)	73 (3.3)	2 (1.2)	0 (0.0)
Northern Ireland	15 (3.1)	78 (3.8)	2 (1.4)	4 (2.2)
Poland	96 (1.1)	4 (1.1)	0 (0.0)	0 (0.0)
Singapore	13 (1.8)	76 (2.2)	10 (1.5)	0 (0.3)
International Average	**28 (0.4)**	**56 (0.4)**	**10 (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 "s" indicates data are available for at least 50% but less than 70% of the students.

Source: Exhibit 9.1, TIMSS 2019 International Results in Mathematics and Science

Table 7.3 Science teachers' formal education

Reported by teachers

Country	Percent of Students by Teacher Education 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
Canada r	16 (2.5)	83 (2.5)	0 (0.4)	0 (0.0)
England s	6 (2.7)	94 (2.7)	0 (0.0)	0 (0.0)
Finland	93 (1.7)	6 (1.7)	1 (0.6)	0 (0.4)
Hong Kong SAR	25 (4.2)	70 (4.4)	5 (1.9)	0 (0.0)
Ireland, Rep. of	31 (3.5)	69 (3.5)	0 (0.4)	0 (0.2)
Korea, Rep. of	26 (3.5)	73 (3.4)	1 (1.1)	0 (0.0)
Northern Ireland	15 (3.1)	78 (3.8)	2 (1.4)	4 (2.2)
Poland	99 (0.7)	1 (0.7)	0 (0.0)	0 (0.0)
Singapore	17 (1.9)	74 (2.2)	9 (1.4)	1 (0.4)
International Average	**29 (0.4)**	**56 (0.4)**	**10 (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. An "s" indicates data are available for at least 50% but less than 70% of the students.

Source: Exhibit 9.2, TIMSS 2019 International Results in Mathematics and Science

7.2 Teachers' educational emphasis / major areas of training

7.2.1 Mathematics: teacher's major area of study during training

In order to investigate the proportion 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 tertiary education. The findings for teachers in Northern Ireland and comparator countries are shown in Table 7.4, where countries are presented in alphabetical order.

Table 7.4 Mathematics teachers' major area of study during training

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
Canada r	11 (1.4)	509 (5.5)	74 (1.9)	515 (2.4)	2 (0.9)	~ ~	13 (1.4)	504 (4.3)	0 (0.0)	~ ~
England s	20 (4.6)	563 (9.9)	56 (5.1)	553 (6.6)	3 (2.1)	578 (14.5)	20 (4.2)	558 (11.8)	0 (0.0)	~ ~
Finland	9 (2.0)	541 (8.4)	84 (2.5)	532 (2.5)	0 (0.1)	~ ~	7 (1.7)	530 (7.4)	0 (0.4)	~ ~
Hong Kong SAR	53 (4.8)	602 (4.6)	20 (3.8)	605 (7.7)	20 (4.2)	596 (10.9)	8 (2.6)	621 (16.8)	0 (0.0)	~ ~
Ireland, Rep. of	12 (2.5)	550 (5.0)	84 (2.8)	549 (3.0)	2 (1.0)	~ ~	3 (1.1)	535 (13.7)	0 (0.2)	~ ~
Korea, Rep. of	19 (3.4)	600 (6.7)	78 (3.4)	599 (2.4)	0 (0.0)	~ ~	2 (1.0)	~ ~	0 (0.0)	~ ~
Northern Ireland r	15 (3.1)	557 (8.2)	66 (4.7)	570 (4.6)	1 (1.2)	~ ~	13 (3.1)	553 (9.5)	5 (2.4)	552 (17.6)
Poland	11 (2.4)	515 (6.3)	0 (0.0)	~ ~	89 (2.4)	521 (2.9)	0 (0.0)	~ ~	0 (0.0)	~ ~
Singapore	66 (2.6)	624 (4.9)	11 (1.7)	643 (8.4)	14 (2.0)	618 (9.9)	9 (1.6)	629 (10.4)	0 (0.3)	~ ~
International Average	**32 (0.4)**	**497 (1.1)**	**43 (0.4)**	**503 (1.4)**	**11 (0.3)**	**487 (2.6)**	**8 (0.3)**	**490 (2.7)**	**6 (0.3)**	**457 (3.1)**

* 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 tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students. An "s" indicates data are available for at least 50% but less than 70% of the students.

Source: Exhibit 9.5., TIMSS 2019 International Results in Mathematics and Science

In Northern Ireland, the majority of pupils (66 per cent) were taught mathematics by teachers whose main area of study was primary education without specialisation in mathematics. Sixteen per cent of pupils were taught mathematics by teachers who were mathematics specialists (for 15 per cent, their teachers had a specialism in mathematics and primary education and for a further one per cent, their teachers specialised in mathematics but not primary education). Similar findings were reported in 2015, where 65 per cent of pupils were taught mathematics by teachers whose main area of study was primary education without specialisation in mathematics and 18 per cent were taught mathematics by teachers who were mathematics specialists.

Among the comparator countries, Canada, Korea and the Republic of Ireland had a similar percentage of pupils taught by mathematics specialists (13 per cent, 19 per cent and 14 per cent respectively). However, in Hong Kong, Poland and Singapore a much larger percentage of pupils were taught by mathematics specialists (73 per cent, 100 per cent and 80 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. Given the size of the differences and that there is no clear pattern across the 2011, 2015 and 2019 TIMSS cycles there is unlikely to be a significant relationship between teacher specialisation and maths performance in Northern Ireland.

7.2.2 Science: teacher's major area of study during training

The findings for teachers in Northern Ireland and comparator countries are shown in Table 7.5. Sixty-seven per cent of pupils in Y6 were taught science by teachers whose main area of study was primary education (without specialisation in science). Fifteen per cent of pupils were taught science by teachers who were science specialists (13 per cent

of these were taught by teachers who specialised in science and primary education; the remainder had teachers with a specialism in science but not primary education). In 2015, 71 per cent of pupils were taught science by teachers whose main area of study was primary education and 12 per cent were taught science by teachers who were science specialists.

Table 7.5 Science teachers' major area of study during training

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
Canada	r	13 (1.8)	530 (5.7)	69 (2.6)	525 (2.4)	6 (2.1)	526 (9.6)	12 (1.5)	520 (3.7)	0 (0.0)	~ ~
England	s	19 (4.0)	522 (4.7)	56 (5.4)	542 (5.8)	8 (2.7)	582 (15.6)	17 (3.8)	524 (7.2)	0 (0.0)	~ ~
Finland		8 (1.8)	544 (8.9)	83 (2.2)	556 (2.7)	1 (0.4)	~ ~	8 (1.8)	555 (6.8)	0 (0.4)	~ ~
Hong Kong SAR		27 (4.1)	526 (5.7)	52 (4.6)	532 (4.6)	4 (1.7)	531 (22.4)	17 (3.6)	541 (13.1)	0 (0.0)	~ ~
Ireland, Rep. of		9 (2.0)	532 (8.4)	87 (2.5)	528 (3.7)	1 (0.5)	~ ~	3 (1.4)	511 (11.9)	0 (0.2)	~ ~
Korea, Rep. of		16 (3.2)	589 (5.9)	80 (3.3)	588 (2.3)	2 (0.8)	~ ~	2 (0.9)	~ ~	0 (0.0)	~ ~
Northern Ireland	r	13 (3.0)	516 (5.8)	67 (4.1)	522 (3.3)	2 (1.2)	~ ~	13 (3.1)	511 (7.6)	5 (2.4)	498 (12.7)
Poland		28 (3.9)	530 (4.8)	0 (0.0)	~ ~	72 (3.9)	532 (2.8)	0 (0.0)	~ ~	0 (0.0)	~ ~
Singapore		57 (2.7)	591 (4.6)	10 (1.5)	598 (9.9)	25 (2.5)	603 (5.2)	8 (1.3)	588 (8.7)	1 (0.5)	~ ~
International Average		**28 (0.5)**	**489 (1.3)**	**44 (0.5)**	**491 (1.2)**	**13 (0.3)**	**480 (2.5)**	**9 (0.3)**	**478 (2.4)**	**5 (0.2)**	**442 (3.8)**

* 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 tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students. An "s" indicates data are available for at least 50% but less than 70% of the students.

Source: Exhibit 9.6., TIMSS 2019 International Results in Mathematics and Science

As was the case for mathematics, the picture among the comparator countries was varied. In Finland and the Republic of Ireland, a smaller percentage of pupils were taught by subject specialists (nine per cent and ten per cent respectively). Whereas in England over a quarter of pupils were taught by a science specialist (eight per cent of these were taught by teachers with a specialism in science but not primary education and 19 per cent had teachers who specialised in science and primary education). In Poland all pupils were taught science by a subject specialist, this mirrors the findings for mathematics.

There was not a clear association within individual countries between teacher specialisation during training and average achievement in science at this level. In Northern Ireland, pupils taught by a subject specialist had lower average achievement, however this may be due to the relatively small numbers of pupils in this group. This association between teachers with a subject specialism and pupil attainment does not appear to be stable over the three TIMSS cycles (2011, 2015 and 2019) Northern Ireland has participated in.

7.3 Teachers' professional development

7.3.1 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 and across comparator countries are shown in Table 7.6, where countries are listed in alphabetical order). The areas of professional development covered by the questionnaire[28] were as follows:

- mathematics content
- mathematics pedagogy / teaching
- mathematics curriculum
- integrating information technology into mathematics teaching
- improving pupils' critical thinking or problem solving skills
- mathematics assessment
- addressing individual pupils' needs.

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, although this is a smaller difference than seen in 2015. The largest percentage of pupils were taught by teachers who had participated in a professional development activity on mathematics pedagogy / teaching (57 per cent) and improving pupils' critical thinking or problem solving skills (56 per cent). Half of the pupils were taught by teachers who had participated in professional development related to mathematics content. However, fewer pupils were taught by teachers who, during the last two years, had participated in the professional development activities of: integrating technology into mathematics teaching (37 per cent); mathematics assessment (30 per cent); and addressing individual pupils' learning needs (33 per cent).

Levels of participation in professional development in mathematics varied across the comparator countries. Finland had the lowest level of participation with between seven

[28] The teacher questionnaire was adapted to suit the Northern Ireland context. Therefore, the wording for the professional areas of development differs slightly from Tables 7.6 and 7.8 below which refer to the international wording.

per cent and 17 per cent of pupils taught mathematics by a teacher who had participated in one of the activities covered in the questionnaire. Whereas in Singapore involvement in professional development on mathematics was more common, for example 82 per cent of pupils were taught by a teacher who had undertaken professional development on mathematics pedagogy / teaching. There was no clear pattern in the most commonly undertaken professional development activities across the comparator countries, perhaps reflecting a different emphasis on the importance of particular areas and/or existing skills of the teaching population in each of the countries.

Table 7.6 Teachers' participation in professional development in Mathematics

Reported by teachers

Country	Percent of Students by Teachers' Participation in Professional Development*						
	Mathematics Content	Mathematics Pedagogy/ Instruction	Mathematics Curriculum	Integrating Technology into Mathematics Instruction	Improving Students' Critical Thinking or Problem Solving Skills	Mathematics Assessment	Addressing Individual Students' Needs
Canada	62 (2.1)	r 68 (1.8)	47 (2.8)	37 (3.0)	58 (2.1)	52 (3.0)	52 (2.1)
Finland	7 (1.9)	17 (2.6)	12 (2.0)	15 (2.3)	8 (2.0)	9 (2.0)	17 (2.6)
Hong Kong SAR	72 (3.2)	72 (3.3)	72 (3.9)	77 (3.9)	58 (4.3)	40 (4.0)	56 (4.2)
Ireland, Rep. of	36 (3.6)	33 (3.5)	23 (3.5)	23 (3.2)	34 (3.6)	19 (3.0)	31 (3.4)
Korea, Rep. of	30 (4.3)	28 (3.7)	39 (4.1)	15 (2.9)	38 (3.8)	38 (4.0)	49 (4.0)
Northern Ireland	50 (4.2)	57 (3.9)	39 (4.2)	37 (4.2)	56 (4.2)	30 (4.0)	33 (4.2)
Poland	74 (3.5)	55 (3.6)	69 (3.7)	63 (3.6)	46 (4.0)	38 (4.0)	54 (3.6)
Singapore	74 (2.4)	82 (2.6)	69 (2.4)	61 (2.3)	62 (2.7)	67 (3.0)	46 (2.6)
England	x 66 (5.9)	x 63 (6.9)	x 57 (6.9)	x 17 (4.4)	x 63 (5.5)	x 47 (7.0)	x 42 (6.8)
International Average	**46 (0.5)**	**45 (0.5)**	**41 (0.5)**	**35 (0.4)**	**44 (0.5)**	**37 (0.0)**	**43 (0.5)**

* Teachers could indicate participating in more than one area of professional development.
( ) 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. An "x" indicates data are available for less than 50% of the students—interpret with caution.

Source: Exhibit 9.13., TIMSS 2019 International Results in Mathematics and Science

Research evidence suggests teacher involvement in professional development has a positive effect on pupils' achievement (Blank and de las Alas, 2009; Yoon *et al,* 2007). Whilst the level of involvement in Northern Ireland in such activities is positive, there were noticeable differences between 2015 and 2019. For example, in 2015, 54 per cent of pupils were taught by teachers who had received mathematics curriculum professional development, 15 percentage points higher than in 2019. Additionally, over half of pupils (57 per cent) in 2015 were taught by a teacher who in the previous two years had received professional development on mathematics assessment, but in 2019 this was just under a third (30 per cent). There was a ten per cent increase, however, in the percentage of pupils who were taught by teachers receiving professional development related to improving pupils' critical thinking or problem solving skills, from 46 per cent in 2015.

The amount of time teachers spent on professional development was similar to 2015, as shown in Table 7.7. For example, around one-tenth of pupils had teachers who reported spending 16 hours or more in professional development activities in 2015, the figure was very similar in 2019. This suggests that, rather than reflecting a decrease in the level of teacher involvement in professional development activities, the findings noted above actually reflect a change in the emphasis of professional development activities, with

teachers participating in professional development activities outside the areas covered by the TIMSS questionnaire.

Table 7.7 Teachers' time spent in professional development for Mathematics over the past two years in Northern Ireland

The percentage of pupils based on teacher reports

Year	None (%)	Less than 6 hours (%)	6-15 hours (%)	16-35 hours (%)	More than 35 hours (%)
2015	22	41	28	8	1
2019	21	38	29	10	2

Sources: 2015 Mathematics Teacher Context Data Almanac by Mathematics Achievement question ATBM10 and 2019 Mathematics Teacher Context Data Almanac by Mathematics Achievement question ATBM10

In 2019, teachers were asked to indicate if they needed future professional development in the areas listed in the questionnaire, this is the first time TIMSS has gathered information on development needs. The findings for Northern Ireland and the eight comparator countries are shown in Table 7.8.

Table 7.8 Teachers' needs for future development in Mathematics

Reported by teachers

Country	Percent of Students by Teachers Indicating a Need for Future Professional Development*						
	Mathematics Content	Mathematics Pedagogy/ Instruction	Mathematics Curriculum	Integrating Technology into Mathematics Instruction	Improving Students' Critical Thinking or Problem Solving Skills	Mathematics Assessment	Addressing Individual Students' Needs
Canada	r 32 (2.4)	r 50 (3.0)	r 32 (2.3)	r 75 (2.4)	r 64 (2.4)	r 50 (3.0)	r 56 (2.5)
Finland	22 (2.5)	54 (3.0)	24 (2.8)	70 (3.0)	65 (2.6)	44 (3.0)	56 (3.3)
Hong Kong SAR	73 (4.5)	82 (4.5)	71 (4.3)	86 (3.4)	82 (4.4)	73 (4.0)	75 (3.6)
Ireland, Rep. of	37 (3.8)	54 (3.7)	37 (3.9)	81 (3.1)	75 (3.5)	49 (4.0)	58 (3.8)
Korea, Rep. of	58 (4.3)	78 (2.8)	60 (4.4)	76 (3.2)	83 (3.0)	67 (4.0)	78 (3.4)
Northern Ireland	33 (4.1)	41 (4.1)	33 (4.1)	71 (4.0)	67 (4.3)	46 (4.0)	54 (4.7)
Poland	32 (3.6)	40 (4.1)	20 (3.2)	53 (3.4)	63 (3.4)	32 (4.0)	49 (4.2)
Singapore	44 (2.9)	64 (2.5)	45 (2.7)	75 (2.2)	79 (2.1)	63 (2.0)	75 (2.1)
England	x 31 (6.7)	y - -	x 31 (6.4)	y - -	y - -	y - -	y - -
International Average	**45 (0.5)**	**55 (0.5)**	**44 (0.5)**	**72 (0.5)**	**69 (0.5)**	**54 (0.0)**	**64 (0.5)**

* Teachers could indicate needing professional development in more than one area.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available.
An "r" indicates data are available for at least 70% but less than 85% of the students.
An "x" indicates data are available for at least 40% but less than 50% of the students—interpret with caution. A "y" indicates data are available for less than 40% of the students.

Source: Exhibit 9.17., TIMSS 2019 International Results in Mathematics and Science

In Northern Ireland, a high proportion of pupils (71 per cent) were taught by teachers who reported needing future professional development on integrating technology into mathematics teaching. The next most pressing professional development need was in the area of improving pupils' critical thinking or problem solving skills, with 67 per cent of pupils taught by teachers reporting this as a future development need. This is a

surprising finding given that over half of pupils were taught by teachers who had participated in professional development in this area within the last two years. Mathematics content and mathematics curriculum training were not identified as pressing developments needs by teachers in Northern Ireland, only one-third of pupils were taught by teachers who reported needing future professional development in these areas.

Across the comparator countries the highest percentage of pupils were taught by teachers who indicated that they needed future professional development on either integrating technology into mathematics teaching (Canada, Finland, Hong Kong, Republic of Ireland and Northern Ireland) or improving pupils' critical thinking or problem solving skills (Korea, Poland and Singapore).

Further discussion on professional development related to integrating technology into mathematics teaching can be found in Chapter 9.

7.3.2 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 and comparator countries are shown in Table 7.9). The areas of professional development covered by the questionnaire[29] were as follows:

- science content
- science pedagogy / teaching
- science curriculum
- integrating technology into science teaching
- improving pupils' critical thinking or inquiry skills
- science assessment
- addressing individual pupils' needs
- integrating science with other subjects.

In Northern Ireland, compared with teacher reports for mathematics there were relatively lower levels of participation in professional development in science; this was also the case on average internationally. Between five per cent and 31 per cent of pupils in

[29] The teacher questionnaire was adapted to suit the Northern Ireland context. Therefore, the wording for the professional areas of development differs slightly from Tables 7.9 and 7.11 below which refer to the international wording.

Northern Ireland were taught science by a teacher who had participated in one of the professional development activities covered in the questionnaire. The most commonly attended area of professional development in Northern Ireland was improving pupils' critical thinking or inquiry skills, with 31 per cent of pupils taught by teachers who had participated in professional development related to this area. Around a quarter (27 per cent) of pupils were taught by teachers who had received professional development on integrating science with other subjects, compared to the International Average (31 per cent).

Five per cent of pupils were taught by teachers who had participated in a professional development activity on science assessment, this was much lower than the International Average (28 per cent). This is also a much lower percentage than was found for professional development on mathematics assessment.

Table 7.9 Teachers' participation in professional development in Science

Reported by teachers

Country	Percent of Students by Teachers' Participation in Professional Development*							
	Science Content	Science Pedagogy/ Instruction	Science Curriculum	Integrating Technology into Science Instruction	Improving Students' Critical Thinking or Inquiry Skills	Science Assessment	Addressing Individual Students' Needs	Integrating Science with Other Subjects
Canada	r 16 (1.7)	r 14 (1.8)	r 15 (1.5)	r 18 (1.7)	r 24 (2.4)	r 9 (2.0)	r 23 (2.2)	r 20 (2.0)
Finland	5 (1.6)	7 (2.0)	8 (1.6)	11 (2.1)	7 (1.9)	7 (2.0)	10 (1.8)	7 (1.8)
Hong Kong SAR	53 (4.2)	47 (4.6)	54 (4.8)	66 (4.9)	61 (4.8)	34 (4.0)	48 (4.2)	58 (4.5)
Ireland, Rep. of	25 (3.6)	22 (3.0)	21 (3.2)	22 (3.3)	29 (3.9)	12 (2.0)	19 (2.8)	28 (3.6)
Korea, Rep. of	31 (3.8)	35 (3.5)	46 (3.7)	27 (3.7)	32 (3.6)	33 (4.0)	33 (3.5)	35 (3.9)
Northern Ireland	21 (3.3)	25 (3.5)	17 (3.6)	25 (3.7)	31 (4.3)	5 (2.0)	14 (3.2)	27 (3.8)
Poland	64 (4.0)	33 (4.0)	57 (4.3)	56 (3.8)	45 (3.9)	34 (4.0)	52 (4.3)	28 (3.8)
Singapore	67 (2.7)	81 (2.1)	63 (2.6)	58 (2.5)	49 (2.6)	71 (3.0)	36 (2.7)	30 (2.6)
England	y - -	y - -	y - -	y - -	y - -	y - -	y - -	y - -
International Average	**35 (0.4)**	**33 (0.4)**	**34 (0.4)**	**32 (0.4)**	**36 (0.5)**	**28 (0.0)**	**33 (0.5)**	**31 (0.5)**

* Teachers could indicate participating in more than one area of professional development.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available.
An "r" indicates data are available for at least 70% but less than 85% of the students.
A "y" indicates data are available for less than 40% of the students.

Source: Exhibit 9.14., TIMSS 2019 International Results in Mathematics and Science

As with mathematics, the levels of participation in professional development in science varied across the comparator countries (as shown in Table 7.9), although they were generally lower than for mathematics activities. As for mathematics, Finland had the lowest level of participation with between five per cent and 11 per cent of pupils taught science by a teacher who had participated in one of the areas of professional development covered in the questionnaire. Whereas in Singapore, involvement in professional development in science was more common, for example 81 per cent of pupils were taught by a teacher who had undertaken professional development on science pedagogy and teaching. As was the case for mathematics, there was no clear pattern in the most commonly undertaken professional development activities in science across the comparator countries, perhaps reflecting a different emphasis on the importance of particular areas in each of the countries.

As shown in Table 7.10, between 2015 and 2019 there were small to moderate decreases in the proportion of pupils who were taught science by a teacher who had participated in professional development in one of the areas covered in the questionnaire. For example, in 2015, 25 per cent of pupils were taught by teachers who had received professional development training related to the science curriculum, eight per cent more than in 2019. However, the changes were not as large as those seen in teacher reports of their professional development activities in mathematics.

Table 7.10 Teachers' time spent in professional development for Science over the past two years in Northern Ireland

The percentage of pupils based on teacher reports

Year	None (%)	Less than 6 hours (%)	6-15 hours (%)	16-35 hours (%)	More than 35 hours (%)
2015	51%	35%	10%	2%	1%
2019	58%	27%	10%	3%	2%

Sources: 2015 Science Teacher Context Data Almanac by Science Achievement question ATBS09 and 2019 Science Teacher Context Data Almanac by Science Achievement question ATBS09

Between 2015 and 2019 there were some moderate changes in how much time teachers' spent on science focused professional development activities. There was a moderate increase in the percentage of pupils whose teachers reported that they had not participated in any professional development in science in the previous two years (from 51 per cent in 2015 to 58 per cent in 2019). There was a decrease in the percentage of pupils whose teachers reported participating in science professional development for *Less than 6 hours* (from 35 per cent in 2015 to 27 per cent in 2018). However, the percentage of pupils taught by teachers who had participated in six hours or more of professional development activities in science remained relatively stable between the two cycles of TIMSS.

In Northern Ireland (as shown in Table 7.11), more than half of pupils were taught by teachers who reported needing future professional development in each of the areas covered in the questionnaire. A high proportion of pupils (74 per cent) were taught by teachers who reported needing future professional development on integrating technology into science teaching and 66 per cent who reported needing future professional development on improving pupils' critical thinking or problem solving skills. As only five per cent of pupils were taught by teachers who had received professional development related to science assessment in the last two years, it is perhaps unsurprising that 59 per cent of pupils were taught by teachers who reported needing more professional development in this area.

Table 7.11 Teachers' needs for future professional development in Science

Reported by teachers

Country	Percent of Students by Teachers Indicating a Need for Future Professional Development*							
	Science Content	Science Pedagogy/ Instruction	Science Curriculum	Integrating Technology into Science Instruction	Improving Students' Critical Thinking or Inquiry Skills	Science Assessment	Addressing Individual Students' Needs	Integrating Science with Other Subjects
Canada	r 50 (2.5)	r 56 (2.9)	r 41 (2.4)	r 70 (2.0)	r 62 (2.8)	r 50 (2.0)	r 48 (3.2)	r 62 (2.2)
Finland	32 (2.9)	46 (2.9)	29 (2.9)	61 (3.0)	53 (3.0)	40 (3.0)	45 (3.4)	51 (2.8)
Hong Kong SAR	r 69 (4.0)	75 (4.5)	68 (3.9)	75 (4.0)	79 (4.1)	r 66 (4.0)	70 (4.1)	80 (3.8)
Ireland, Rep. of	47 (3.7)	58 (3.9)	42 (3.7)	78 (3.1)	73 (3.6)	62 (4.0)	54 (3.6)	67 (3.3)
Korea, Rep. of	62 (3.8)	66 (3.9)	59 (4.1)	75 (3.7)	79 (3.2)	58 (4.0)	66 (3.7)	74 (3.4)
Northern Ireland	62 (4.4)	63 (4.8)	61 (4.5)	r 74 (4.1)	r 66 (4.3)	59 (4.0)	r 55 (4.4)	64 (4.2)
Poland	25 (4.2)	23 (3.5)	17 (3.4)	47 (4.6)	46 (4.0)	r 29 (4.0)	r 35 (4.0)	33 (4.1)
Singapore	53 (2.3)	71 (2.1)	56 (2.6)	78 (2.2)	81 (2.4)	68 (2.0)	70 (2.5)	66 (2.6)
England	y - -	y - -	y - -	y - -	y - -	y - -	y - -	y - -
International Average	**54 (0.5)**	**57 (0.5)**	**49 (0.5)**	**68 (0.5)**	**65 (0.5)**	**54 (1.0)**	**57 (0.5)**	**62 (0.5)**

* Teachers could indicate needing professional development in more than one area.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available.
An "r" indicates data are available for at least 70% but less than 85% of the students.
A "y" indicates data are available for less than 40% of the students.

Source: Exhibit 9.18., TIMSS 2019 International Results in Mathematics and Science

Notably, in the majority of the comparator countries the area most commonly identified as a future professional development need was integrating technology into science teaching. In five of the comparator countries (Canada, Finland, Republic of Ireland, Northern Ireland and Poland) between 47 per cent and 78 per cent of pupils are taught by teachers who identify this training need.

Further discussion on professional development related to integrating technology into science teaching can be found in Chapter 9.

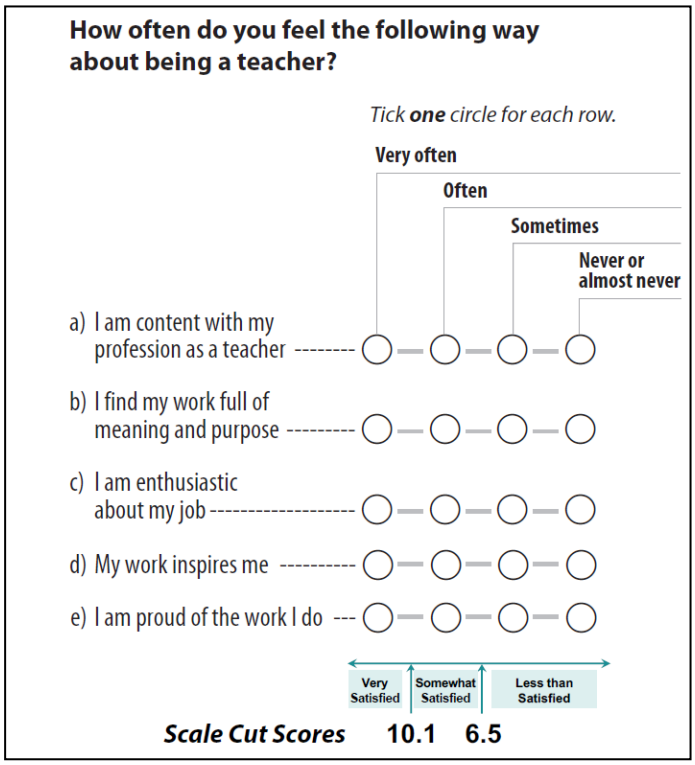
7.4 Teachers' reported job satisfaction

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 7.1. The results for mathematics and science are shown in Table 7.12 and Table 7.13, and countries are listed in descending order of the proportion of pupils whose teachers expressed the most job satisfaction.

The international analysis uses responses to these statements to create the *Teacher job satisfaction* scale. Teachers were categorised as being *Very satisfied*, *Somewhat satisfied*, and *Less than satisfied*. It is worth noting that the construction of the scale has changed since 2015 and therefore caution should be taken when interpreting trends over time[30].

[30] In 2015 teachers responded to seven statements about their career satisfaction and were categorised into three bands: *Very Satisfied, Satisfied and Less than Satisfied*. All five statements in 2019 appeared in the 2015 questionnaire.

Figure 7.1 Teacher job satisfaction



Source: adapted from Exhibit 9.21., TIMSS 2019 International Results in Mathematics and Science

In Northern Ireland, 50 per cent of pupils, in both subjects, had teachers who reported that they were *Very satisfied* with their job and a further 39 per cent had teachers who were *Somewhat satisfied*. Teachers of 11 per cent of pupils reported that they were *Less than satisfied*. The percentage of pupils in Northern Ireland falling into the highest category of job satisfaction was lower than the International Average on this scale. Whilst the percentage of pupils whose teachers were in the *Somewhat satisfied* category[31] was similar to that seen in 2015, the percentage of pupils who had teachers reporting they were *Very satisfied* decreased by nine per cent since 2015 and the percentage taught by teachers who were *Less than satisfied* increased by seven per cent. These are moderate differences between cycles.

Among the comparator countries, the country with the highest percentage of pupils taught by *Very satisfied* teachers was Canada (59 per cent in mathematics, 58 per cent in science) followed by the Republic of Ireland (52 per cent in both subjects) and Hong Kong (50 per cent in mathematics, 47 per cent in science). Teacher job satisfaction among the remaining comparator countries was lower than in Northern Ireland. Notably, the percentage of pupils in England taught by teachers who reported being *Very satisfied* with their jobs was 41 per cent for both mathematics and science.

[31] *Satisfied* in 2015

Table 7.12 Mathematics teacher job satisfaction

Reported by teachers

Students were scored according to their teachers' responses to five statements on the *Teachers' Job Satisfaction scale*. Cut scores divide the scale into three categories. Students with **Very Satisfied** teachers had a score at or above the cut score corresponding to their teachers responding "very often" to three of the five statements and "often" to the other two, on average. Students with **Less than Satisfied** teachers had a score at or below the cut score corresponding to their teachers responding "sometimes" to three of the five statements and "often" to the other two, on average. All other students had **Somewhat Satisfied** teachers.

Country	Very Satisfied		Somewhat Satisfied		Less than Satisfied		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Canada	59 (2.5)	509 (2.8)	36 (2.2)	516 (2.3)	5 (1.2)	518 (9.4)	10.0 (0.10)
Ireland, Rep. of	52 (3.9)	549 (3.8)	40 (3.6)	551 (3.2)	8 (2.3)	533 (6.5)	9.7 (0.15)
Northern Ireland	50 (4.3)	566 (4.1)	39 (4.1)	568 (6.1)	11 (3.0)	561 (8.3)	9.6 (0.19)
Hong Kong SAR	50 (4.4)	609 (5.6)	40 (4.3)	599 (4.5)	10 (2.5)	576 (7.8)	9.6 (0.17)
Singapore	47 (2.3)	631 (5.6)	44 (2.5)	618 (5.1)	9 (1.4)	637 (10.7)	9.6 (0.09)
England s	41 (6.1)	566 (7.4)	57 (5.9)	553 (6.6)	1 (1.2)	~ ~	9.8 (0.19)
Finland	39 (3.0)	534 (3.7)	52 (3.3)	531 (3.0)	9 (1.6)	531 (5.1)	9.3 (0.09)
Korea, Rep. of	38 (3.6)	601 (4.2)	49 (3.7)	602 (3.4)	13 (2.5)	587 (5.0)	9.1 (0.16)
Poland	32 (3.4)	523 (4.4)	49 (3.2)	518 (3.4)	18 (2.8)	520 (6.3)	8.6 (0.15)
International Average	**61 (0.5)**	**503 (0.6)**	**34 (0.4)**	**499 (0.9)**	**5 (0.2)**	**515 (2.1)**	

This TIMSS context 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.
A tilde (~) indicates insufficient data to report achievement.
An "s" indicates data are available for at least 50% but less than 70% of the students.

Source: Exhibit 9.22., TIMSS 2019 International Results in Mathematics and Science

Table 7.13 Science teacher job satisfaction

Reported by teachers

Students were scored according to their teachers' responses to five statements on the *Teachers' Job Satisfaction scale*. Cut scores divide the scale into three categories. Students with **Very Satisfied** teachers had a score at or above the cut score corresponding to their teachers responding "very often" to three of the five statements and "often" to the other two, on average. Students with **Less than Satisfied** teachers had a score at or below the cut score corresponding to their teachers responding "sometimes" to three of the five statements and "often" to the other two, on average. All other students had **Somewhat Satisfied** teachers.

Country	Very Satisfied		Somewhat Satisfied		Less than Satisfied		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Canada r	58 (2.6)	526 (2.7)	36 (2.4)	523 (2.3)	6 (1.3)	521 (6.4)	10.0 (0.10)
Ireland, Rep. of	52 (3.9)	528 (5.0)	40 (3.6)	532 (3.4)	8 (2.3)	511 (8.1)	9.7 (0.15)
Northern Ireland	50 (4.3)	518 (3.3)	39 (4.1)	520 (4.6)	11 (3.0)	515 (6.5)	9.6 (0.19)
Hong Kong SAR	47 (4.3)	535 (5.1)	44 (4.1)	533 (4.7)	8 (2.1)	511 (8.6)	9.6 (0.16)
Singapore	43 (2.6)	593 (4.8)	47 (2.7)	593 (4.9)	9 (1.5)	611 (10.4)	9.4 (0.11)
England s	41 (6.1)	544 (6.3)	56 (5.9)	536 (5.9)	2 (1.7)	~ ~	9.7 (0.20)
Korea, Rep. of	41 (3.4)	589 (3.3)	45 (3.5)	588 (3.1)	14 (2.4)	581 (6.1)	9.1 (0.15)
Finland	39 (3.1)	557 (3.6)	51 (3.3)	554 (3.3)	10 (1.6)	550 (5.9)	9.3 (0.10)
Poland	32 (4.0)	531 (4.9)	46 (4.6)	531 (4.0)	22 (3.7)	533 (4.2)	8.6 (0.18)
International Average	**61 (0.5)**	**493 (0.6)**	**34 (0.5)**	**490 (1.0)**	**5 (0.2)**	**508 (2.2)**	

This TIMSS context 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.
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. An "s" indicates data are available for at least 50% but less than 70% of the students.

Source: Exhibit 9.23., TIMSS 2019 International Results in Mathematics and Science

Compared with previous cycles of TIMSS, in 2019 there was only a small difference between levels of teacher job satisfaction for mathematics teachers in Singapore and Northern Ireland. In Singapore, the percentage of pupils taught by teachers who were *Very satisfied* with their job has increased from 37 per cent in 2015 to 47 per cent in 2019.

The International Averages for mathematics and science showed small differences in the achievement scores of pupils with *Very satisfied* teachers and those with *Somewhat satisfied* teachers, and counter intuitively, average achievement was highest for pupils with *Less than satisfied* teachers, although the small number of pupils in this category

means the finding should be interpreted with caution. In Northern Ireland, however, the average mathematics and science achievements for pupils with *Very satisfied* (566 for mathematics, 518 for science) and *Somewhat satisfied* (568 for mathematics, 520 for science) teachers were similar, and there were small differences compared with the *Less than satisfied* group (561 for mathematics, 515 for science).

7.5 Conclusion

In Northern Ireland, three-quarters of pupils attend schools where the principal had completed a postgraduate degree (for example a doctorate or master's). This was much higher than the International Average. The majority of pupils, 78 per cent, were taught by a teacher with a bachelor's degree or equivalent, however only 15 per cent of pupils were taught by teachers with a postgraduate degree. This was lower than the International Average (28 per cent for mathematics and 29 per cent for science).

For both mathematics and science, around two-thirds of pupils were taught by teachers whose main area of study was primary education without a subject specialisation. The percentage of pupils taught by a subject specialist was 16 per cent for mathematics and 15 per cent for science, similar to findings from 2015.

There was no clear association within individual countries, or on average, between being taught by a subject specialist and average achievement in mathematics or science at this level. In Northern Ireland, pupils taught by a subject specialist in science had lower average achievement, however this may be due to the relatively small numbers of pupils in this group. For mathematics, there is unlikely to be a significant relationship between teacher specialisation and maths performance. This association between teachers with a subject specialism and pupil attainment does not appear to be stable over the three TIMSS cycles Northern Ireland has participated in; 2011, 2015 and 2019.

Teachers were asked about the professional development activities they had participated in during the previous two years. For mathematics, in Northern Ireland the level of participation in professional development activities was higher in most areas than on average internationally. The most common mathematics areas for teachers in Northern Ireland to participate in professional development were pedagogy / teaching and improving pupils' critical thinking or problem solving skills, the latter was also the most common professional development area for science. The level of participation in the areas of professional development covered by the questionnaire had decreased since 2015. The largest decreases were seen in the percentage of pupils taught by teachers who had participated in professional development activities on mathematics assessment or on mathematics curriculum (a decrease of 17 per cent and 15 per cent respectively). However, time spent on professional development over the same period remained stable,

indicating a change on the emphasis of particular areas rather than professional development happening less often amongst teachers.

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 for science were improving critical thinking or inquiry skills and integrating science with other subjects. Levels of participation in professional development activities on assessment were much lower for science than for mathematics with five per cent of pupils taught by teachers who had participated in a professional development activity on science assessment, this was also much lower than for mathematics (30 per cent) and the International Average (37 per cent).

For the first time, teachers were asked in which areas they felt they needed future professional development. The majority of pupils were taught by teachers who reported needing future professional development on integrating technology into mathematics (71 per cent) and science (74 per cent) teaching. Despite it being one of the common areas of professional development, around two-thirds of pupils were taught mathematics and science by teachers who reported needing more professional development on improving pupils' critical thinking or problem solving skills.

Half of pupils in Northern Ireland in 2015 and 2019 were taught mathematics and science by teachers who are *Very satisfied* with their job. This was lower than the International Average in 2015 (61 per cent) and 2019 (59 per cent). Job satisfaction did not appear to be linked with achievement as there were only small differences in the means scores between pupils in the highest and lowest categories on this scale for both mathematics and science.

8 School resources

Chapter outline

This chapter summarises the principal responses concerning the 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 comparator countries, where relevant.

Key Findings

- In Northern Ireland, more than 80 per cent of pupils attended schools where the principal reported that teaching was *Somewhat Affected* by a shortage of resources, this was true for both mathematics and science. The percentages internationally were below 70 per cent for mathematics and science.
- In Northern Ireland, between 2015 and 2019 the percentages of pupils that attended schools where the principal reported that teaching was *Somewhat Affected* by a shortage of resources increased. The increase was larger in mathematics than in science.
- In Northern Ireland, two per cent of pupils attended schools where the principal reported that teaching was *Affected a lot* by shortages in science and mathematics resources, below the International Averages.
- In Northern Ireland pupils were more likely than those in comparator countries, with the exception of Canada and the Republic of Ireland, to attend a school with classroom libraries and less likely than pupils in comparator countries, with the exception of Finland and the Republic of Ireland, to attend a school with a school library.
- In 2019, no schools in Northern Ireland reported having a science laboratory for Y6 pupils, as was the case in 2015. This compares to over a third of pupils, on average internationally, who attended schools with a science laboratory in 2019. Among comparator countries, only the Republic of Ireland had a similar percentage of pupils to Northern Ireland, while in England nearly a quarter of pupils attend schools with a science laboratory.

- In Northern Ireland, principals reported that fewer than 20 per cent of pupils were taught by teachers with access to assistance when the pupils were conducting experiments, below both the International Average (which was more than a third of pupils) and all the comparator countries, with the exception of Canada which had a similar percentage.

Interpreting the data: percentages in tables

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

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.

Interpreting the data: differences

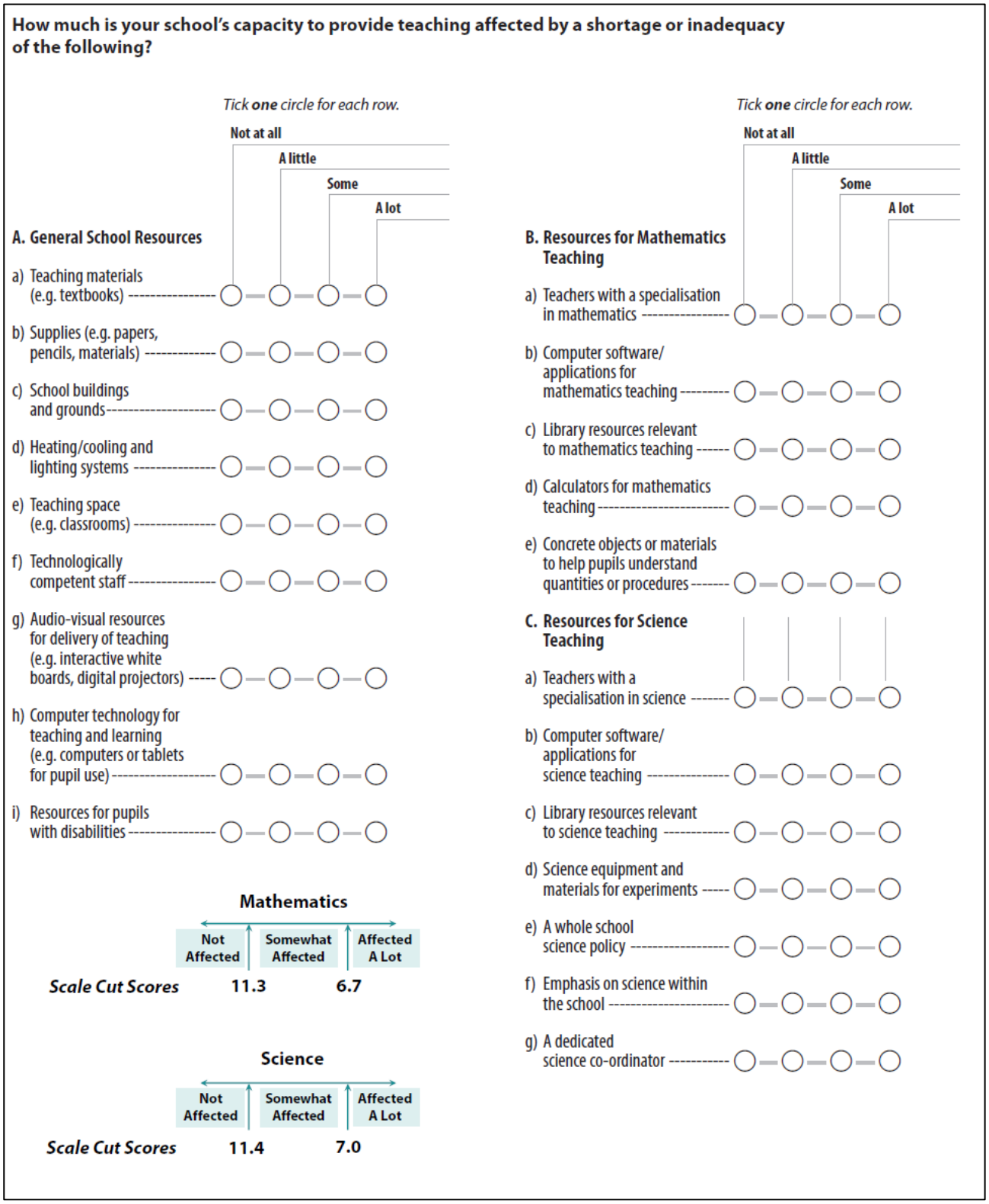
In this section, we do not report whether differences are statistically significant as, due to the large sample sizes, small differences can be statistically significant but not meaningful from a policy or practice perspective. Instead, we report on the size of differences. Throughout the remainder of the chapter, differences of three percentage points or fewer may be described as similar, differences of four to six percentage points as small, differences of seven to nine percentage points as moderate, and differences of ten or more percentage points as large.

8.1 Resources for mathematics and science learning and their impact on instruction

Effective teaching and learning in any subject is supported by the provision of adequate resources. These resources range from the general learning environment, such as school buildings and sufficient, comfortable classroom space, to the subject-specific requirements of trained specialist staff, and instructional materials such as textbooks. In addition, learning is supported by relevant technological and online provision as well as library resources and, in the case of science, resources for experimentation.

TIMSS addresses the resourcing of mathematics and science teaching through the school-level questionnaire. Principals were asked to rate the extent to which their school's capacity to teach was limited by a shortage of resources. Pupils were scored according to their principals' responses concerning the resources shown below (Figure 8.1).

Figure 8.1 Questionnaire on the extent that teaching is affected by resource shortages



Source: TIMSS 2019 Northern Ireland, School questionnaire Q13, Exhibits 6.13 and 6.16, International Results in Mathematics and Science

For mathematics and science, the scale contained general resources and relevant subject-specific resources. The question was analysed as two separate scales, one for each subject. The data for each subject is shown in Tables 8.1 and 8.2. It is worth noting that there have been some small changes to the categories and cut scores (defined in Tables 8.1, 8.2) since 2015 and therefore some caution should be taken when interpreting trends over time[32].

Table 8.1 Limitations on teaching caused by resourcing in Mathematics

Reported by Principals

Students were scored according to their principals' responses regarding thirteen school and classroom resources on the Instruction *Affected by Mathematics Resource Shortages* scale. Cut scores divide the scale into three categories. Students in schools where instruction was **Not Affected** by resource shortages had a score at or above the cut score corresponding 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 at or below the cut score corresponding 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 **Somewhat Affected** by resource shortages.

Country	Not Affected		Somewhat Affected		Affected A Lot		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	18 (3.7)	571 (10.7)	82 (3.7)	566 (3.5)	0 (0.0)	~ ~	9.9 (0.14)
International Average	**26 (0.4)**	**514 (1.3)**	**68 (0.5)**	**499 (0.6)**	**6 (0.2)**	**473 (3.2)**	

This TIMSS context 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 students.

Source: Exhibits 6.13 and 6.14, TIMSS 2019 International Results in Mathematics and Science

According to their principals, 82 per cent of pupils in Northern Ireland were *Somewhat affected* by resource shortages in mathematics. This was a large increase of 15 percentage points on the equivalent result from 2015 (67 per cent). Since 2015, there was also a marked change in the proportion of pupils *Not affected* by resource shortages in mathematics, from six percentage points above the International Average in 2015 to eight percentage points below it in 2019. This represents a large decrease on the percentage of pupils in this category between the two TIMSS cycles. Note that no pupils were reported as being *Affected a lot* by resource shortages in Northern Ireland. This is below the International Average and was also the case in 2015.

In mathematics, there was some evidence of an attainment gap developing between pupils who were *Not Affected* and those who were *Somewhat affected* by resource shortages. There was a five scale point difference in mathematics attainment scores between these groups in 2019 and this gap was one point in 2015. Although significance tests have not been conducted for this analysis, based on the size of the standard errors

[32] In 2015 principals responded to the same statements as in 2019 but their responses were split into three slightly different categories: *Not affected, Affected* and *Affected a lot*. Pupils in schools where teaching was *Not affected* had a score on the scale of at least 11.1 (mathematics) or 11.2 (science) and pupils in schools where teaching was *Affected a lot* had a score no higher than 6.9 (mathematics) and 7.2 (science).

the difference in achievement scores for mathematics in Northern Ireland is unlikely to be statistically significant.

Table 8.2 Limitations on teaching caused by resourcing in Science

Reported by Principals

Students were scored according to their principals' responses regarding thirteen school and classroom resources on the Instruction *Affected by Science Resource Shortages* scale. Cut scores divide the scale into three categories. Students in schools where instruction was **Not Affected** by resource shortages had a score at or above the cut score corresponding 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 at or below the cut score corresponding 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 **Somewhat Affected** by resource shortages.

Country	Not Affected		Somewhat Affected		Affected A Lot		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Northern Ireland r	12 (3.1)	526 (6.8)	85 (3.4)	518 (2.9)	2 (1.5)	~ ~	9.5 (0.13)
International Average	**24 (0.4)**	**508 (1.4)**	**69 (0.5)**	**488 (0.6)**	**7 (0.3)**	**472 (3.0)**	

This TIMSS context 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 students.

Source: Exhibits 6.16 and 6.17, TIMSS 2019 International Results in Mathematics and Science

According to their principals, 85 per cent of pupils in Northern Ireland were *Somewhat affected* by resource shortages in science. This was a small increase of five percentage points on the equivalent result from 2015 (80 per cent). Compared to the International Average in 2019, Northern Ireland had a higher percentage of pupils *Somewhat affected* by resource shortages in science. Whilst Northern Ireland was also above the International Average for pupils *Somewhat affected* in 2015, the gap between Northern Ireland and the International Average increased by a small amount from 11 percentage points in 2015 to 16 percentage points in 2019. Two per cent of pupils were reported as *Affected a lot* by shortages in science, below the International average of seven per cent. This was zero in 2015.

In science, there was an attainment gap of eight scale points between pupils *Not Affected* and those *Somewhat Affected* by resource shortages. This was larger than the gap in mathematics and similar to the gap in science in 2015. Although significance tests have not been conducted for this analysis, based on the size of the standard errors the difference in achievement scores for science in Northern Ireland is unlikely to be statistically significant, as was also the case for mathematics.

In summary, principals reported that a higher proportion of pupils were affected by a lack of resources in 2019 compared to 2015, and this was a larger change than the international trend. There is some evidence that in mathematics this was associated with a decrease in the achievement score of the pupils affected. Finally, the proportion of pupils *Affected a lot* by a lack of resources remains low and below the International Average.

8.2 Limitations of teaching caused specifically by technological resources

Many of the questions on resources in the school questionnaire relate to the use of technological resources (Figure 8.1). These are discussed in detail in Chapter 9, which looks at access to IT resources in school and home as well as IT use in mathematics and science lessons.

8.3 Access to school library resources

Principals were asked about the access pupils have to school library facilities (Table 8.3). In Northern Ireland, 73 per cent of pupils attended schools with a school library, a similar percentage to 2011 and 2015. This was lower than the International Average, which was 86 per cent of pupils, which has also changed little since 2011. Among comparator countries, Northern Ireland had the third lowest percentage of pupils with access to a school library, above only Finland (69 per cent) and the Republic of Ireland (52 per cent). All pupils in Hong Kong, 99 per cent of pupils in Singapore and Korea, and 98 per cent of pupils in Poland attended a school with a library.

Principals were also asked whether their school libraries contained more than 2,000 print books with different titles, excluding magazines and periodicals. In Northern Ireland, 21 per cent of pupils were in this category, which is below the International Average and was the lowest of all of the comparator countries. However, this percentage was similar to Finland and the Republic of Ireland, the only other comparator countries below the International Average.

Table 8.3 Availability of books in school libraries

Country	Percentage of Y6 pupils in schools with a library (%)	Percentage of Y6 pupils in schools with a library of more than 2,000 books (excluding periodicals) (%)	Percentage of Y6 pupils in a school with classroom libraries. (%)
Canada	95	66	92
England	93	53	89
Finland	69	22	25
Hong Kong	100	92	89
Republic of Ireland	52	23	95
Korea	99	88	53
Northern Ireland	**73**	**21**	**92**
Poland	98	84	62
Singapore	99	90	88
International Avg.	**86**	**52**	**53**

Sources: 2019 School Context Data Almanac by Mathematics Achievement and 2019 School Context Data Almanac by Science Achievement questions ACBG10A and ACBG10B and ACBG11.

A third question asked principals whether their schools had classroom libraries and 92 per cent of pupils in Northern Ireland were in schools that did, which is above the International Average of 53 per cent. Among the comparators, only Canada (92 per cent) and the Republic of Ireland (95 per cent) had the same or similar percentages as in Northern Ireland. Therefore, although fewer Y6 pupils in Northern Ireland have access to large school libraries, nearly all have access to classroom library facilities.

8.4 School resources for science experiments

Principals were asked about the resources available to conduct science experiments (Table 8.4). In Northern Ireland, no schools had a science laboratory for Y6 pupils, as was also the case in 2015. All of the other 57 participating countries recorded at least some pupils with access to laboratory facilities for this age group and the International Average was 36 per cent. Amongst the comparator countries, only the Republic of Ireland was similar to Northern Ireland, with two per cent of pupils; three other comparators also had below the International Average (Canada, England and Finland).

This particular measure showed extreme variation, as in Korea and Singapore nearly all pupils had access to a laboratory (99 and 98 per cent respectively).

Table 8.4 School resources for Science experiments.

Country	Percentage of Y6 pupils in schools with a science laboratory (%)	Percentage of Y6 pupils in schools where teachers have assistance available when pupils are conduction experiments (%)
Canada	11	20
England	24	37
Finland	13	32
Hong Kong	42	62
Republic of Ireland	2	9
Korea	99	74
Northern Ireland	**0**	**19**
Poland	66	50
Singapore	98	67
International Avg.	**36**	**35**

Exhibit 13.14, International Results in Mathematics and Science

Principals were asked about whether teachers had assistance available when pupils conduct science experiments. Nineteen percent of pupils in Northern Ireland did have such support, similar to 2015. This was below the International Average of 35 per cent, but exceeded the percentage of pupils in the Republic of Ireland (nine per cent) and was similar to that of Canada (20 per cent). Again, Korea and Singapore scored well above the International Average with 74 and 67 percent respectively.

8.5 Conclusion

In Northern Ireland, the majority of pupils attended schools where the principal reported that teaching was *Somewhat Affected* by a shortage of resources, and this was true for both subjects. Northern Ireland was above the International Average, which represents a change in mathematics from 2015 when it was similar to the International Average. Two per cent of pupils were reported as being *Affected a lot* by shortages in science which is the first time pupils in Northern Ireland have been recorded in this category. With pupils

Affected lot and those *Somewhat affected* their scores were lower than those who were not affected, but this difference is unlikely to be significant.

Compared with International Averages pupils in Northern Ireland were less likely to attend schools with a school library and they were also less likely to have libraries that contained more than 2,000 printed books (as were pupils in Finland and the Republic of Ireland). However, more pupils were likely to attend a school that had classroom libraries (similar to pupils in Canada and the Republic of Ireland).

In Northern Ireland, no schools reported having a science laboratory, which was lower than all participating countries. However, there was some support for conducting science experiments in class, with 19 per cent of pupils taught by teachers with access to assistance when conducting experiments, this was below the International Average (35 per cent).

9 Digital learning environment

Chapter outline

This chapter summarises Year 6 (Y6, ages 9-10) pupils' access to digital resources in the home as well as access to and use of computers in mathematics and science lessons. This chapter also explores teachers' reports of professional development on integrating technology into lessons and principals' reports of limitations of teaching caused by shortages or inadequacies of digital resources.

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 countries where relevant.

Key findings

- There was good access to and use of digital resources at home and in schools for Y6 pupils in Northern Ireland compared to the average internationally.
- The vast majority of pupils in Northern Ireland had access to a computer or tablet at home and an internet connection, more so than seen internationally with the exception of Norway where the level was the same, suggesting that pupils in Northern Ireland had a means of accessing education material online.
- Northern Ireland had slightly lower numbers of computers per school for Y6 pupils than the International Average but there was a small increase since 2015. However, compared with the picture internationally, computer availability was favourable in Northern Ireland; they were ranked[33] eleventh for availability of computers in mathematics lessons and eighth for science lessons.
- Of the comparator countries, Singapore had by far the highest number of computers available per school but this reflects that, on average, there are many more Y6 pupils per school in Singapore.

[33] This finding should be interpreted with caution as rankings can be volatile, varying according to the mix of countries participating in any given cycle. In addition, small differences may or may not be statistically significant, depending on the size of the standard error for each country.

- Pupil access to computers in lessons was higher for science lessons than for mathematics lessons, but teachers used computers for activities less often in science than in mathematics. This is likely to reflect the fact that less time is spent on science teaching overall than it is a reflection of the way ICT is used in science lessons.
- Across both subjects, it was most common for teachers to report shared access to computers, i.e. the school having computers that the class can sometimes use in mathematics and science lessons, rather than each pupil having their own computer or a set in the class.
- Although generally a less common type of computer access across countries, classes having a shared set of computers was seen more often in Northern Ireland than in any other comparator country and the International Average.
- Using digital devices for science tests was much less common than for mathematics in Northern Ireland. However, this is perhaps less reflective of the use of digital devices in science tests and more a result of less testing in general in science than mathematics at primary level.
- There was no clear link between higher computer availability and higher mathematics or science performance in Northern Ireland, or on average internationally.
- Principals were asked to what extent teaching in their school was limited by a shortage or inadequacy of specific digital resources. In Northern Ireland, the biggest issue was *A shortage or inadequacy of computer software / applications for science*; one-fifth of pupils in Northern Ireland were taught in schools affected *A lot* by shortages or inadequacies of science software or applications, and this has increased since 2015.
- Less than one-tenth of pupils in Northern Ireland were reported as having teaching affected *A lot* by inadequacies of *Technologically competent staff* according to principals' responses. However, the principals' views are not reflected in the responses of teachers regarding needing professional development in integrating technology into their lessons.
- In Northern Ireland and across comparator countries, teachers reported a need for future professional development on integrating technology into science and maths lessons. This is likely to reflect the growing role technology is having in education.

- All pupils in Northern Ireland attend schools where an online management system is used to support learning (such as MY-SCHOOL and Fronter). This reflects the fact that all primary, post-primary and special schools have access to C2k, an education technology system which delivers a comprehensive range of information and communication tools to support teaching and learning.

Interpreting the data: percentages in tables

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

Y6 pupils were sampled by class. The Y6 teacher questionnaire would, in most cases therefore, 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.

Interpreting the data: differences

In this section, we do not report whether differences are statistically significant as, due to the large sample sizes, small differences can be statistically significant but not meaningful from a policy or practice perspective. Instead, we report on the size of differences. Throughout the remainder of the chapter, differences of three percentage points or less may be described as similar, differences of four to six percentage points as small, differences of seven to nine percentage points as moderate, and differences of ten or more percentage points as large.

9.1 Digital resources in the home

As discussed in Chapter 4, pupils with *Many resources* at home scored significantly higher in mathematics and science than pupils with *Some resources* at home. One question about home resources asked pupils to indicate which key study supports they had at home: a computer or tablet and an internet connection. Table 9.1 presents the proportion of pupils in Northern Ireland who reported having these resources, along with the International Average.

The vast majority of pupils in Northern Ireland had access to a computer or tablet at home (96 per cent) and an internet connection (99 per cent), more than was seen internationally (87 per cent and 85 per cent respectively). Northern Ireland had a higher proportion of pupils who had access to an internet connection than any another country, with the exception of Norway where this was also 99 per cent. Access to these digital resources was limited in less developed countries such as Pakistan, Morocco and the Philippines, where just under half of pupils had access to a computer or tablet and less than 40 per cent of pupils had an internet connection in their home. Across all the comparator countries, the vast majority of pupils (over 90 per cent), indicated that they had access to a laptop or a tablet, this was also the case for an internet connection.

Table 9.1 Pupils' access to a computer or tablet and an internet connection

Country	Percentage of pupils indicating they had access to a computer or tablet (%)	Percentage of pupils indicating they had access to an internet connection (%)
Northern Ireland	96	99
International Average	87	85

Sources: 2019 Mathematics Student Context Data Almanac by Mathematics Achievement questions ASBG05A and 2019 Science Student Context Data Almanac by Science Achievement questions ASBG05A

9.2 Availability of computers in schools

Principals were asked about the availability of computers, including tablets, in their schools. Table 9.2 shows the average number of computers available for Y6 pupils in 2015 and 2019. This table also presents the average number of Y6 pupils enrolled in the school on the first day of the month the TIMSS test was taken. Information on the average number of Y6 pupils enrolled is included to contextualise the number of computers available for Y6 pupils in Northern Ireland, the comparator countries and the International Average.

The average number of computers available (per school for use by Y6 pupils) in Northern Ireland was 34, which was slightly lower than the International Average of 40. This was less than one computer per pupil when considering the average number of Y6 pupils enrolled (47). In Northern Ireland there has been a small increase in the average number of computers since 2015, although in both cycles the average number of computers was less than the International Average.

Table 9.2 Availability of computers

Average number of computers available for Y6 and average number of Y6 pupils enrolled in the school on the first day of the month TIMSS testing began.

Country	2019 Average number of computers available for Y6	2019 Average number of Y6 pupils enrolled	2015 Average number of computers available for Y6	2015 Average number of Y6 pupils enrolled
Canada	53	60	50	56
England	89	64	47	52
Finland	50	52	31	44
Hong Kong	123	131	74	120
Korea	61	137	46	137
Northern Ireland	**34**	**47**	**30**	**41**
Poland	29	75	25	60
Republic of Ireland	23	46	18	42
Singapore	224	230	180	238
International Avg.	**40**	**90**	**35**	**87**

Sources: 2015 School Context Data Almanac by Mathematics Achievement and 2015 School Context Data Almanac by Science Achievement question ACBG11 and ACBG02 and 2019 School Context Data Almanac by Mathematics Achievement and School Context Data Almanac by Science Achievement question ACBG07 and ACBG02

Of the comparator countries, Singapore had by far the highest number of computers per school for Y6 pupils (224), with Hong Kong also exceeding 100 computers per school. These two countries do have, on average, a larger number of Y6 pupils enrolled than in

the other comparator countries (230 and 131 respectively) but on average, there is almost one computer per Y6 pupil. There were more computers available for Y6 pupils, in England[34] than there were number of Y6 pupils enrolled in the school (89 computers compared with 64 Y6 pupils), but this finding is unusual and warrants further investigation.

Internationally, Y6 access to computers averaged to just over two pupils per computer (90 Y6 pupils with an average of 40 computers available). This was greater access than in Republic of Ireland (46 pupils and 23 computers) and in Poland (75 pupils and 29 computers) but not as good as the access in Northern Ireland.

Since 2015, in all of the comparator countries there has been an increase in the number of computers available for Y6 pupils. In Northern Ireland the increase is relatively small (four additional computers) when compared with Hong Kong, Singapore and England (49, 44 and 42 increase respectively). These countries with the largest improvements in access between cycles also have a higher ratio of computers to Y6 pupils. Northern Ireland, therefore, appears less well-equipped, compared to some of the high-scoring nations, to make the move to computer-based learning in schools.

9.3 Access to computers for mathematics and science lessons

Teachers were asked whether computers were available for pupils to use during mathematics and science lessons and the types of access they have:

- each pupil in the class has a computer
- the class has computers that pupils can share
- the school has computers that the class can sometimes share.

Teachers could indicate more than one type of access. Access to computers in mathematics and science lessons is discussed below, drawing on comparisons to the International Average and across comparator countries.

9.3.1 Access to computers for mathematics lessons

In Northern Ireland, as shown in Table 9.3, 69 per cent of pupils had teachers who reported that computers were available for use during mathematics lessons, above the International Average (39 per cent). This high availability of computers in mathematics

[34] Data are available for at least 50 per cent but less than 70 per cent of the pupils in England, therefore, findings should be interpreted with caution.

lessons in Northern Ireland was consistent with the 2015 results, where 71 per cent of Y6 pupils had access to computers.

Northern Ireland ranked eleventh[35] in terms of the percentage of pupils who had computers available to use in mathematics lessons, in 2015 only three countries had computers available for a larger proportion of their pupils. Large increases in computer availability for mathematics lessons in countries such as Sweden, Hong Kong, Norway and the United States between 2015 and 2019 means computer access is now higher than in Northern Ireland.

Table 9.3 Access to computers for Mathematics lessons

Reported by teachers

Country	Computers Available for Students to Use During Mathematics Lessons				Percent of Students by Computer Access*		
	Yes		No		Each Student has a Computer	The Class has Computers that Students can Share	The School has Computers that the Class can Sometimes Use
	Percent of Students	Average Achievement	Percent of Students	Average Achievement			
Hong Kong SAR	81 (4.6)	602 (3.9)	19 (4.6)	599 (12.2)	38 (4.3)	23 (3.8)	67 (4.8)
Northern Ireland	69 (4.0)	564 (4.3)	31 (4.0)	568 (5.9)	3 (1.2)	48 (4.3)	58 (4.2)
Finland	65 (3.6)	531 (2.9)	35 (3.6)	535 (3.3)	15 (2.5)	17 (2.4)	57 (3.5)
Canada	51 (2.9)	506 (3.0)	49 (2.9)	520 (4.2)	13 (2.1)	32 (2.7)	r 43 (2.8)
Singapore	46 (2.6)	626 (5.4)	54 (2.6)	625 (4.7)	18 (1.9)	18 (2.0)	44 (2.5)
Ireland, Rep. of	43 (4.0)	548 (4.7)	57 (4.0)	548 (2.8)	5 (2.0)	19 (2.9)	36 (4.1)
Korea, Rep. of	34 (3.8)	595 (4.2)	66 (3.8)	602 (2.7)	6 (2.1)	6 (2.1)	32 (3.8)
Poland	29 (3.4)	514 (4.6)	71 (3.4)	522 (3.0)	6 (1.8)	4 (1.4)	27 (3.2)
England	x 32 (4.4)	566 (5.6)	68 (4.4)	554 (6.5)	x 7 (2.3)	x 20 (4.4)	x 24 (4.9)
International Average	**39 (0.4)**	**506 (1.4)**	**61 (0.4)**	**500 (0.7)**	**13 (0.3)**	**17 (0.4)**	**29 (0.4)**

* Teachers could indicate the class having more than one type of computer access.
( ) 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.
An "x" indicates data are available for at least 40% but less than 50% of the students—interpret with caution.

Source: Exhibit 14.1, TIMSS 2019 International Results in Mathematics and Science

For the sub-set of pupils who did have access to a computer during mathematics lessons (69 per cent in Northern Ireland), the way in which they accessed the computers during their mathematics lessons varied. Three per cent of pupils in Northern Ireland had teachers who reported that *each pupil* has access to a computer for use in mathematics lesson (i.e. each pupil has access to a designated computer). This percentage was similar to the Republic of Ireland (five per cent), Korea (six per cent) and Poland (six per cent). In comparison, 38 per cent of pupils in Hong Kong had teachers who reported that each pupil has access to a designated computer for use in mathematics lessons. Despite having a high availability of computers (as noted above), only 18 per cent of pupils in Singapore and seven per cent of pupils in England had teachers who reported that each pupil has access to a designated computer for mathematics lessons.

[35] This finding should be interpreted with caution, as rankings can be volatile, varying according to the mix of countries participating in any given cycle. In addition small differences may or may not be statistically significant, depending on the size of the standard error for each country.

In Northern Ireland, nearly half (48 per cent) of pupils had teachers who reported that the class has computers[36] that pupils can share for mathematics lessons. This percentage was higher than the International Average (17 per cent) and across comparator countries. In Northern Ireland and across all comparator countries, access to computers for mathematics lessons was most commonly achieved through school computers that the class could sometimes use in mathematics lessons; 58 per cent of pupils in Northern Ireland had teachers reporting this type of access. This percentage was higher than the International Average (29 per cent) and most of the comparator countries, with the exception of Hong Kong where 67 per cent of pupils had teachers reporting this type of access.

Across the comparator countries, the percentage of pupils whose teachers reported access to computers for mathematics lessons was highest in Hong Kong (81 per cent of pupils) and lowest in Poland (29 per cent). 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 for mathematics lessons (46 per cent of pupils) was only moderately higher than the International Average. In Northern Ireland, the small difference between the average achievement of those pupils who have access to a computer in mathematics lessons (564) and those who do not (568) is unlikely to be significant based on the size of the standard errors. In this case, it is important to consider that the relationship between computer availability and average attainment is complex, and that achievement data in this area should be interpreted with caution. For example, in some countries, computers might be made available to high-achieving pupils in order to challenge them and stretch their skills. In other countries, they might be made available to lower-achieving pupils for drill and practice. Thus, any association, or lack of association, with achievement might be moderated by the learning task or the group of pupils at which computer use is targeted.

9.3.2 Access to computers for science lessons

In Northern Ireland, 80 per cent of Y6 pupils were taught by teachers who reported that computers were available for use in science lessons. This percentage was higher than the International Average (45 per cent). This is a small increase to what was seen in 2015, where 76 per cent of pupils were taught by teachers who reported computers were available for science in Northern Ireland.

As shown in Table 9.4, with the exception of Finland, computer availability for science lessons was higher in Northern Ireland than in all comparator countries, and it ranked

[36] It is worth noting that this question does not determine how many computers are within this class set, it may be a couple which pupils take turns accessing or it may be a larger set which can be shared more equally between pupils (e.g. two pupils per computer).

eighth[37] internationally. There was considerable variation among comparator countries in computer availability in science lessons, ranging from 20 per cent in Poland to 83 per cent in Finland.

Table 9.4 Access to computers for Science lessons

Reported by teachers

Country	Computers Available for Students to Use During Science Lessons				Percent of Students by Computer Access*		
	Yes		No		Each Student has a Computer	The Class has Computers that Students can Share	The School has Computers that the Class can Sometimes Use
	Percent of Students	Average Achievement	Percent of Students	Average Achievement			
Finland	83 (2.5)	554 (2.8)	17 (2.5)	557 (4.8)	18 (2.7)	25 (2.7)	76 (2.8)
Northern Ireland	80 (3.5)	518 (2.8)	20 (3.5)	518 (5.9)	7 (2.1)	60 (4.4)	71 (4.2)
Hong Kong SAR	70 (4.4)	533 (4.5)	30 (4.4)	532 (8.4)	45 (5.0)	28 (4.4)	59 (4.6)
Canada	r 64 (3.0)	524 (2.3)	36 (3.0)	525 (4.1)	r 16 (2.0)	r 40 (3.1)	r 52 (3.1)
Singapore	60 (2.6)	594 (4.4)	40 (2.6)	595 (4.6)	25 (2.4)	29 (2.2)	57 (2.8)
Korea, Rep. of	49 (3.8)	587 (3.6)	51 (3.8)	588 (2.3)	15 (2.6)	12 (2.8)	45 (4.0)
Ireland, Rep. of	45 (3.8)	526 (5.6)	55 (3.8)	530 (3.5)	7 (2.2)	20 (3.2)	36 (3.8)
Poland	20 (2.9)	522 (5.7)	80 (2.9)	534 (2.8)	2 (1.2)	5 (1.8)	18 (2.7)
England	x 36 (4.9)	550 (7.0)	64 (4.9)	533 (5.9)	x 4 (2.0)	x 24 (5.1)	x 27 (5.2)
International Average	**45 (0.4)**	**496 (1.0)**	**55 (0.4)**	**490 (0.8)**	**14 (0.3)**	**22 (0.4)**	**36 (0.5)**

* Teachers could indicate the class having more than one type of computer access.
( ) 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.
An "x" indicates data are available for at least 40% but less than 50% of the students—interpret with caution.

Source: Exhibit 14.2, TIMSS 2019 International Results in Mathematics and Science

In many countries, and consistent with the findings from 2015, a higher percentage of pupils had computers available for their science lessons than for their mathematics lessons, with the International Average for science six percentage points higher than for mathematics. In Northern Ireland, and internationally, there was no clear association between science achievement and computer availability in science lessons; this mirrors what was seen in mathematics.

As with mathematics, the type of access varied across this sub-set of pupils (80 per cent) who had computers available for use during their science lessons. Table 9.4 also shows that seven per cent of pupils in Northern Ireland had teachers who reported that *each pupil* had a computer for use during science lessons (i.e. each pupil has access to a designated computer). This percentage was the same as the Republic of Ireland (7 per cent) but lower than for most of the comparator countries and the International Average. In Northern Ireland, 60 per cent of pupils had teachers who reported that the class has computers that pupils can share for science lessons[38]. This was the highest percentage seen across comparator countries, as was the case for mathematics.

As with mathematics, in Northern Ireland access to computers for science lessons was most commonly achieved through school computers that the class could sometimes use for science lessons, with 71 per cent of pupils having teachers reporting this type of

[37] This finding should be interpreted with caution, as rankings can be volatile, varying according to the mix of countries participating in any given cycle
[38] As with mathematics, this question does not determine how many computers were available for a class to share in science lessons

access. Across the comparator countries pupils were more likely to have teachers reporting this type of access to computers for science lessons than a computer each or class computers to share.

9.4 Technology to support learning

9.4.1 Technology to support learning in mathematics lessons

In order to investigate the use of technology to support learning in mathematics lessons, teachers were asked how often they did activities on the computers during their mathematics lessons (the findings for teachers in Northern Ireland and across comparator countries are shown in Table 9.5).

In Northern Ireland, 12 per cent of pupils had teachers who reported that they did activities on the computer during their mathematics lessons *Every or almost every day*. This was a higher percentage of pupils than was seen in the majority of the comparator countries, and the same as in Hong Kong. In contrast, 38 per cent of pupils had teachers who reported that they *Never or almost never* did activities on the computers during their mathematics lessons, the lowest amongst comparator countries with the exception of Hong Kong (30 per cent).

Table 9.5 Teachers do computer activities to support learning in Mathematics

Reported by teachers

Country	Every or Almost Every Day		Once or Twice a Week		Once or Twice a Month		Never or Almost Never	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Canada	6 (1.0)	503 (6.2)	24 (2.0)	503 (3.9)	19 (2.5)	511 (6.1)	52 (3.0)	519 (4.0)
Finland	3 (0.8)	529 (10.2)	19 (2.5)	523 (5.4)	36 (3.4)	536 (3.6)	43 (3.8)	534 (3.7)
Hong Kong SAR	12 (3.2)	587 (10.5)	15 (3.3)	597 (10.6)	42 (4.2)	609 (4.6)	30 (4.8)	600 (8.5)
Ireland, Rep. of	3 (1.2)	519 (18.3)	15 (3.1)	543 (7.4)	15 (2.9)	559 (6.9)	66 (3.5)	548 (2.6)
Korea, Rep. of	0 (0.0)	~ ~	0 (0.4)	~ ~	10 (2.5)	590 (7.0)	90 (2.6)	600 (2.4)
Northern Ireland	12 (2.9)	566 (11.9)	19 (3.0)	565 (6.7)	31 (3.8)	563 (6.0)	38 (3.9)	567 (5.2)
Poland	1 (0.8)	~ ~	5 (1.5)	513 (12.0)	17 (2.7)	511 (5.9)	76 (3.2)	523 (3.0)
Singapore	0 (0.3)	~ ~	11 (1.7)	626 (10.8)	30 (2.4)	629 (7.2)	59 (2.6)	623 (4.4)
England x	5 (1.5)	587 (10.0)	10 (3.4)	578 (17.0)	13 (4.0)	557 (6.0)	72 (4.3)	553 (6.2)
International Average	**7 (0.2)**	**515 (2.4)**	**14 (0.3)**	**509 (1.6)**	**13 (0.3)**	**510 (1.6)**	**67 (0.4)**	**500 (0.7)**

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An "x" indicates data are available for at least 40% but less than 50% of the students—interpret with caution.

Source: Exhibit 14.5, TIMSS 2019 International Results in Mathematics and Science

There was no clear association between frequency of computer activities in mathematics lessons and attainment in Northern Ireland or across comparator countries. This was also reflected in the varied picture in the high-achieving countries. For example in Korea, one of the countries with the highest mathematics achievement, 90 per cent of pupils had teachers reporting they *Never or almost never* did activities on the computer during their

mathematics lessons, the remainder of pupils had teachers who did activities on the computer *Once or twice a month.*

9.4.2 Technology to support learning in science lessons

As in mathematics, to investigate the use of technology to support learning in science lessons, teachers were asked how often they did activities on the computers during their science lessons (the findings for teachers in Northern Ireland and across comparator countries are shown in Table 9.6).

In Northern Ireland, five per cent of pupils had teachers who reported that they did activities on the computer during their science lessons *Every or almost every day*, moderately lower than the findings for mathematics lessons. Forty per cent of pupils in Northern Ireland had teachers who reported *Never or almost never* doing activities on computers, much lower than the International Average (60 per cent). As with mathematics, Hong Kong had the highest frequency of using technology to support learning across comparator countries, with ten per cent of pupils taught science by teachers who reported doing activities on the computers in science lessons *Every or almost every day*.

Table 9.6 Teachers do computer activities to support learning in Science

Reported by teachers

Country	Every or Almost Every Day		Once or Twice a Week		Once or Twice a Month		Never or Almost Never	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Canada r	5 (1.2)	526 (9.8)	18 (2.1)	521 (3.8)	32 (2.4)	524 (3.3)	45 (2.6)	526 (2.9)
Finland	4 (1.2)	544 (8.7)	19 (2.7)	554 (4.3)	51 (3.3)	557 (3.2)	25 (2.8)	552 (5.0)
Hong Kong SAR	10 (2.6)	534 (11.3)	16 (3.3)	540 (8.7)	39 (4.0)	529 (4.5)	36 (4.1)	532 (6.5)
Ireland, Rep. of	1 (0.8)	~ ~	8 (2.0)	510 (12.8)	21 (3.0)	532 (7.4)	69 (3.5)	530 (3.0)
Korea, Rep. of	2 (1.1)	~ ~	3 (1.5)	568 (16.7)	28 (3.6)	586 (4.2)	66 (3.3)	589 (2.2)
Northern Ireland	5 (1.6)	514 (13.3)	14 (3.1)	529 (7.9)	42 (3.9)	520 (3.6)	40 (4.4)	513 (4.1)
Poland	2 (1.0)	~ ~	5 (1.8)	527 (8.0)	6 (1.6)	510 (7.8)	86 (2.4)	533 (2.8)
Singapore	1 (0.5)	~ ~	9 (1.3)	592 (13.0)	40 (2.8)	595 (5.8)	50 (2.7)	595 (4.1)
England x	5 (1.9)	566 (13.5)	10 (3.0)	556 (17.5)	18 (4.5)	543 (11.2)	68 (4.8)	533 (5.7)
International Average	**6 (0.2)**	**498 (2.3)**	**13 (0.3)**	**498 (1.6)**	**20 (0.4)**	**500 (1.5)**	**60 (0.4)**	**490 (0.7)**

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students.
An "x" indicates data are available for at least 40% but less than 50% of the students—interpret with caution.

Source: Exhibit 14.6, TIMSS 2019 International Results in Mathematics and Science

Similar to the findings for mathematics, there was no clear association between frequency of computer activities in science lessons and attainment in Northern Ireland or comparator countries.

9.4.3 Online learning management systems to support learning

Principals were asked if their school uses an online management system to support learning. All pupils in Northern Ireland attend schools where an online management system is used to support learning (such as MY-SCHOOL and Fronter). This reflects the fact that all primary, post-primary and special schools have access to C2k, an education technology system which delivers a comprehensive range of information and communication tools to support teaching and learning.

All pupils in Singapore also attend schools where an online management system is used to support learning. Online learning management systems were less common in England (42 per cent of pupils had principals who responded *Yes* to this questions) and Korea (52 per cent).

Table 9.7 School use of online management system to support learning

The percentage of pupils whose principals reported 'Yes' to use of online management systems

Country	Yes(%)
Canada	62
England	42
Finland	95
Hong Kong	86
Korea	52
Northern Ireland	**100**
Poland	82
Republic of Ireland	64
Singapore	100
International Avg.	**64**

Sources: 2019 School Context Data Almanac by Mathematics Achievement and School Context Data Almanac by Science Achievement question ACBG09

9.4.4 Access to digital learning resources

As well as the access for pupils to school library facilities and printed books (see Chapter 8), principals were asked if their school provided pupils with access to digital learning resources (e.g. books and videos). Table 9.8 shows the percentages of pupils whose principal responded *Yes* to this question in Northern Ireland and comparator countries.

In Northern Ireland, 84 per cent of pupils had principals who reported that there was access to digital learning resources (e.g. books and videos) in their school. Across the comparator countries, the majority of pupils attended schools where their principals indicated that pupils had access to digital learning resources, this ranged from 66 per cent in Korea to 98 per cent in Hong Kong.

Table 9.8 Access to digital learning resources

The percentage of pupils whose principals reported 'Yes' to access to digital learning resources.

Country	Yes (%)
Canada	89
England	78
Finland	90
Hong Kong	98
Korea	66
Northern Ireland	**84**
Poland	86
Republic of Ireland	79
Singapore	95
International Avg.	**75**

Sources: 2019 School Context Data Almanac by Mathematics Achievement and School Context Data Almanac by Science Achievement question ACBG12

9.5 Tests delivered on digital devices

9.5.1 Tests delivered on digital devices in mathematics

Table 9.9 presents teachers' responses for Northern Ireland and the comparator countries on the frequency with which pupils take mathematics tests on computers or tablets. In Northern Ireland, eight per cent of pupils had teachers who reported that mathematics tests are taken on computers or tablets *Once a month or more*, this was lower than seen internationally (17 per cent). A large number of pupils in Northern Ireland (70 per cent) had teachers who reported that mathematics tests were taken on computers or tablets *Once or twice a year,* a much larger percentage than the International Average (18 per cent). This may reflect the use of online assessments for end of year summative assessments rather than using digital devices in formative assessments or an end of topic.

Table 9.9 Pupils take Mathematics tests on computers or tablets

Reported by teachers

Country	Once a Month or More		Once or Twice a Year		Never	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Canada	13 (1.5)	500 (7.5)	9 (1.1)	508 (7.2)	79 (1.9)	515 (2.3)
Finland	14 (2.2)	538 (5.5)	26 (3.1)	531 (4.4)	60 (3.3)	531 (2.5)
Hong Kong SAR	30 (4.5)	601 (6.1)	25 (3.6)	593 (5.9)	45 (4.9)	607 (6.4)
Ireland, Rep. of	8 (2.5)	554 (6.6)	10 (2.8)	546 (12.9)	82 (3.5)	548 (2.5)
Korea, Rep. of	2 (0.9)	~ ~	6 (1.8)	592 (11.3)	93 (2.1)	600 (2.4)
Northern Ireland	8 (2.4)	567 (8.0)	70 (3.9)	564 (3.7)	23 (3.6)	568 (6.3)
Poland	9 (2.0)	510 (8.7)	20 (3.0)	518 (6.6)	71 (3.6)	522 (3.1)
Singapore	14 (1.5)	625 (8.7)	31 (2.5)	626 (6.5)	54 (2.4)	625 (5.5)
England x	11 (3.9)	545 (5.5)	27 (5.2)	564 (11.5)	62 (5.6)	559 (6.1)
International Average	**17 (0.4)**	**502 (1.4)**	**18 (0.4)**	**504 (1.2)**	**64 (0.4)**	**501 (0.7)**

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An "x" indicates data are available for at least 40% but less than 50% of the students—interpret with caution.

Source: Exhibit 14.9, TIMSS 2019 International Results in Mathematics and Science

Across comparator countries, taking mathematics tests on computers or tablets was most common in Hong Kong (30 per cent of pupils whose teachers reported doing this type of assessment *Once a month or more*). Only two per cent of pupils in Korea had teachers who reported using computers or tablets for mathematics tests this frequently and 93 per cent of pupils had teachers reporting they *Never* take mathematics tests on computers or tablets.

There appears to be no association between the frequency of taking mathematics tests on computers or tablets and attainment, as there is no clear pattern in the International Average, in Northern Ireland or comparator countries.

9.5.2 Tests delivered on digital devices in science

Table 9.10 presents teachers' responses for Northern Ireland and the comparator countries on the frequency with which pupils take science tests on computers or tablets. In Northern Ireland, nearly all pupils (99 per cent) had teachers who reported that science tests are *Never* taken on computers or tablets, with only one per cent of pupils having teachers reporting computers or tablets were used for this purpose *Once or twice a year*. Using digital devices for science tests was less common than for mathematics. However, this is perhaps less reflective of the use of digital devices in science tests and more a result of less testing in science in general in primary schools in Northern Ireland.

Table 9.10 Pupils take Science tests on computers or tablets

Reported by teachers

Country	Once a Month or More		Once or Twice a Year		Never	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Canada r	11 (1.5)	520 (4.3)	10 (1.5)	536 (5.3)	79 (2.1)	524 (2.3)
Finland	21 (2.4)	550 (5.8)	35 (3.3)	560 (3.0)	45 (3.3)	553 (3.2)
Hong Kong SAR	31 (4.2)	529 (6.2)	26 (3.1)	527 (5.7)	43 (4.7)	538 (5.3)
Ireland, Rep. of	2 (0.9)	~ ~	5 (1.6)	521 (19.1)	93 (1.8)	528 (2.8)
Korea, Rep. of	9 (2.3)	584 (8.2)	9 (2.3)	585 (7.3)	82 (3.2)	588 (2.1)
Northern Ireland	0 (0.0)	~ ~	1 (0.8)	~ ~	99 (0.8)	519 (2.5)
Poland	5 (1.5)	556 (8.7)	20 (3.4)	524 (5.4)	76 (3.7)	532 (3.0)
Singapore	9 (1.3)	573 (12.0)	27 (2.1)	597 (5.6)	64 (2.3)	596 (4.5)
England y	- -	- -	- -	- -	- -	- -
International Average	**17 (0.4)**	**489 (1.5)**	**14 (0.3)**	**491 (1.5)**	**69 (0.4)**	**491 (0.7)**

( ) 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.
A "y" indicates data are available for less than 40% of the students.

Source: Exhibit 14.10, TIMSS 2019 International Results in Mathematics and Science

Across comparator countries, taking science tests on computers or tablets was most common in Hong Kong (31 per cent of pupils had teachers who reported doing this type of assessment *Once a month or more* for this question) and Finland (21 per cent of pupils *Once a month or more*).

As was the case for mathematics, there appears to be no association between the frequency of taking sciences tests on computers or tablets and attainment, as there is no clear pattern in the International Average, in Northern Ireland or comparator countries.

9.6 Teachers' professional development on integrating technology into mathematics and science lessons

In Chapter 7, teachers' professional development in mathematics and science and their needs for future development in mathematics and science were explored. As part of this, teachers were asked to indicate whether they had participated in professional development in integrating technology into mathematics or science lessons, or if they needed future development in this area. The findings are discussed further below.

9.6.1 Teachers' professional development on integrating technology into mathematics lessons

In Northern Ireland, as shown in Table 9.11, 37 per cent of pupils had teachers who reported they had participated in professional development in integrating technology into mathematics lessons in the last two years. This was similar to the International Average (35 per cent) and the same as in Canada (37 per cent). Hong Kong had the largest percentage of pupils whose teacher had recently participated in professional development in this area (77 per cent), much higher than in Northern Ireland. Of the comparator countries, Finland and Korea had the lowest percentage of pupils whose

teacher had recently participated in professional development in this area (15 per cent) although, participation in professional development was generally lower in Finland (see Chapter 7 for more information).

Table 9.11 Professional development on integrating technology into Mathematics teaching

Percentage of pupils whose teachers reported professional development activities and needs on this area

Country	Participating in professional development on this area in the last two years (%)	Indicating a need for future professional development on this area (%)
Canada	37	75
Finland	15	70
Hong Kong	77	86
Korea	15	76
Northern Ireland	**37**	**71**
Poland	63	53
Republic of Ireland	23	81
Singapore	61	75
International Avg.	**35**	**72**

Sources: Exhibit 9.13 and 9.17, TIMSS 2019 International Results in Mathematics and Science

Data for England has not been included as data are available for less than 40 per cent of the pupils.

Seventy-one per cent of pupils in Northern Ireland had teachers who indicated a need for future development on integrating technology into mathematics lessons. This was higher than Poland (53 per cent), similar to Finland (70 per cent) and the International Average (72 per cent) and lower than the other comparator countries. The highest percentage of pupils whose teachers indicated needing future professional development on this area was in Hong Kong (86 per cent), despite also having the highest percentage of pupils whose teachers have attended professional development on this area in the last two years. This suggests that even teachers who have had professional development in this area do not feel confident in integrating technology into mathematics lessons, perhaps reflecting how quickly technology evolves and teachers' awareness of how much they need to adapt.

9.6.2 Teachers professional development on integrating technology into science lessons

In Northern Ireland, as shown in Table 9.12, a quarter of pupils had teachers who reported they had participated in professional development in integrating technology into science lessons in the last two years. This was similar to Korea (27 per cent) and the Republic of Ireland (22 per cent) but lower than Poland (56 per cent), Singapore (58 per cent) and Hong Kong (66 per cent). Hong Kong also had the largest proportion of pupils whose teacher had participated in professional development in this area across comparator countries.

Table 9.12 Professional development on integrating technology into Science teaching

Percentage of pupils whose teachers reported professional development activities and needs on this area

Country	Participating in professional development on this area in the last two years (%)	Indicating a need for future professional development on this area (%)
Canada	18	70
Finland	11	61
Hong Kong	66	75
Korea	27	75
Northern Ireland	**25**	**74**
Poland	56	4
Republic of Ireland	22	78
Singapore	58	78
International Avg.	**32**	**68**

Sources: Exhibit 9.14 and 9.18, TIMSS 2019 International Results in Mathematics and Science

Data for England has not been included as data are available for less than 40 per cent of the pupils

Nearly three-quarters (74 per cent) of pupils in Northern Ireland had teachers who indicated a need for future development in integrating technology into science lessons. This was the case in most of the comparator countries, regardless of whether they had participated in professional development on this area in the last two years, such as Hong Kong (75 per cent), Korea (75 per cent), the Republic of Ireland (78 per cent) and Singapore (78 per cent). This reflects the ever-growing role of technology in teaching.

9.7 Limitations on teaching caused by technological resources

Principals reported the extent to which their school's capacity to provide teaching was affected by shortages or inadequacies of digital resources (limitations on teaching caused by resourcing in mathematics and science is discussed in Chapter 7).

Table 9.13 shows the percentages of pupils in schools where the principals reported that teaching was affected *A lot* by shortages of these specific technological resources. In Northern Ireland, the biggest issue in terms of digital resources appears to be *A shortage or inadequacy of computer software / applications for science,* 20 per cent of pupils were taught in schools affected *A lot* by shortages or inadequacies which was higher than the International Average of 14 per cent. The percentage of pupils in this category in Northern Ireland increased since 2015, when it was nine per cent. In terms of the other digital resources, between seven and nine per cent of pupils were taught in schools where principals indicated that the capacity to provide teaching was affected by a shortage or inadequacy of these resources.

In Northern Ireland, between 2015 and 2019 there was also a moderate increase in the percentages of pupils in schools where the principals reported teaching being *Affected a lot* by shortages or inadequacies of *audio-visual resources of delivery for teaching* (from zero per cent in 2015 to seven per cent in 2019) and *Computer software / applications for mathematics* (from one per cent in 2015 to eight per cent in 2019). This may reflect changes to the expectations of what teachers want to and need to use in their teaching.

Among comparator countries and internationally, the picture is varied; this may reflect the way in which different education systems benchmark availability of resources and the technical competence of staff. For example, throughout this chapter Hong Kong has been highlighted as having good access to technology in school and more teachers attending professional development on integrating technology into lessons, yet 15 per cent of pupils had principals reporting that teaching was affected *A lot* by inadequacies of *Technologically competent staff*, the highest percentage across comparator countries.

Table 9.13 Limitations on teaching caused by technological resources

Percentage of pupils whose principals reported teaching being affected A lot by shortages or inadequacies

Country	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 (%)
Canada	5	6	7	6	10
England	0	2	6	0	0
Finland	4	3	6	2	2
Hong Kong	15	15	13	8	12
Korea	5	7	8	2	2
Northern Ireland	**9**	**7**	**7**	**8**	**20**
Poland	4	5	11	7	5
Republic of Ireland	3	6	17	12	25
Singapore	12	14	14	7	6
International Avg.	**13**	**16**	**17**	**12**	**14**

Sources: 2019 School Context Data Almanac by Mathematics Achievement and 2019 School Context Data Almanac by Science Achievement questions ACBG13AF, ACBG13AG, ACBG13AH, ACBG13BB, ACBG13CB

9.8 Conclusion

The vast majority of pupils in Northern Ireland had access to a computer or tablet at home, and an internet connection. Access to an internet connection was higher in Northern Ireland than across all other participating countries (with the exception of Norway, where access was the same). Although TIMSS took place before the Covid-19 pandemic, it is encouraging that Y6 pupils had good access to such digital resources at home. The findings suggest that pupils in Northern Ireland were in a good position to take on the challenges of a move to accessing education material. However, TIMSS did not

explore whether pupils had their own computer or tablet, and more research would be needed to investigate the impact of sharing such resources within households.

The average number of computers available for use by Y6 pupils in Northern Ireland was 34 per school, slightly lower than the International Average, but a small increase from 2015. This ratio of available computers per Y6 pupil in Northern Ireland has remained stable between cycles. Of the comparator countries, Singapore had by far the highest number of computers per school for Y6 (224), with Hong Kong also exceeding 100 computers per school; this was close to one computer per Y6 pupil.

Overall, there was good access to and use of digital resources in primary classrooms in Northern Ireland. Eighty per cent of Y6 pupils were taught by teachers who reported that computers were available for use in science lessons. A lower percentage (69 per cent) of pupils had teachers reporting that computers were available for use during mathematics lessons. There was no clear association between achievement and computer availability in either science or mathematics lessons.

Across both subjects it was most common for teachers to report shared access to computers, that is, the school having computers that the class can sometimes use in mathematics or science lessons. A small proportion of pupils had teachers reporting that pupils had individual access to a computer in mathematics (three per cent) and science (seven per cent) lessons. In comparison, individual access to computers was more likely in Hong Kong (38 per cent mathematics and 45 per cent science).

In Northern Ireland, 12 per cent of pupils had teachers who reported that they did activities on the computer during their mathematics lessons *Every or almost every day*. This was one of the highest percentages of pupils amongst comparator countries and the same as in Hong Kong. Using computers for activities in science lessons *Every or almost every day* was less common in Northern Ireland than for mathematics, despite the higher access noted above for science lessons. However this may well reflect the lower prominence of science in the Northern Ireland curriculum as less time is spent on science teaching than it is a reflection on the way in which computers are used in science lessons.

In terms of online assessment, digital devices were used to deliver mathematics tests *Once a month or more* for eight per cent of pupils in Northern Ireland. Using digital devices for science tests was much less common than for mathematics. However, this says more about the approach to science assessment in primary schools in Northern Ireland, as there is greater emphasis placed on mathematics, rather than being a reflection on the appropriateness or availability of digital assessments in science.

In Northern Ireland, 37 per cent of pupils had teachers who reported they had participated in professional development in integrating technology into mathematics

lessons in the last two years, more than for professional development on integrating technology into science (25 per cent). Teacher responses indicated there is a future need for professional development in integrating technology into mathematics and science lessons in Northern Ireland and across comparator countries, likely reflecting the growing role of technology in teaching.

All pupils in Northern Ireland attend schools where an online management system is used to support learning (such as MY-SCHOOL and Fronter). This reflects the fact that all primary, post primary and special schools have access to C2k, an education technology system which delivers a comprehensive range of information and communication tools to support teaching and learning.

Principals also reported on the extent to which their school's capacity to provide teaching was affected by shortages or inadequacies of digital resources and the findings were fairly similar across the categories. However, limitations of teaching caused specifically by *A shortage or inadequacy of computer software / applications* for science teaching had the highest percentage across Northern Ireland's data, and a large increase from 2015. Chapter 8 considers limitations on teaching caused by all resources, digital and non-digital, and only two per cent of pupils were reported as being *Affected a lot* by shortages in science (the first time pupils in Northern Ireland have been recorded in this category). No pupils were recorded in this category for mathematics (see Chapter 8 for more information).

It is encouraging that less one-tenth of pupils in Northern Ireland were reported as having teaching affected *A lot* by inadequacies of *Technologically competent staff* according to principals' responses. However the principals' views did not reflect the responses of teachers regarding needing professional development in integrating technology into their lessons.

When exploring the findings from International Large Scale Assessments it is useful to look at the school and classroom contexts of the high performing countries. In terms of the digital learning environment Hong Kong is a particularly interesting comparator country. Despite Hong Kong having excellent access to technology in school and more teachers attending professional development on integrating technology into lessons, more pupils were taught in schools where principals reported that teaching was affected *A lot* by inadequacies of *Technologically competent staff*. Additionally, compared with the other comparator countries, Hong Kong had a greater proportion of pupils with teachers indicating a need for future professional development on integrating technology into mathematics and science lessons than in any other comparator country. This this may reflect the way in which different education systems use digital resources and benchmark competence of staff.

10 School learning environment

Chapter outline

This chapter presents findings relating to the school learning environment, as reported by principals, teachers and pupils. The sections report on scales relating to: the emphasis placed on academic success and discipline at the school level; perceptions of a safe and orderly classroom and the impact to teaching caused by pupils not ready for instruction at the class level; and the experience of bullying behaviours at the pupil level.

Key findings

- The findings presented in the chapter characterise education for Year 6 (Y6, ages 9-10) pupils in Northern Ireland as having a *High emphasis* on academic success with *Hardly any problems* with school discipline, *Very safe and orderly* classrooms, with *Some* teaching limited by pupils who are not ready for instruction and pupils experiencing bullying behaviours *Never or almost never*.
- A school's emphasis on academic success has an association with pupil scores. In Northern Ireland, pupils in schools with a *Very high* academic emphasis scored higher in mathematics and science than those from school with a *High* academic emphasis.
- Northern Ireland is one of the top ten countries with regard to the schools' emphasis on academic success scale.
- The school learning environment in Northern Ireland compares well internationally, performing above the International Average on all but one of the scales. However, performance on the *Teaching limited by pupils who are not ready for instruction* measure was below the International Average.
- Approximately three quarters of pupils in Northern Ireland were in schools whose principals reported *Hardly any problems* with discipline or safety, indicating lower discipline and safety problems than on average internationally.
- There was evidence that pupils in 2019 experienced a less good learning environment than in 2015 as the performance of Northern Ireland on the scales has fallen since the previous TIMSS cycle in 2015. This is particularly apparent in the change in percentage of pupils experiencing a safe and orderly classroom

- There is evidence that the experience of bullying is associated with achievement in mathematics and science. In Northern Ireland and internationally, pupils who *Never or almost never* experienced bullying achieved better on average than those who experienced bullying *About monthly*, and much better than those who experienced bullying *About weekly*.
- Teachers' perceptions of the safety and the behaviour of pupils has an association with pupil scores. Pupils from schools in Northern Ireland rated as *Very safe and orderly* by their teachers scored higher on average in mathematics and science compared to pupils in schools rated as *Somewhat safe and orderly*. An achievement gap was also observed internationally, however the performance gaps were larger in Northern Ireland for both subjects. These achievement gaps in Northern Ireland increased slightly since 2015.

Interpreting the data: percentages in tables

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

Y6 pupils were sampled by class. The Y6 teacher questionnaire would, in most cases therefore 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 or science.

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[39].

[39] This is unlikely in Northern Ireland as pupils are generally taught mathematics and science in the same classes with a single teacher at 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.

10.1 Schools' emphasis on academic success – views of principals

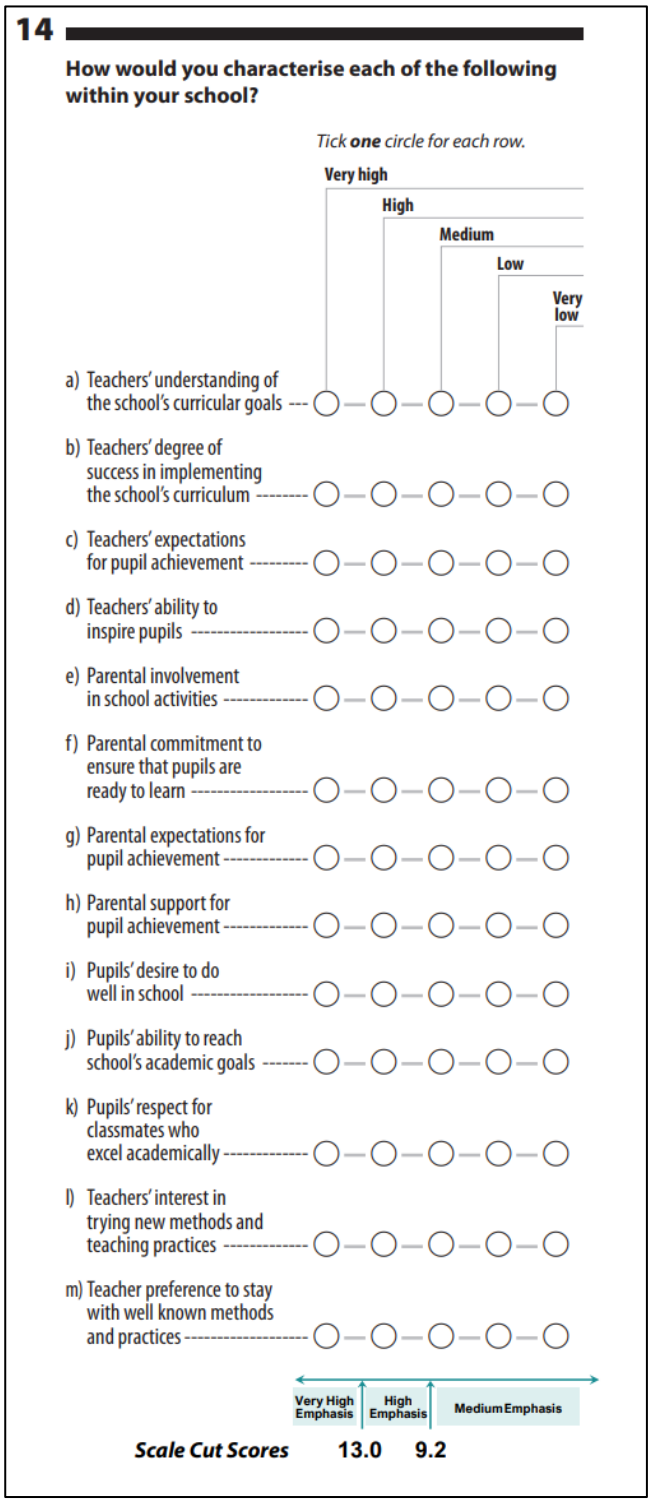
Principals were asked to rate the emphasis placed on academic success within their school by teachers, parents and pupils. Principals were asked the set of questions shown in Figure 10.1, which rate levels of parental support and pupil motivation, as well as teachers' understanding of curricular goals and their expectations of pupils.

The questions were analysed as a separate scale for each subject[40]. The scale categories for each subject are summarised in Figure 10.1 and the data for each subject is shown in Table 10.1 which presents the Northern Ireland data alongside that of the comparator countries.

It should be noted that the data provided by principals for this scale comes from the school questionnaires. The majority of the questions are not subject specific and therefore the overall proportions are broadly the same for mathematics and science[41]. Differences in achievement scores, however, are subject specific and have been reported separately where appropriate.

[40] The same questions were also included in the teacher questionnaire, but these were not included in a scale and are not reported here.
[41] Small differences in percentages may arise from patterns of non-response, or rounding.

Figure 10.1 School's emphasis on academic success – principals' questionnaire



Sources: TIMSS 2019 Northern Ireland, School questionnaire Q14. Exhibit 7.1 TIMSS 2019 International Results in Mathematics and Science.

Statements l and m did not contribute to the *School emphasis on academic success* scale Statements a-k were also used in 2015

Table 10.1 School emphasis on academic success scale

Students were scored according to their principals' responses characterizing eleven aspects on the *School Emphasis on Academic Success* scale. Cut scores divide the scale into three categories. Students in schools with a **Very High Emphasis** on academic success had a score at or above the cut score corresponding to their principals characterizing six of the eleven aspects as "very high" and the other five as "high," on average. Students in schools with a **Medium Emphasis** on academic success had a score at or below the cut score corresponding to their principals characterizing six of the eleven aspects as "medium" and the other five as "high," on average. All other students attended schools with a **High Emphasis** on academic success.

Mathematics

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	
Korea, Rep. of	33 (4.1)	613 (4.8)	54 (4.4)	596 (2.7)	13 (3.0)	580 (5.2)	12.0 (0.20)
Ireland, Rep. of	21 (3.4)	562 (5.3)	63 (3.7)	552 (3.4)	16 (3.0)	520 (6.3)	11.5 (0.17)
Northern Ireland r	15 (3.6)	590 (11.5)	68 (4.7)	569 (4.1)	17 (3.5)	537 (6.7)	11.1 (0.17)
England s	12 (3.1)	605 (19.0)	68 (5.6)	556 (4.4)	20 (4.9)	534 (7.8)	10.9 (0.19)
Canada	9 (1.9)	537 (7.7)	59 (2.6)	514 (1.8)	32 (2.9)	501 (6.8)	10.2 (0.13)
Singapore	9 (0.0)	648 (12.8)	70 (0.0)	628 (4.5)	21 (0.0)	607 (7.6)	10.6 (0.00)
Hong Kong SAR	5 (2.4)	628 (21.1)	51 (4.5)	607 (4.3)	44 (3.9)	592 (5.5)	9.8 (0.19)
Finland	4 (1.4)	545 (9.6)	53 (4.1)	538 (3.2)	44 (4.4)	524 (3.7)	9.9 (0.14)
Poland	3 (1.7)	536 (7.1)	55 (4.0)	527 (3.7)	42 (4.3)	509 (3.8)	9.8 (0.14)
International Average	**7 (0.3)**	**515 (2.1)**	**55 (0.5)**	**508 (0.7)**	**37 (0.5)**	**486 (0.8)**	

Science

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	
Korea, Rep. of	33 (4.1)	599 (4.2)	54 (4.4)	585 (2.5)	13 (3.0)	571 (4.9)	12.0 (0.20)
Ireland, Rep. of	21 (3.4)	539 (5.5)	63 (3.7)	532 (4.6)	16 (3.0)	501 (6.9)	11.5 (0.17)
Northern Ireland r	15 (3.6)	534 (8.3)	68 (4.7)	521 (3.1)	17 (3.5)	497 (5.6)	11.1 (0.17)
England s	12 (3.1)	583 (13.7)	68 (5.6)	536 (4.2)	20 (4.9)	515 (8.1)	10.9 (0.19)
Canada	9 (1.9)	543 (6.0)	59 (2.6)	526 (1.8)	32 (2.9)	513 (5.2)	10.2 (0.13)
Singapore	9 (0.0)	617 (11.4)	70 (0.0)	598 (4.0)	21 (0.0)	575 (6.8)	10.6 (0.00)
Hong Kong SAR	5 (2.4)	567 (27.8)	51 (4.5)	539 (4.4)	44 (3.9)	519 (5.7)	9.8 (0.19)
Finland	4 (1.4)	570 (9.5)	53 (4.1)	561 (3.1)	44 (4.4)	546 (4.1)	9.9 (0.14)
Poland	3 (1.7)	546 (8.6)	55 (4.0)	538 (3.6)	42 (4.3)	521 (3.5)	9.8 (0.14)
International Average	**7 (0.3)**	**508 (2.4)**	**55 (0.5)**	**499 (0.7)**	**37 (0.5)**	**474 (0.9)**	

This TIMSS context 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.
An "r" indicates data are available for at least 70% but less than 85% of the students. An "s" indicates data are available for at least 50% but less than 70% of the students.

Sources: Exhibits 7.2 and 7.3, TIMSS 2019 International Results in Mathematics and Science.

In Northern Ireland, across both mathematics and science, principals of 83 per cent of pupils reported that their schools placed a *High emphasis* or *Very high emphasis* on academic success. This is a moderate decrease from 2015[42], when over 90 per cent of pupils were in these two categories. The change from 2015 is due to a moderate decrease in the proportion of pupils in schools with a *High emphasis* on academic success (from 76 per cent to 68 per cent) and a corresponding increase in the proportion with *Medium emphasis* (from nine per cent to 17 per cent). The average score on the School emphasis on academic success scale for Northern Ireland was 11.1. This categorises Northern Ireland as a country with a *High emphasis* on academic success, the second of the three groupings.

The figures for Northern Ireland are above the International Average and places it as one of the top ten countries with regard to emphasis on academic success. This is the case

[42] The same 11 questions were used for this scale in 2019 and 2015, so comparisons are valid. However, the 2011 scale contained only six of the questions, so comparisons will not be made to 2011 in this discussion.

both in terms of the percentage of pupils categorised as being from schools with a *Very high emphasis* on academic success and the average score on the scale, which takes into account all of the categories. When looking at the comparator countries, only Korea and the Republic of Ireland had a larger percentage of pupils in the highest category of the scale (33 per cent and 21 per cent respectively). By contrast Finland and Poland had some of the lowest figures internationally with only four and three per cent respectively of pupils in schools where principals reported placing a *Very high emphasis* on academic success.

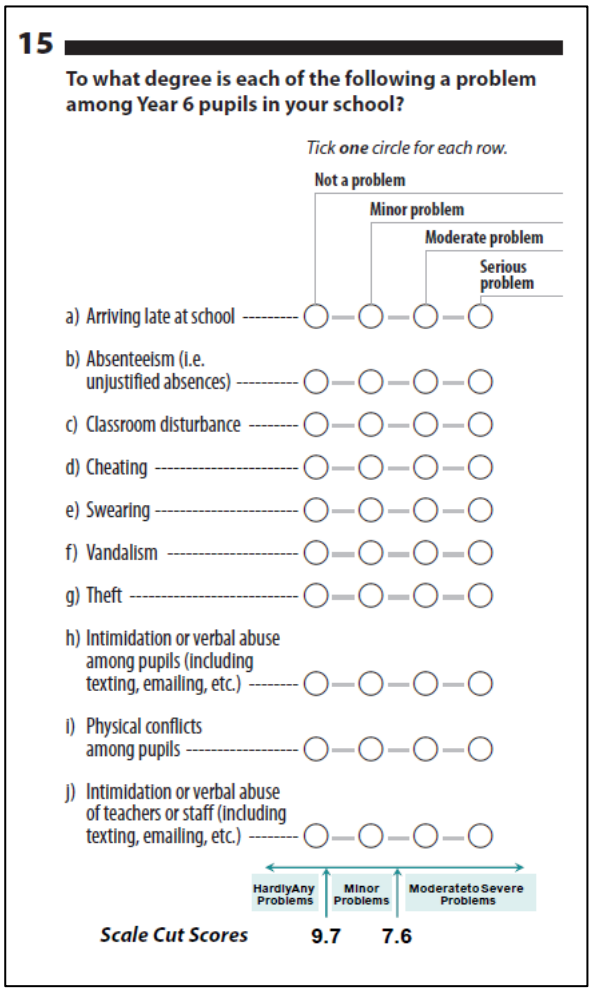
In both subjects, this contextual factor has a potential association with pupil attainment. In mathematics, Northern Ireland pupils in schools with a *Very high* academic emphasis scored on average 21 scale points higher than those from school with *High emphasis* and these pupils in turn scored on average 32 scale points higher than pupils in the *Medium emphasis* category. These gaps are larger than those for the International Average (seven points and 22 points). A similar pattern was also seen in science with differences of 13 and 24 scale points respectively[43] (compared to nine points and 25 points internationally).

10.2 Principals' views of school discipline

Principals were asked about the degree to which a number of discipline issues were a problem in their school. Based on principal responses, pupils were categorised as attending schools with *Hardly any problems*, *Minor problems* or *Moderate to severe problems.* The questions and details of the scoring are shown in Figure 10.2 and the results for both subjects are shown in Table 10.2 which presents the Northern Ireland data alongside that of the comparator countries.

[43] In this section, we do not report whether differences are statistically significant as, due to the large sample sizes, small differences can be statistically significant but not meaningful from a policy or practice perspective.

Figure 10.2 School discipline – principals' questionnaire



Sources: TIMSS 2019 Northern Ireland, School questionnaire Q15. Exhibit 8.1 TIMSS 2019 International Results in Mathematics and Science. All statements also used in 2011 and 2015

Table 10.2 School discipline scale

Students were scored according to their principals' reports regarding eleven potential problems on the *School Discipline* scale. Cut scores divide the scale into three categories. Students in schools with **Hardly Any Problems** had a score at or above the cut score corresponding to their principals reporting that six of the eleven issues are "not a problem" and the other five are a "minor problem," on average. Students in schools with **Moderate to Severe Problems** had a score at or below the cut score corresponding to their principals reporting that six of the eleven issues are a "moderate problem" and the other five are a "minor problem," on average. All other students were in schools with **Minor Problems**.

Mathematics

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	
Ireland, Rep. of		82 (3.2)	552 (3.1)	16 (3.1)	540 (5.5)	2 (1.2)	~ ~	10.8 (0.11)
Hong Kong SAR		77 (4.3)	607 (3.2)	23 (4.2)	583 (7.7)	1 (0.7)	~ ~	10.7 (0.14)
Singapore		76 (0.0)	628 (4.3)	24 (0.0)	616 (8.3)	0 (0.0)	~ ~	10.6 (0.00)
Korea, Rep. of		73 (3.7)	602 (2.7)	16 (2.8)	595 (5.7)	12 (3.0)	588 (7.1)	10.6 (0.18)
Northern Ireland	r	73 (3.8)	573 (4.2)	27 (3.9)	552 (6.2)	1 (0.8)	~ ~	10.4 (0.11)
England	s	67 (5.1)	566 (5.5)	33 (5.1)	540 (7.6)	0 (0.0)	~ ~	10.1 (0.10)
Finland		53 (3.8)	537 (3.4)	42 (3.8)	529 (3.1)	5 (1.9)	499 (11.9)	9.9 (0.10)
Canada		53 (2.9)	516 (2.4)	43 (3.0)	510 (4.7)	4 (1.0)	470 (9.4)	9.9 (0.09)
Poland		36 (4.1)	522 (4.9)	60 (4.2)	518 (3.2)	4 (1.6)	538 (7.6)	9.3 (0.10)
International Average		**60 (0.5)**	**508 (0.7)**	**32 (0.5)**	**494 (0.9)**	**8 (0.3)**	**466 (1.8)**	

Science

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	
Ireland, Rep. of		82 (3.2)	530 (3.9)	16 (3.1)	524 (5.9)	2 (1.2)	~ ~	10.8 (0.11)
Hong Kong SAR		77 (4.3)	538 (3.2)	23 (4.2)	510 (7.7)	1 (0.7)	~ ~	10.7 (0.14)
Singapore		76 (0.0)	597 (3.8)	24 (0.0)	585 (7.5)	0 (0.0)	~ ~	10.6 (0.00)
Korea, Rep. of		73 (3.7)	590 (2.5)	16 (2.8)	582 (5.6)	12 (3.0)	579 (6.2)	10.6 (0.18)
Northern Ireland	r	73 (3.8)	524 (3.3)	27 (3.9)	508 (5.0)	1 (0.8)	~ ~	10.4 (0.11)
England	s	67 (5.1)	545 (4.8)	33 (5.1)	521 (7.3)	0 (0.0)	~ ~	10.1 (0.10)
Finland		53 (3.8)	560 (3.6)	42 (3.8)	552 (2.9)	5 (1.9)	518 (13.4)	9.9 (0.10)
Canada		53 (2.9)	528 (2.3)	43 (3.0)	521 (3.6)	4 (1.0)	489 (9.6)	9.9 (0.09)
Poland		36 (4.1)	533 (4.6)	60 (4.2)	528 (3.0)	4 (1.6)	549 (7.7)	9.3 (0.10)
International Average		**60 (0.5)**	**498 (0.8)**	**32 (0.5)**	**483 (1.0)**	**8 (0.3)**	**457 (1.9)**	

This TIMSS context 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 students. An "s" indicates data are available for at least 50% but less than 70% of the students.

Sources: Exhibits 8.2 and 8.3, TIMSS 2019 International Results in Mathematics and Science.

The majority of pupils in Northern Ireland (73 per cent) had principals who reported *Hardly any problems* with discipline or safety in their schools, which was a small decrease of five percentage points from 2015. Only one per cent of pupils attended schools where principals reported *Moderate to severe* discipline problems. This percentage was zero in 2015. The average score on the scale was 10.4, which rates Northern Ireland as a country with *Hardly any problems* with school discipline for Y6 pupils. The percentage of pupils in Northern Ireland in schools with *Hardly any problems* with discipline was above the International Average of 60 per cent and in the middle of the comparator countries (Table 10.2).

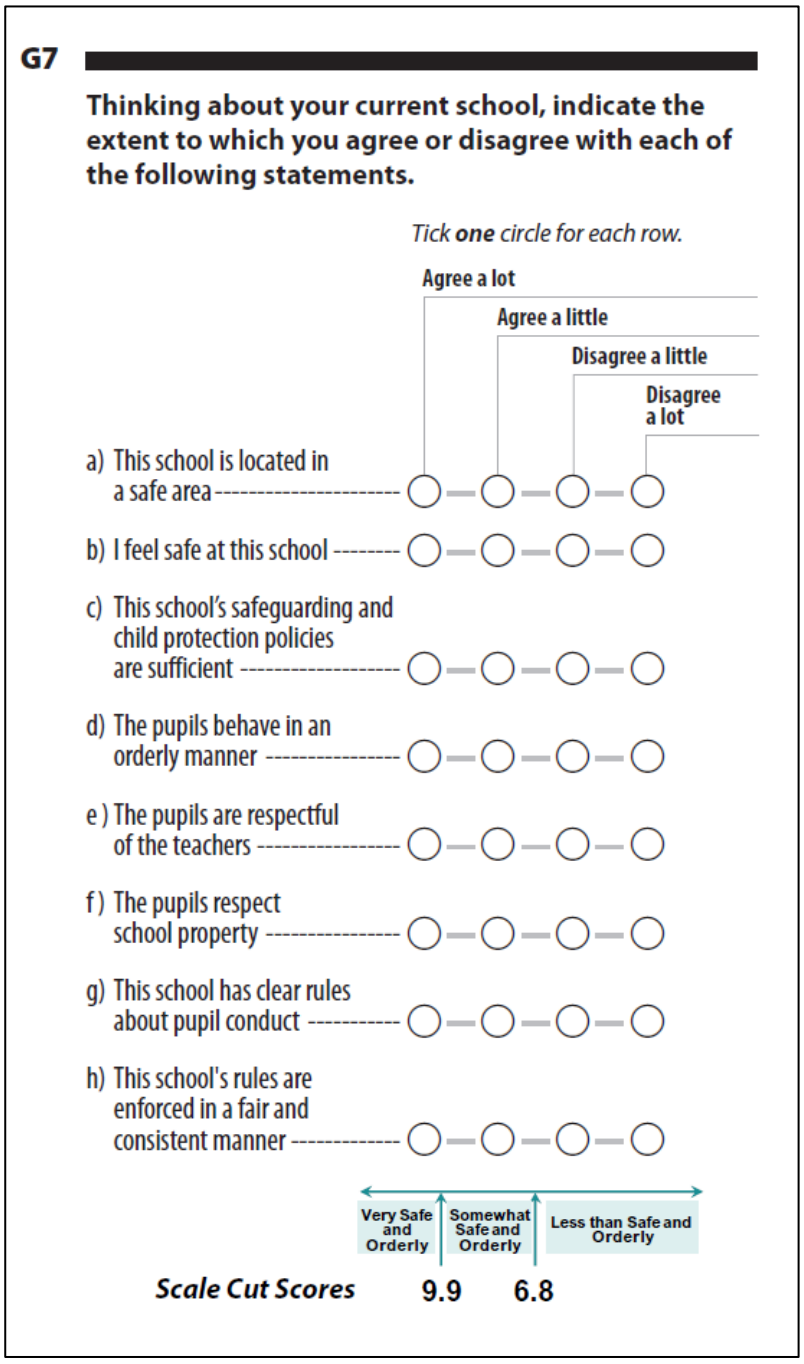
In Northern Ireland, there was evidence of a performance gap between pupils in the different categories of the *School discipline* scale. Pupils from schools categorised as having *Hardly any problems* performed on average 21 scale points higher in mathematics and 16 scale points higher in science compared to pupils in schools with *Minor problems.*

This performance gap is also seen on average internationally and in all of the comparator countries. The performance gap seen in Northern Ireland is one of the larger gaps among the comparators, with only Hong Kong and England showing larger attainment gaps between pupils in the different categories of the *School discipline* scale in mathematics and science.

10.3 Teachers' ratings of the extent to which their schools are 'safe and orderly'

Teachers were asked about their perceptions of safety and the behaviour of pupils in their school. Based on teachers' responses, pupils were categorised as attending schools which were *Very safe and orderly*, *Somewhat safe and orderly* or *Less than safe and orderly*. The questions and details of the scaling are shown in Figure 10.3 and the results for each subject are shown in Table 10.3 which presents the Northern Ireland data alongside that of the comparator countries.

Figure 10.3 Safe and orderly schools – teachers' questionnaire



Statements a-h were used in the 2015 survey. Statement c referenced 'school's security policies and practices' in 2015.

Sources: TIMSS 2019 Northern Ireland, Teacher questionnaire QG7. Exhibit 8.6, TIMSS 2019 International Results in Mathematics and Science.

Table 10.3 Safe and orderly schools scale

Students were scored according to their teachers' responses to eight statements on the *Safe and Orderly School* scale. Cut scores divide the scale into three categories. Students in **Very Safe and Orderly** schools had a score at or above the cut score corresponding to their teachers "agreeing a lot" with four of the eight statements and "agreeing a little" with the other four, on average. Students in **Less than Safe and Orderly** schools had a score at or below the cut score corresponding to their teachers "disagreeing a little" with four of the eight statements and "agreeing a little" with the other four, on average. All other students were in **Somewhat Safe and Orderly** schools.

Mathematics

Country	Very Safe and Orderly		Somewhat Safe and Orderly		Less than Safe and Orderly		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Ireland, Rep. of	78 (3.1)	553 (2.8)	19 (2.9)	535 (5.8)	3 (1.4)	511 (11.3)	11.5 (0.15)
Northern Ireland	75 (3.6)	572 (3.4)	23 (3.4)	545 (6.1)	2 (1.5)	~ ~	11.6 (0.18)
Singapore	68 (2.5)	627 (4.6)	30 (2.5)	624 (6.4)	3 (0.9)	594 (29.4)	10.9 (0.10)
Hong Kong SAR	61 (4.3)	612 (3.7)	38 (4.4)	585 (5.4)	0 (0.5)	~ ~	10.5 (0.16)
England s	55 (5.6)	564 (6.1)	41 (5.6)	553 (7.9)	4 (1.9)	537 (20.9)	10.4 (0.22)
Poland	51 (3.8)	520 (3.4)	47 (3.9)	520 (4.4)	2 (1.0)	~ ~	9.7 (0.12)
Canada	48 (2.9)	515 (4.4)	45 (2.9)	512 (3.6)	7 (1.3)	493 (7.8)	10.0 (0.13)
Korea, Rep. of	33 (4.1)	610 (4.1)	61 (4.2)	594 (2.9)	6 (1.7)	599 (7.3)	9.5 (0.18)
Finland	31 (2.9)	542 (3.7)	63 (3.1)	528 (2.4)	6 (1.5)	516 (9.5)	9.2 (0.10)
International Average	**61 (0.4)**	**507 (0.6)**	**36 (0.4)**	**495 (0.9)**	**4 (0.2)**	**495 (2.4)**	

Science

Country	Very Safe and Orderly		Somewhat Safe and Orderly		Less than Safe and Orderly		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Ireland, Rep. of	78 (3.1)	533 (3.7)	19 (2.9)	512 (6.4)	3 (1.4)	491 (10.4)	11.5 (0.15)
Northern Ireland	75 (3.6)	524 (2.6)	23 (3.4)	503 (4.4)	2 (1.5)	~ ~	11.6 (0.18)
Singapore	67 (2.0)	594 (4.2)	31 (2.0)	597 (5.7)	2 (0.7)	~ ~	10.9 (0.08)
Hong Kong SAR	55 (4.2)	536 (4.5)	42 (4.2)	528 (5.5)	2 (1.4)	~ ~	10.3 (0.17)
England s	55 (5.6)	542 (5.5)	41 (5.6)	535 (6.8)	4 (1.9)	515 (21.4)	10.4 (0.22)
Poland	55 (4.1)	529 (3.2)	42 (4.0)	536 (4.4)	3 (1.4)	528 (10.6)	9.8 (0.13)
Canada r	49 (2.5)	532 (2.6)	44 (2.5)	520 (2.9)	7 (1.3)	500 (4.5)	10.0 (0.11)
Korea, Rep. of	35 (3.7)	595 (3.9)	59 (3.6)	584 (2.6)	6 (2.0)	582 (7.0)	9.5 (0.16)
Finland	32 (2.8)	562 (3.2)	62 (3.0)	552 (3.1)	7 (1.5)	538 (10.4)	9.2 (0.11)
International Average	**61 (0.4)**	**497 (0.6)**	**35 (0.4)**	**484 (0.9)**	**4 (0.2)**	**493 (2.7)**	

This TIMSS context 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 students. An "s" indicates data are available for at least 50% but less than 70% of the students.

Sources: Exhibits 8.7 and 8.8, TIMSS 2019 International Results in Mathematics and Science

Across mathematics and science, three quarters of pupils (75 per cent) in Northern Ireland had teachers who reported that their schools were *Very safe and orderly.* However, this was a large decrease of 10 percentage points, since 2015. Additionally, Northern Ireland reported two per cent of pupils in classes categorised as *Less that safe and orderly*, whereas no children were in this category in 2015. This suggests that since 2015 teachers' perceptions of the safety and the behaviour of pupils in their school has become more negative. Nevertheless, the average score on this scale for Northern Ireland was 11.6, which categorises Northern Ireland as a country that has *Very safe and orderly* classrooms.

Across the comparator countries, there was sizeable variation in the percentage of pupils in the categories of this scale. For example, only the Republic of Ireland, Northern Ireland and Singapore exceed the International Average (61 per cent) for the percentage of pupils taught in *Very safe and orderly* classrooms, whilst Korea and Finland both had below 40 per cent in this category.

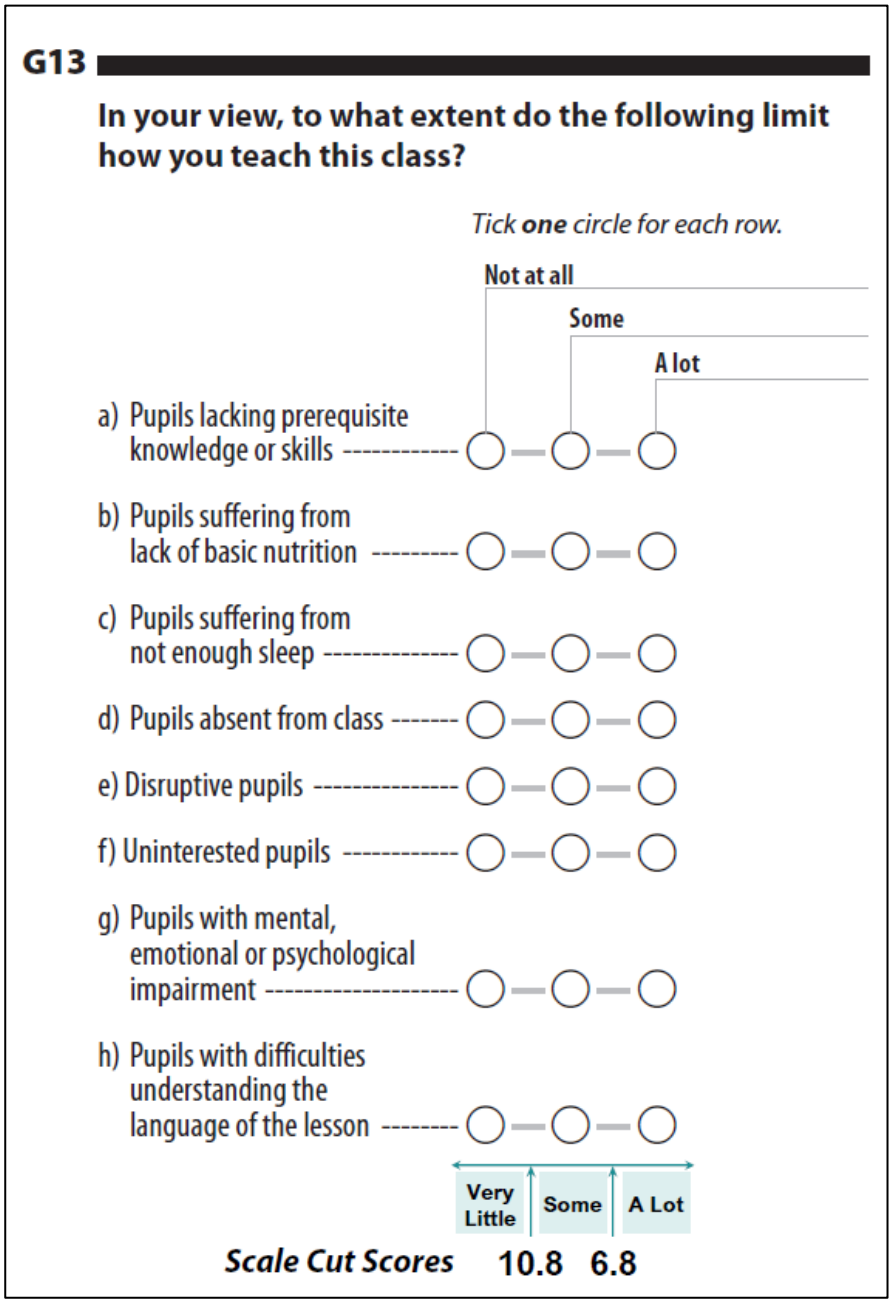
There was some evidence of an association between achievement and teachers' perceptions of the safety and the behaviour of pupils. Pupils from schools in Northern Ireland rated as *Very safe and orderly* by their teachers scored on average 27 scale points higher in mathematics and 21 scale points higher in science compared to pupils in schools rated as *Somewhat safe and orderly*. This is a slightly larger gap than was seen in 2015. The direction of the differences in achievement between the two groups in 2019 was in line with the International Average and the majority of comparator countries (all except for Poland in mathematics and science and Singapore in science). Although it is difficult to make firm conclusions from these differences, it is noteworthy that none of the other comparator countries had a higher gap in achievement between *Very* and *Somewhat safe and orderly* than Northern Ireland; Hong Kong also had a 27 point gap for mathematics and the Republic of Ireland also had a 21 point gap for science.

The teacher-reported *Safe and orderly school* scale aligns with the principal reported *School discipline* scale (section 9.2), indicating they measure similar effects at different levels within Northern Ireland schools and that there is agreement between the opinions of principals and teachers about school and classroom order.

10.4 Teaching limited by pupils not ready for instruction

Teachers were asked to indicate the extent to which they felt that their teaching was limited by pupils in their class not ready for instruction. The questions and details of the scaling are shown in Figure 10.4 and the results for each subject are shown in Table 10.4 which presents the Northern Ireland data alongside that of the comparator countries.

Figure 10.4 Teaching limited by students not ready for instruction – teacher questionnaire



This scale was administered in 2015, with only questions a-c and e-g. This was reported in 2015 as the *Teaching limited by student needs* scale.

Sources: TIMSS 2019 Northern Ireland, Teacher Questionnaire QG13. Exhibit 10.9, TIMSS 2019 International Results in Mathematics and Science.

Table 10.4 Classroom teaching limited by pupils not ready for instruction scale

Students were scored according to their teachers' reports regarding eight student attributes on the *Classroom Teaching Limited by Students Not Ready for Instruction* scale. Cut scores divide the scale into three categories. Students with teachers who felt their teaching was limited **Very Little** had a score at or above the cut score corresponding to their teachers reporting they were "not at all" limited by four of the eight student attributes and were limited "some" by the other four, on average. Students with teachers who felt their teaching was limited **A Lot** had a score at or below the cut score corresponding to their teachers reporting they were limited "a lot" by four of the eight attributes and were limited "some" by the other four, on average. All other students had teachers who felt their teaching was limited **Some**.

Mathematics

Country	Very Little		Some		A Lot		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Singapore	52 (2.8)	656 (3.9)	45 (2.9)	591 (5.0)	3 (0.9)	613 (23.1)	10.8 (0.11)
Hong Kong SAR	47 (3.8)	614 (5.6)	53 (3.8)	590 (4.1)	0 (0.0)	~ ~	10.7 (0.13)
Finland	40 (2.9)	542 (3.2)	58 (3.1)	527 (3.0)	1 (0.5)	~ ~	10.4 (0.09)
Ireland, Rep. of	40 (3.7)	557 (4.6)	59 (3.7)	542 (2.9)	1 (0.4)	~ ~	10.3 (0.14)
Poland	39 (3.6)	533 (4.5)	59 (3.7)	513 (3.1)	2 (0.9)	~ ~	10.4 (0.12)
Korea, Rep. of	32 (3.8)	608 (4.6)	52 (3.7)	597 (3.1)	16 (2.9)	590 (6.3)	9.5 (0.20)
Northern Ireland	26 (3.9)	583 (6.6)	72 (4.1)	560 (3.7)	2 (1.3)	~ ~	9.9 (0.12)
Canada	22 (1.9)	537 (4.7)	71 (2.2)	507 (2.4)	6 (1.3)	484 (7.9)	9.4 (0.09)
England s	22 (3.9)	576 (12.2)	71 (4.5)	551 (5.2)	7 (2.9)	552 (5.4)	9.5 (0.17)
International Average	**36 (0.4)**	**517 (0.9)**	**59 (0.5)**	**495 (0.6)**	**6 (0.2)**	**476 (2.2)**	

Science

Country	Very Little		Some		A Lot		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Singapore	52 (3.2)	620 (3.7)	46 (3.1)	568 (4.6)	2 (0.7)	~ ~	10.8 (0.11)
Poland	46 (3.4)	539 (4.3)	52 (3.3)	526 (2.9)	2 (0.9)	~ ~	10.6 (0.12)
Hong Kong SAR	45 (3.7)	550 (4.7)	54 (3.8)	518 (4.7)	1 (0.7)	~ ~	10.7 (0.16)
Ireland, Rep. of	40 (3.7)	534 (6.7)	59 (3.7)	523 (3.2)	1 (0.4)	~ ~	10.3 (0.14)
Finland	40 (2.9)	565 (3.3)	59 (3.1)	549 (3.1)	1 (0.5)	~ ~	10.3 (0.09)
Korea, Rep. of	30 (3.7)	599 (3.7)	57 (3.5)	584 (2.8)	13 (2.7)	577 (6.3)	9.4 (0.18)
Northern Ireland	26 (3.9)	530 (4.7)	72 (4.1)	515 (3.0)	2 (1.3)	~ ~	9.9 (0.12)
Canada r	24 (2.1)	543 (3.4)	70 (2.5)	521 (2.2)	6 (1.2)	499 (7.0)	9.5 (0.09)
England s	22 (3.9)	557 (9.9)	71 (4.5)	531 (4.7)	7 (2.9)	534 (5.7)	9.5 (0.17)
International Average	**37 (0.5)**	**506 (1.1)**	**58 (0.5)**	**484 (0.7)**	**6 (0.2)**	**465 (2.5)**	

This TIMSS context 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.
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. An "s" indicates data are available for at least 50% but less than 70% of the students.

Sources: Exhibits 10.10 and 10.11, TIMSS 2019 International Results in Mathematics and Science.

In Northern Ireland, just over a quarter of pupils (26 per cent) had teachers who reported that their teaching was limited *Very little* by pupils not ready for instruction. This percentage was below the International Average. The composition of this scale has changed since 2015[44], so it is difficult to make direct comparison and as such should be interpreted with caution. However, it is worth noting that the 2019 figure was less than the 43 per cent of pupils whose teaching was reported as *Not limited by student needs* in 2015.

The average score for Northern Ireland in 2019 on this scale was 9.9. This identifies Northern Ireland as a country where classroom teaching is limited by pupils not being ready for instruction to *Some* extent, which is the second of the three categories for this scale.

There was quite a lot of variation in this measure amongst the comparator countries, with 52 per cent of pupils in Singapore impacted *Very little* in contrast with 22 per cent in

[44] Six of the eight questions for this scale were administered in 2015.

England. In Northern Ireland only two per cent of pupils were impacted *A lot* by pupils in their class not being ready for instruction which was below the International Average and in line with the majority of the comparators.

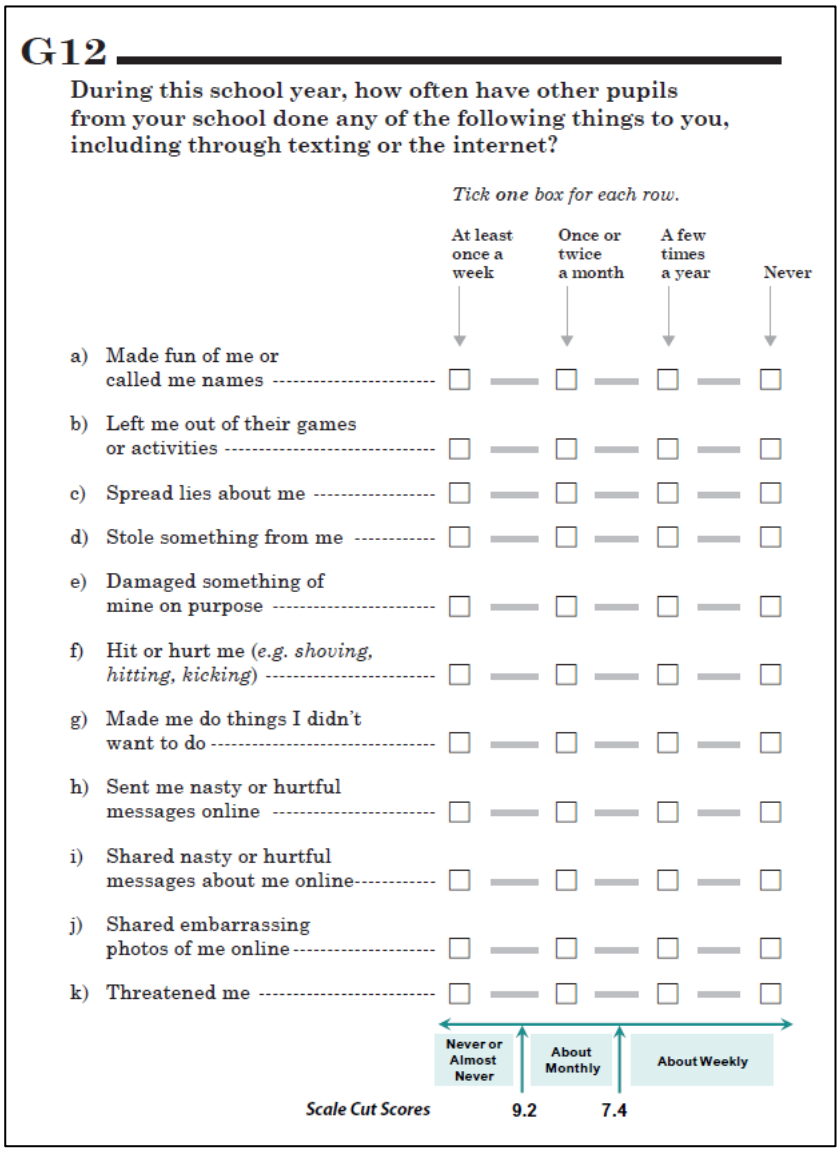
The performance gap in mathematics between pupils whose teaching was reported as limited *Very little* and those limited to *Some* extent was 23 scale points in Northern Ireland, which was similar to the International Average and the gaps observed in Hong Kong and England, whilst the largest gap was observed in Singapore (65 scale points). In science the performance gap in Northern Ireland was 15 scale points, below that of the International Average and similar to Korea and Finland.

10.5 Pupil reports of bullying in school

Pupils were asked about the extent to which they had experienced a range of behaviours indicative of bullying at school. The questions and details of the scaling are shown in Figure 10.5 and the results for each subject are shown in Table 10.5 which presents the Northern Ireland data alongside that of the comparator countries.

Based on their responses, pupils were categorised as being in one of three bands which described the frequency with which they had experienced the eleven bullying behaviours in their school during the last year: *Almost never*, *About monthly* and *About weekly.*

Figure 10.5 Pupils bullied at school – pupil questionnaire



Statements a-d, f, g, and k were also used in 2015. In 2015 statements I and j were covered by the more general 'Shared embarrassing information about me'.

Sources: TIMSS 2019 Northern Ireland, Pupil Questionnaire Q G12.

Exhibit 8.11, TIMSS 2019 International Results in Mathematics and Science.

Table 10.5 Pupil bullying scale

Students were scored according to their reports regarding eleven bullying behaviors on the *Student Bullying* scale. Cut scores divide the scale into three categories. Students bullied **Never or Almost Never** had a score at or above the cut score corresponding to reporting that they "never" experienced six of the eleven bullying behaviors and experienced the other five "a few times a year," on average. Students bullied **About Weekly** had a score at or below the cut score corresponding to reporting that they experienced six of the eleven behaviors "once or twice a month" and the other five "a few times a year," on average. All other students were bullied **About Monthly**.

Mathematics

Country	Never or Almost Never		About Monthly		About Weekly		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Finland	79 (1.0)	538 (2.2)	19 (0.9)	519 (4.0)	2 (0.2)	~ ~	10.7 (0.04)
Korea, Rep. of	77 (1.1)	601 (2.3)	21 (1.0)	596 (3.9)	2 (0.3)	~ ~	10.6 (0.05)
Ireland, Rep. of	76 (0.9)	555 (2.6)	21 (0.7)	536 (3.8)	3 (0.4)	497 (8.5)	10.5 (0.05)
Poland	73 (0.9)	527 (2.8)	22 (0.8)	513 (3.4)	5 (0.4)	470 (8.4)	10.4 (0.04)
Northern Ireland	68 (1.4)	574 (3.2)	28 (1.3)	556 (3.7)	4 (0.4)	501 (9.4)	10.1 (0.06)
Hong Kong SAR	62 (1.2)	608 (3.1)	32 (1.0)	595 (4.7)	6 (0.5)	576 (7.8)	9.9 (0.05)
England	60 (1.3)	566 (4.4)	34 (1.1)	546 (4.1)	6 (0.6)	513 (8.5)	9.8 (0.05)
Singapore	59 (0.9)	638 (3.6)	34 (0.7)	616 (4.0)	7 (0.4)	569 (9.1)	9.7 (0.03)
Canada	55 (0.7)	520 (2.2)	38 (0.7)	505 (2.2)	8 (0.3)	477 (4.4)	9.6 (0.03)
International Average	**63 (0.2)**	**512 (0.5)**	**29 (0.1)**	**495 (0.6)**	**8 (0.1)**	**451 (1.1)**	

Science

Country	Never or Almost Never		About Monthly		About Weekly		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Finland	79 (1.0)	560 (2.4)	19 (0.9)	542 (4.3)	2 (0.2)	~ ~	10.7 (0.04)
Korea, Rep. of	77 (1.1)	589 (2.3)	21 (1.0)	585 (3.5)	2 (0.3)	~ ~	10.6 (0.05)
Ireland, Rep. of	76 (0.9)	534 (3.3)	21 (0.7)	517 (4.0)	3 (0.4)	471 (9.7)	10.5 (0.05)
Poland	73 (0.9)	538 (2.7)	22 (0.8)	523 (3.2)	5 (0.4)	481 (8.2)	10.4 (0.04)
Northern Ireland	68 (1.4)	526 (2.4)	28 (1.3)	511 (3.7)	4 (0.4)	458 (8.2)	10.1 (0.06)
Hong Kong SAR	62 (1.2)	536 (3.3)	32 (1.0)	526 (4.2)	6 (0.5)	508 (9.2)	9.9 (0.05)
England	60 (1.3)	545 (3.9)	34 (1.1)	531 (3.5)	6 (0.6)	505 (7.3)	9.8 (0.05)
Singapore	59 (0.9)	606 (3.2)	34 (0.7)	586 (3.6)	7 (0.4)	542 (9.1)	9.7 (0.03)
Canada	55 (0.7)	533 (2.2)	38 (0.7)	517 (2.2)	8 (0.3)	491 (4.3)	9.6 (0.03)
International Average	**63 (0.2)**	**503 (0.5)**	**29 (0.1)**	**486 (0.7)**	**8 (0.1)**	**437 (1.2)**	

This TIMSS context questionnaire scale was established in 2019 based on the combined response distribution of all countries that participated in TIMSS 2019. 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.

Sources: Exhibits 8.12 and 8.13, TIMSS 2019 International Results in Mathematics and Science.

Sixty-eight per cent of pupils in Northern Ireland reported that they *Never or almost never* experienced bullying behaviours, while responses from 28 per cent of pupils suggested that they experience bullying behaviours *About monthly* and four per cent *About weekly*. These figures were very similar to the International Average of 63 per cent for *Never or almost never*, 29 per cent *About monthly* and 8 per cent *About weekly*. The average score for Northern Ireland on this scale was 10.1 placing it in the first category of the scale which implies that in general bullying is not a widespread issue in Y6 classrooms in Northern Ireland. This scale was revised for TIMSS 2019, so comparison with results from 2015 should be treated with caution, but were broadly similar.

Northern Ireland sits in the middle of the comparator countries on this scale and is above the International Average by a small difference. Finland, Korea and the Republic of Ireland had the highest proportion of pupils reporting that they were *Never or almost never* bullied, all with a large difference above the International Average. In contrast, Canada reported a percentage that was a moderate difference below the International Average.

There is evidence that the experience of bullying was associated with performance in mathematics and science. In Northern Ireland, pupils that *Never or almost never* experience bullying perform better on average than those who experience bullying *About monthly* and much better than those who experience bullying *About weekly*. The pattern seen in Northern Ireland is similar to that seen with the International Average.

10.6 Conclusion

This chapter reviews the information about the school learning environment that is captured at multiple levels via the different context questionnaires that are part of TIMSS 2019. At the school level this is collected through the principals' questionnaire and reported through the *School emphasis on academic success* and *School discipline* scales. At the classroom level, information is collected via the teacher questionnaire and reported as the *Safe and orderly classroom* and the *Classroom teaching limited by pupils not for instruction* scales. Finally, the pupils experience is reported through the *Student bullying* scale.

The findings in this chapter place the school learning environment for Y6 pupils in Northern Ireland in a good position on the measures. Northern Ireland is a country identified as having a *High emphasis* on academic success, *Hardly any problems* with school discipline, *Very safe and orderly* classrooms, and although *Some* teaching is limited by pupils who are not ready for instruction, pupils experience bullying behaviours *Never or almost never*.

Northern Ireland compared favourably with the comparator countries on the *School emphasis on academic success* scale and the *Safe and orderly classroom* scale. However, Northern Ireland compared less well on the *Classroom teaching limited by pupils not ready for instruction* scale, with only two comparator countries performing less well. This was also the only scale reported in this chapter where Northern Ireland performed below the International Average for the most positive category. This suggests that teaching limited by pupils who are not ready was a larger problem in Northern Ireland than internationally. This scale is investigated in more detail in Chapter 12.

In terms of the performance of the comparator countries, there was a lot of variation across the scales, however the Republic of Ireland performed consistently well across all of the scales, whilst Poland and Canada tended to be at the lower end of the comparator scales.

For all of the scales reported in this chapter, there was evidence of an association with the performance of the pupils in mathematics and science. The average achievement scores for pupils from the most positive category exceeded that of the second category[45]

[45] Too few pupils fell into the third categories on each scale to allow comparison.

by a margin of between 27 and 13 achievement scale points[46]. When comparing internationally, for three of the scales (*School emphasis on academic success, School discipline* and *Safe and orderly classroom*) the performance gap in mathematics in Northern Ireland exceeded the International Average gap by at least 10 achievement scale points. For science this only occurred for one scale (*Safe and orderly classrooms*). Together this evidence suggests that these differences in classroom environment are associated with performance in mathematics and science and that, in mathematics particularly, this effect is greater in Northern Ireland than the pattern seen internationally.

Some of the scales have changed since previous TIMSS cycles and, therefore, comparisons over time should be interpreted with caution. Where comparisons can be made, in general the proportion of pupils in the most positive category on the scales has decreased. This is most clearly seen in the classroom measures of the *Safe and orderly classroom* and *Classroom teaching limited by pupils not ready for instruction*, which both showed a large decrease in the percentage of pupils in the most positive category compared to the largely similar scale in 2015.

[46] In this section, we do not report whether differences are statistically significant as, due to the large sample sizes, small differences can be statistically significant but not meaningful from a policy or practice perspective.

11 The curriculum and learning activities

Chapter outline

This chapter presents findings relating to teaching practices and the curriculum in mathematics and science in Year 6 (Y6, ages 9-10) reported by teachers, principals and National Research Coordinators[47] (or their designated national contact). Within each sub-section, 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 considerably higher than the International Average. However, for science, teaching time was considerably below the International Average. These patterns were seen in 2015 and 2011.
- A 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 but shows a large increase since 2015.
- Among pupils in Northern Ireland whose teachers emphasised science investigation in *About half the lessons or more*, average achievement is slightly higher than among those for whom it was emphasised in *Less than half the lessons.* However, the difference in scores between the two groups is small.
- The international evidence from TIMSS suggests that there is no clear relationship between the level of emphasis placed on scientific investigations in lessons and achievement in science.
- The international evidence from TIMSS suggests there is no clear pattern between the amount of time spent on mathematics teaching per year and achievement in mathematics.

[47] Each participating country has a National Research Coordinator (NRC). The NRC plays an important role in helping to develop the assessment questions and questionnaires, administering the assessment, reporting the results, and interpreting the findings within their own national context.

Interpreting the data: percentages in tables

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

Y6 pupils were sampled by class. The Y6 teacher questionnaire would, in most cases therefore 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 or science.

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.

Interpreting the data: differences

In this section, we do not report whether differences are statistically significant as, due to the large sample sizes, small differences can be statistically significant but not meaningful from a policy or practice perspective. Instead, we report on the size of differences. Throughout the remainder of the chapter, differences of three percentage points or less may be described as similar, differences of four to six percentage points as small, differences of seven to nine percentage points as moderate, and differences of 10 or more percentage points as large.

11.1 Teaching time

Total teaching time[48] for both subjects, as reported by principals and teachers, was calculated using the following formula. These calculations enabled direct comparison of teaching time to be made between different countries.

Figure 11.1 Formula for calculation of teaching time

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

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

Source: adapted from Exhibit 12.1, TIMSS 2019: International Results in Mathematics and Science

Total teaching time was higher in Northern Ireland than the International Average. Among the comparator countries, teaching time was higher than the International Average in Canada, England, Hong Kong, the Republic of Ireland and Singapore, and below the average in Finland, Korea and Poland.

11.1.1 Teaching time for mathematics

Table 11.1 shows the average amount of time spent teaching mathematics to Y6 pupils in Northern Ireland was 203 hours per year, out of a possible 947 hours (total hours of teaching per year). This was higher than the International Average (154 hours). Teachers in Northern Ireland spend a relatively high proportion of their total teaching time per year dedicated to mathematics teaching, just over a fifth of the total hours of teaching per year. Among comparator countries, the percentage of total teaching time spent teaching mathematics ranged from 21 per cent to 15 per cent. There does not appear to be a clear pattern between the amount of time spent on mathematics teaching per year and achievement in mathematics[49].

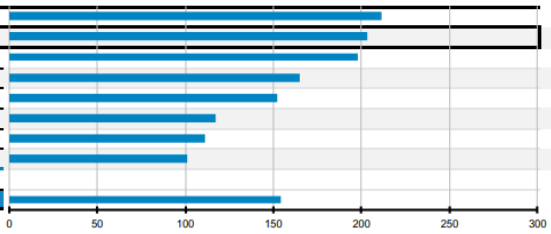
Since 2015, there has been a slight decrease in the number of hours spent teaching mathematics (a decrease of 12 hours) in Northern Ireland. However, the proportion of

[48] Teaching time is referred to as 'Instructional time' in the international data and report
[49] The ranking of countries by teaching time in mathematics does not match the ranking of countries by achievement – see Exhibit 12.2, TIMSS 2019: International Results in Mathematics and Science.

time spent teaching mathematics has remained stable between 2015 and 2019 at 22 per cent and 21 per cent respectively.

Table 11.1 Teaching time for Mathematics in Y6

Country		Total Instructional Hours per Year		Hours per Year for Mathematics Instruction
Singapore		1009 (0.0)		211 (2.7)
Northern Ireland	r	947 (7.1)	r	203 (3.9)
Canada		951 (3.9)	r	198 (2.7)
Ireland, Rep. of		925 (5.0)		165 (2.6)
Hong Kong SAR	r	1022 (14.3)	r	152 (3.3)
Finland		746 (9.9)		117 (2.0)
Poland	r	737 (10.1)	r	111 (1.4)
Korea, Rep. of		694 (8.7)		101 (1.9)
England	s	989 (11.2)	y	- -
International Average		**895 (1.9)**		**154 (0.5)**



( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available.
An "r" indicates data are available for at least 70% but less than 85% of the students. An "s" indicates data are available for at least 50% but less than 70% of the students.
A "y" indicates data are available for less than 40% of the students.

Source: adapted from Exhibit 12.2, TIMSS 2019: International Results in Mathematics and Science

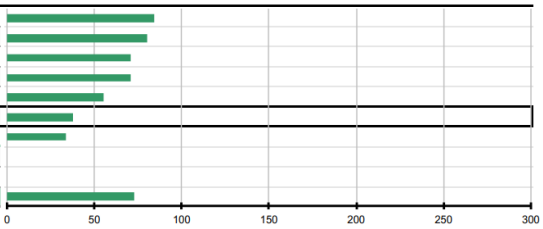
11.1.2 Teaching time for science

Table 11.2 shows that in Northern Ireland, the amount of time for teaching science to Y6 pupils was 38 hours out of 947 hours (total hours of teaching per year), and this has not changed since 2015. This was considerably lower than the International Average (73 hours). The standard errors suggest that it is likely that the amount of time dedicated to teaching science in Northern Ireland is significantly below the International Average. Like the majority of countries, in Northern Ireland, teaching time was higher for mathematics than science in Y6. As with mathematics, there does not appear to be a clear pattern internationally between the amount of time spent on science teaching per year and achievement in science[50].

[50] The ranking of countries by teaching time in science does not match the ranking of countries by achievement – see Exhibit 13.2, TIMSS 2019: International Results in Mathematics and Science.

Table 11.2 Teaching time for Science in Y6

Country	Total Instructional Hours per Year	Hours per Year for Science Instruction
Singapore	1009 (0.0)	84 (0.9)
Canada	951 (3.9)	r 80 (2.0)
Finland	746 (9.9)	71 (1.6)
Korea, Rep. of	694 (8.7)	71 (1.5)
Poland	r 737 (10.1)	s 55 (0.9)
Northern Ireland	r 947 (7.1)	r 38 (2.8)
Ireland, Rep. of	925 (5.0)	34 (0.9)
England	s 989 (11.2)	y - -
Hong Kong SAR	r 1022 (14.3)	y - -
International Average	**895 (1.9)**	**73 (0.4)**



( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available.
An "r" indicates data are available for at least 70% but less than 85% of the students. An "s" indicates data are available for at least 50% but less than 70% of the students.
A "y" indicates data are available for less than 40% of the students.

Source: adapted from Exhibit 13.2, TIMSS 2019: International Results in Mathematics and Science

Among comparator countries, teaching time for science was considerably higher in Singapore, Canada, Finland, Korea and Poland (84, 80, 71, 71 and 55 hours respectively), as well as in most other high performing countries[51]. 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 per year decreased considerably between 2011 and 2015, from 72 hours in 2011 to almost half of this in 2015. However, it has remained consistent from 2015 to 2019, with teachers reporting 38 hours of teaching time per year dedicated to science in both TIMSS cycles. Within the Northern Ireland curriculum, there are no statutory minimum hours for teaching mathematics or science.

11.2 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 can be 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 11.2). The international analysis used responses to these statements to create the *Emphasis on science investigation* scale. Pupils were categorised into two bands: those whose

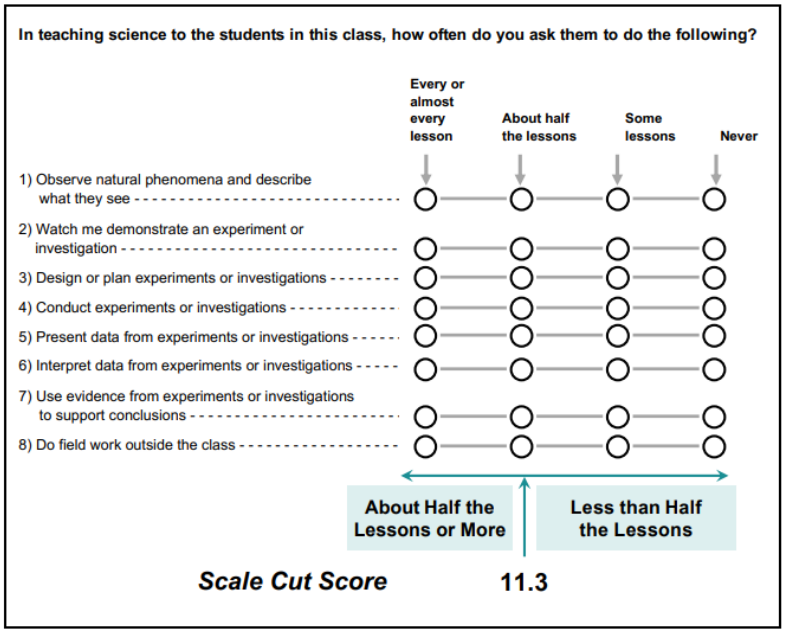
[51] In England, data was available for less than 40 per cent of the pupils so is not provided in the international data for comparison.

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 11.3).

Figure 11.2 Schools' emphasis on Science investigation – questions for teachers

About the Scale

Students were scored according to their teachers' reports regarding how often they asked students to do eight instructional activities on the *Emphasis on Science Investigation* scale. Cut scores divide the scale into two categories. Students with teachers reporting they emphasize science investigation in **About Half the Lessons or More** had a score at or above the cut score corresponding to their teachers reporting they do all eight activities in "about half the lessons," on average. All other students had teachers reporting they emphasize science investigation in **Less than Half the Lessons**.



Source: adapted from Exhibit 13.11 TIMSS 2019: International Results in Mathematics and Science

Table 11.3 shows that 14 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 (31 per cent), but was a large increase since 2015 TIMSS (3 per cent). Two of the higher performing comparator countries, Korea and Singapore, had the highest proportion of pupils in classes where teachers emphasised science investigation in *About half the lessons or more* (66 and 30 per cent respectively).

Table 11.3 Teachers' emphasis on Science investigation in Y6

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	
Korea, Rep. of	66 (4.1)	590 (2.9)	34 (4.1)	583 (3.0)	11.6 (0.14)
Singapore	30 (2.7)	602 (5.5)	70 (2.7)	591 (4.3)	10.4 (0.08)
Ireland, Rep. of	19 (2.9)	524 (6.9)	81 (2.9)	529 (3.1)	9.4 (0.15)
Canada r	17 (1.7)	519 (3.9)	83 (1.7)	526 (2.2)	9.6 (0.09)
Northern Ireland	14 (3.3)	528 (6.2)	86 (3.3)	517 (2.6)	8.5 (0.18)
Hong Kong SAR	8 (2.8)	543 (20.8)	92 (2.8)	531 (3.6)	8.7 (0.22)
Poland	6 (1.8)	527 (8.4)	94 (1.8)	532 (2.7)	8.5 (0.14)
Finland	6 (1.4)	559 (7.7)	94 (1.4)	555 (2.6)	8.2 (0.10)
England x	12 (4.0)	538 (9.9)	88 (4.0)	538 (5.2)	9.8 (0.19)
International Average	**31 (0.4)**	**491 (1.1)**	**69 (0.4)**	**490 (0.7)**	

This TIMSS context 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.
An "r" indicates data are available for at least 70% but less than 85% of the students.
An "x" indicates data are available for at least 40% but less than 50% of the students—interpret with caution.

Source: Exhibit 13.12 TIMSS 2019: International Results in Mathematics and Science.

As noted above, emphasis on scientific investigation was most prevalent in Korea, one of the highest performers, where 66 per cent of pupils were taught by teachers where emphasis was placed on science investigation in *About half the lessons or more*. This was a considerably higher percentage than the other comparator countries. In contrast, Finland, another high performer, had less than ten per cent of pupils taught by teachers who placed this level of emphasis on science investigation in their science lessons. This suggests that there is not a clear relationship between the level of emphasis placed on scientific investigations in lessons and high achievement in science.

As noted above, between the 2015 and 2019 cycles of TIMSS, there has been a large increase in the percentage of pupils in Northern Ireland taught by teachers who emphasise science investigation in *About half the lessons or more*. Whilst this mirrors what was seen on average internationally, Northern Ireland has shown a relatively large increase. The International Average for the percentage of pupils taught by teachers who emphasised science investigation in *About half the lessons or more* saw a small increase of four per cent from 27 per cent in 2015 to 31 per cent in 2019.

There are no clear associations between teachers' emphasis on science investigation and pupils' average achievement within Northern Ireland or most comparator countries. In 29 countries, average achievement was higher for pupils where science investigation was emphasised in *About half the lessons or more,* whereas in 26 countries, the opposite was true, with average achievement being higher for pupils where the emphasis was in *Less than half the lessons*.

Among pupils in Northern Ireland whose teachers emphasised science investigation in *About half the lessons or more*, average achievement is slightly higher than among those for whom it was emphasised in *Less than half the lessons* (528 and 517 respectively),

however, this is unlikely to be significant.[52] This is in contrast to the findings from 2015, where higher average achievement was associated with pupils whose teachers emphasised science investigation in *Less than half the lessons*. The change in direction here may suggest that the relationship is changing, however there were very few pupils in the comparison group in 2015 (three per cent) and therefore the findings should be viewed with caution.

11.3 The Y6 mathematics and science curriculum

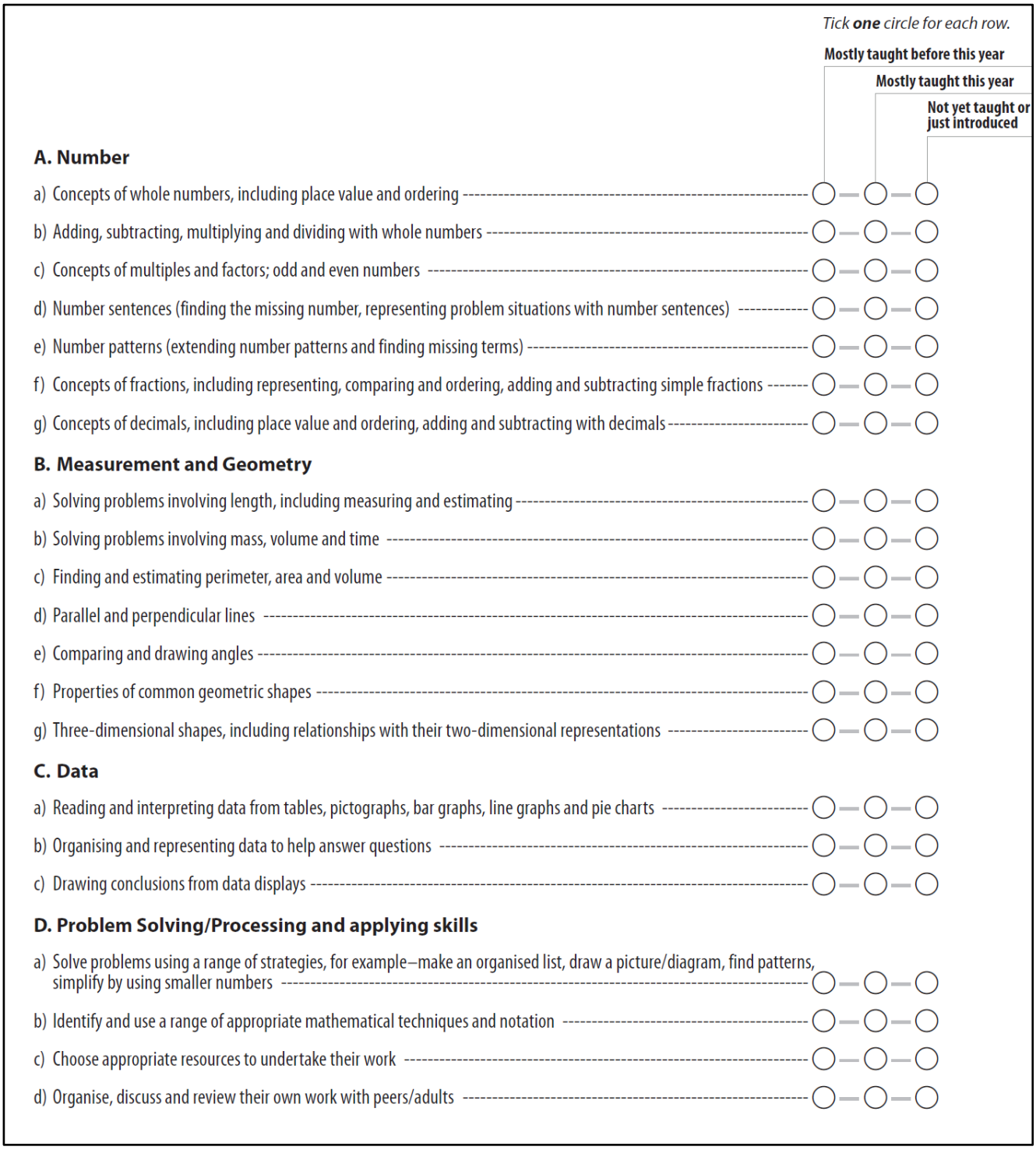
The TIMSS Assessment Frameworks (Mullis and Martin, 2017) are not designed to match exactly the curriculum of any one participating country. Teachers were asked to indicate whether each of the topics was *Mostly taught before this year*, *Mostly taught this year* or *Not yet taught or just introduced* (see Figures 11.3 and 11.4 for further details). Tables 11.4 and 11.5 show the percentage of pupils whose teachers reported that they have been taught the topics either prior to or during the year of the assessment, averaged across topics, presented both as an overall percentage and according to content domain.

11.3.1 The Y6 mathematics curriculum

Table 11.4 shows that 94 per cent of pupils in Northern Ireland were taught the TIMSS mathematics topics either before or during the year of the TIMSS assessment. This was the third highest percentage internationally, similar to Singapore (93 per cent of pupils) and 14 percentage points above the International Average. In 2019, the proportion of pupils in Northern Ireland taught the TIMSS mathematics topics either before or during the year of TIMSS assessment was similar to the 2015 findings.

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

Figure 11.3 TIMSS Mathematics topics taught – questions for teachers



Source: TIMSS 2019 Northern Ireland, Teacher questionnaire M5

Table 11.4 Percentage of pupils taught the TIMSS Mathematics topics

The exhibit reports the percentage of students whose teachers responded "mostly taught before this year" or "mostly taught this year," averaged across topics.

Country	All Mathematics (17 Topics)	Number (7 Topics)	Measurement and Geometry (7 Topics)	Data (3 Topics)
Canada	r 82 (0.8)	r 86 (0.9)	r 76 (1.0)	r 89 (1.3)
Finland	77 (1.0)	93 (0.8)	69 (1.5)	58 (2.5)
Hong Kong SAR	89 (0.8)	95 (0.8)	84 (1.3)	89 (2.6)
Ireland, Rep. of	88 (0.8)	94 (0.9)	81 (1.4)	92 (1.9)
Korea, Rep. of	77 (1.0)	84 (1.3)	70 (1.1)	77 (2.8)
Northern Ireland	94 (0.8)	98 (0.5)	94 (1.1)	87 (2.4)
Poland	68 (1.5)	75 (1.6)	73 (1.7)	40 (3.7)
Singapore	93 (0.3)	99 (0.2)	87 (0.7)	95 (0.7)
England	x 88 (1.7)	x 94 (1.3)	x 83 (2.9)	x 84 (3.7)
International Average	**80 (0.1)**	**86 (0.1)**	**76 (0.2)**	**78 (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 students.
An "x" indicates data are available for at least 40% but less than 50% of the students—interpret with caution.

Source: adapted from Exhibit 12.5 TIMSS 2019: International Results in Mathematics and Science

There was a varied picture internationally in terms of the content domains most commonly taught. The most commonly taught domains in Northern Ireland were Number (98 per cent) and Measurement and Geometry (94 per cent). This is in contrast to the findings from 2015 where Data was the second most commonly taught topic in Northern Ireland. Between the two cycles of TIMSS, there has been a moderate decrease in the percentage of pupils taught the topics in the Data content domain and a moderate increase in the percentage taught the Measurement and Geometry content domain. Although, as noted above, the TIMSS Assessment Frameworks are not designed to exactly match each country's curriculum, this finding may highlight a shift in emphasis in what is being taught in mathematics in Northern Ireland. On average internationally, Measurement and Geometry was less commonly taught (76 per cent), while Number (86 per cent) and Data (78 per cent) were the most commonly taught.

Across the comparator countries, with the exception of Canada, Number topics were more commonly taught than Data topics, although it is important to note that there are only three topics in the TIMSS Data content domain, compared to seven topics for Number. Singapore was most similar to Northern Ireland in its teaching of the TIMSS Number topics, 99 and 98 per cent of pupils respectively were taught these topics in comparison to 86 per cent on average internationally. As noted above, internationally there was a large difference between the percentage of pupils taught the Number topics and the percentage taught Measurement and Geometry, and Data topics. The percentage of pupils taught Measurement and Geometry and Data topics was similar. This pattern was not replicated in Northern Ireland, where there was only a small difference between the percentage taught the Number topics and the percentage taught Measurement and Geometry topics, whereas the difference between Measurement and Geometry and Data was moderate.

11.3.2 The Y6 science curriculum

Table 11.5 shows that 62 per cent of pupils in Northern Ireland were taught the TIMSS science topics either before or during the year of the TIMSS assessment. This was similar to the findings from the 2015 TIMSS survey and was the same as the International Average of 62 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[53], the percentage of pupils taught the TIMSS science topics was lower than Northern Ireland in all countries with the exception of the Republic of Ireland (71 per cent). As was the case in 2015, the most commonly taught content domain in Northern Ireland was Life Science (75 per cent); this was the same in all the comparator countries other than Singapore, where the most commonly taught domain was Physical Science.

Table 11.5 Percentage of pupils taught the TIMSS Science topics

The exhibit reports the percentage of students whose teachers responded "mostly taught before this year" or "mostly taught this year," averaged across topics.

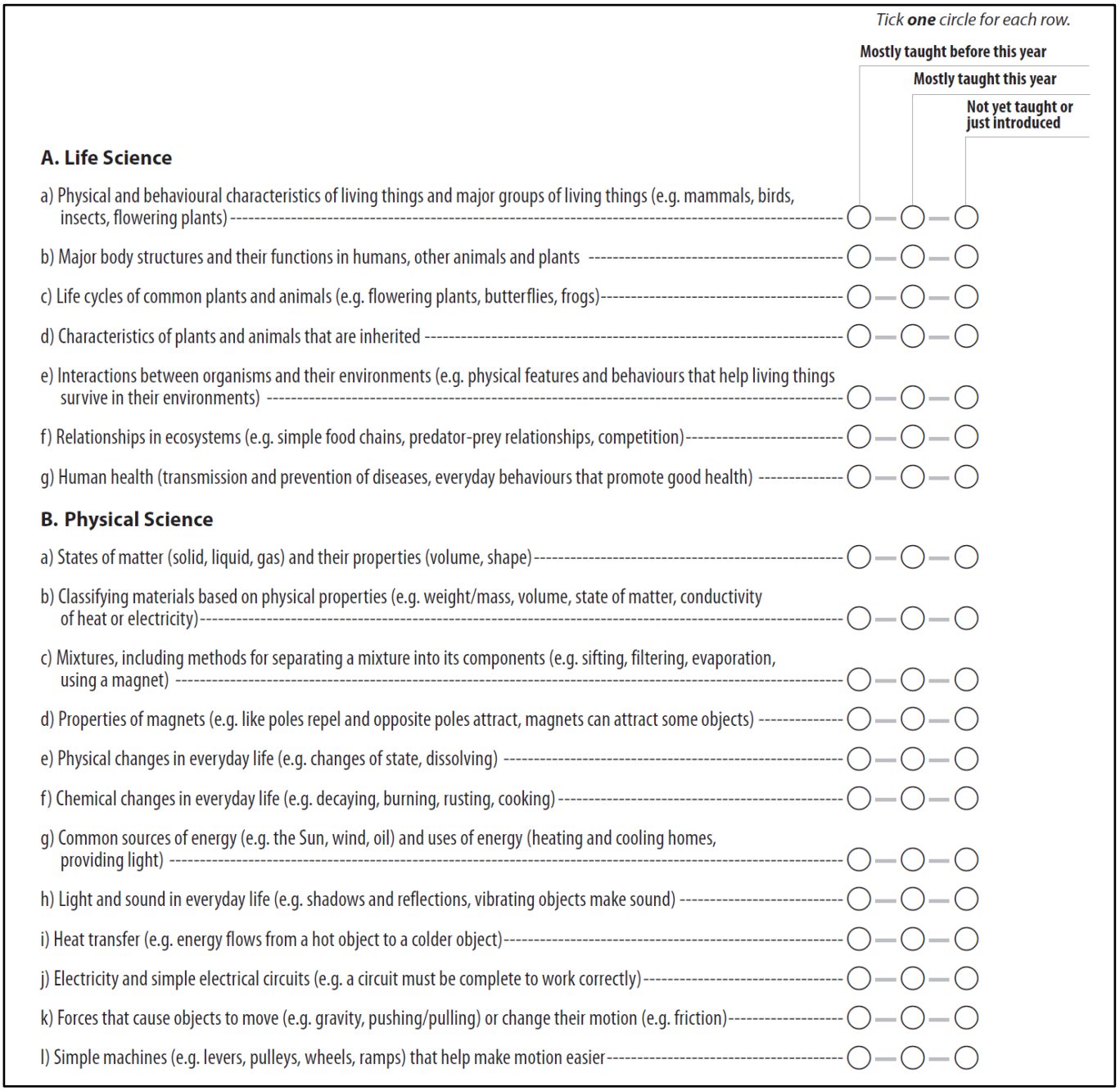
Country	All Science (26 Topics)	Life Science (7 Topics)	Physical Science (12 Topics)	Earth Science (7 Topics)
Canada	r 56 (1.2)	r 68 (1.6)	r 50 (1.3)	r 53 (1.7)
Finland	54 (1.3)	70 (1.3)	46 (1.8)	54 (1.5)
Hong Kong SAR	54 (1.5)	67 (2.6)	51 (1.6)	46 (2.2)
Ireland, Rep. of	71 (1.3)	76 (1.6)	68 (1.6)	72 (1.5)
Korea, Rep. of	48 (1.4)	55 (1.9)	46 (1.5)	46 (2.2)
Northern Ireland	62 (2.0)	75 (2.3)	55 (2.7)	60 (2.4)
Poland	35 (1.2)	61 (1.5)	21 (1.4)	35 (1.9)
Singapore	39 (0.4)	51 (0.8)	54 (0.5)	2 (0.4)
England	y - -	y - -	y - -	y - -
International Average	**62 (0.2)**	**73 (0.2)**	**58 (0.2)**	**60 (0.3)**

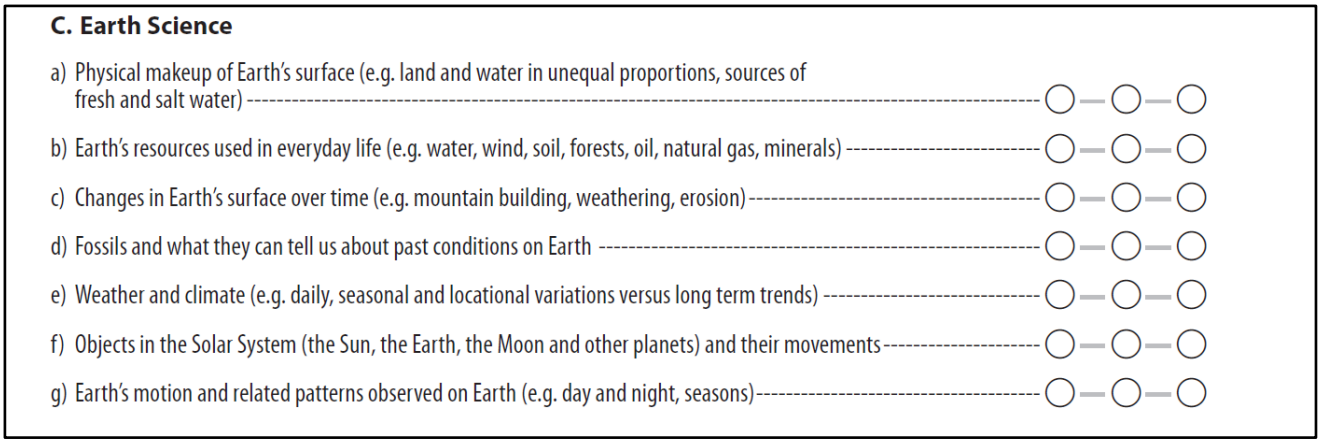
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available.
An "r" indicates data are available for at least 70% but less than 85% of the students.
A "y" indicates data are available for less than 40% of the students.

Source: adapted from Exhibit 13.5 TIMSS 2019: International Results in Mathematics and Science

[53] No data was available for England.

Figure 11.4 TIMSS Science topics taught – questions for teachers





Source: TIMSS 2019 Northern Ireland, Teacher questionnaire S4

11.4 Conclusion

Teachers, principals and National Research Coordinators 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 the amount of time spent teaching mathematics and science. 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, teachers reported on whether the TIMSS topics were covered in lessons, according to content domain.

In Northern Ireland, teaching time for mathematics was higher than the International Average. However, for science, teaching time was lower than the International Average.

In Northern Ireland, a small proportion (14 per cent) of Y6 pupils were taught science by teachers who emphasise science investigation in at least half of their science lessons; this was considerably lower than the International Average (31 per cent) but was a large increase since 2015. 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.

According to teachers' reports of topics taught in lessons, in Northern Ireland 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.

12 Pupil factors impacting on classroom instruction

Chapter outline

This chapter summarises teacher reports of pupils' readiness for instruction in mathematics and science lessons and the impact that has on teaching. This analysis looks at the reports of specific pupil factors that are linked to instructional readiness in three broad areas: pupils' readiness for lessons; pupils' engagement with lessons and factors limiting pupils' engagement with lessons. Note that in Northern Ireland Year 6 (Y6, ages 9-10) pupils are generally taught mathematics and science in the same classes with a single teacher, so reported results are broadly the same for both subjects. International data and subject achievement data may differ.

Key Findings

- In Northern Ireland the pupil factors that had the largest association with achievement in both mathematics and science were those linked to pupils' readiness for lessons: pupils lacking knowledge and skills; pupils suffering from a lack of basic nutrition; pupils suffering from not enough sleep. There was also an association between the pupil engagement factor of pupils' absence from the class and mathematics and science achievement. In each case the association was that greater the reported limitation to teaching, the lower the pupils' scores. For all these factors, the association with achievement was greater for mathematics than science.

- The evidence regarding pupils' readiness for instruction shows pupils suffering from not enough sleep was a larger issue for teaching of Y6 lessons in Northern Ireland than internationally and this has become a bigger issue over time. A lack of nutrition was a less common issue for teaching in Northern Ireland than internationally

- The evidence regarding pupils' readiness for instructions also shows that pupils lacking the prerequisite knowledge and skills for Y6 lessons has increased as an issue for teaching in Northern Ireland since 2015. Internationally the percentage of pupils in this category remained unchanged.

- The evidence regarding pupils' engagement with lessons shows that teaching limited by pupils absent from class has a reported larger impact on teaching in Northern Ireland than internationally.

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- The evidence regarding pupils' engagement with lessons also showed that teaching was limited to a lesser extent in Northern Ireland by disruptive pupils than internationally, but there was evidence of a moderate increase in the impact of disruptive pupils on teaching since 2015.
- A higher percentage of pupils were in lessons limited to *Some* extent by pupils with mental, emotional or psychological impairment in Northern Ireland than internationally, but fewer were impacted *A lot* by this factor.
- The evidence shows that teaching in Northern Ireland was limited less by pupils who have difficulties understanding the language of the lesson than internationally.

Interpreting the data: differences

In this section, we do not report whether differences are statistically significant as, due to the large sample sizes, small differences can be statistically significant but not meaningful from a policy or practice perspective. Instead, we report on the size of differences. Throughout the remainder of the chapter, differences of three percentage points or less may be described as similar, differences of four to six percentage points as small, differences of seven to nine percentage points as moderate, and differences of ten or more percentage points as large.

Interpreting the data: percentages in tables

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

Y6 pupils were sampled by class. The Y6 teacher questionnaire would, in most cases, therefore 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 or science.

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[54].

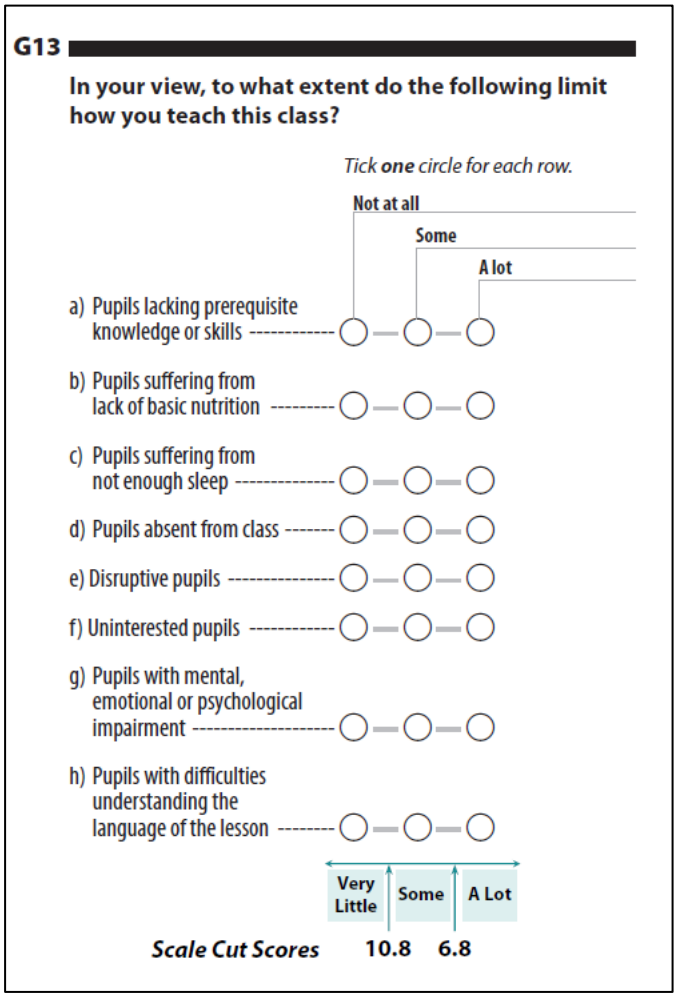
12.1 Pupil level factors that limit teaching

Teachers were asked to rate the extent to which a number of pupil level factors limited their teaching. Teachers responded to the questions shown in Figure 12.1. In this chapter responses to these individual questions are analysed to identify specific factors that may impact on teaching in Y6 classes in Northern Ireland. Note that these questions were used to form the *Classroom teaching limited by pupils not ready for instruction* scale which is discussed in Chapter 10 of this report. Interestingly, as noted in Section 10.4, this was the only school learning environment scale in which Northern Ireland performed below the International Average. Therefore this chapter looks in more detail at the underlying pupil factors included in the scale which might explain this finding.

Note that in all data tables reported in this chapter the percentages of pupils reported for mathematics and science are the same, as the practice in Northern Ireland is for the same teacher to teach both subjects to their class. However, the results for the subjects are presented separately as the International Averages and some data from comparator countries differ between the subjects.

[54] This is unlikely in Northern Ireland as pupils are generally taught mathematics and science in the same classes with a single teacher at year 6.

Figure 12.1 Classroom teaching limited by pupils not ready for instruction – reported by teachers



Northern Ireland scale score = 9.9

This scale was administered in 2015, but only with questions a-c and e to g. This was reported in 2015 as the Teaching Limited by Student Needs scale.

Sources: TIMSS 2019 Northern Ireland Teacher Questionnaire QG13.

Exhibit 10.9, TIMSS 2019 International Results in Mathematics and Science.

12.2 Pupils' readiness for lessons

This section focuses on the first three elements of the question in Figure 12.1 to understand more about the extent to which pupils are ready for their lessons: teachers' perceptions of pupils' lack of prerequisite skills and knowledge, pupils' lack of basic nutrition and pupils suffering from not enough sleep.

Table 12.1 Pupils readiness for lessons

Mathematics

The percentage of pupils whose teachers reported teaching was limited by the factor as indicated

Country	Pupils lacking the prerequisite knowledge and skills			Pupils suffering from a lack of basic nutrition			Pupils suffering from not enough sleep		
2019	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**
Northern Ireland	13	69	18	76	23	1	22	65	13
International Average	16	67	17	65	30	6	41	50	9
2015	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**
Northern Ireland	21	67	12	75	24	2	32	60	8
International Average	16	65	19	67	28	5	42	50	9

Science

The percentage of pupils whose teachers reported teaching was limited by the factor as indicated

Country	Pupils lacking the prerequisite knowledge and skills			Pupils suffering from a lack of basic nutrition			Pupils suffering from not enough sleep		
2019	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**
Northern Ireland	13	69	18	76	23	1	22	65	13
International Average	18	67	15	65	30	5	43	48	9
2015	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**
Northern Ireland	21	67	12	75	24	2	31	61	8
International Average	18	64	17	68	28	5	44	48	8

Sources: 2019 Mathematics and Science Teacher Context Data Almanacs, questions ATBG13A, ATBG13B and ATBG13C.

2015 Mathematics and Science Teacher Context Data Almanac, questions ATBG15A, ATBG15B and ATBG15C.

Table 12.1 shows that in Northern Ireland, 13 per cent of pupils were taught by teachers who reported that teaching was *Not at all* limited by pupils lacking pre-requisite knowledge in mathematics and science, while the majority of pupils (69 per cent) were taught in classrooms where teaching was limited to *Some* extent by pupils lacking pre requisite skills. Additionally, 18 per cent of pupils were taught by teachers who reported that their teaching was limited *A lot* by this factor. In mathematics, this result was similar to the International Average. However, in science there was a small difference below the International Average for pupils *Not at all* affected and above the average for those affected *A lot*.

Among the comparator countries, Northern Ireland had a similar percentage of pupils whose teachers reported teaching was *Not at all* limited by a lack of prerequisite knowledge and skills as Poland, Hong Kong and Canada, and had a higher percentage, by a small margin, than England (eight per cent). Finland and Singapore had the highest percentage of pupils in this category (24 per cent and 26 per cent respectively). However, compared with Northern Ireland, Canada was the only comparator country which had a higher proportion of pupils whose teaching was limited *A lot* by this factor (23 per cent in mathematics and 21 per cent in science).

Over time, by comparison to the equivalent measure from TIMSS 2015, there has been a moderate decrease (by eight percentage points) in the percentage of pupils whose teaching was *Not at all* affected by pupils lacking the knowledge and skills and a moderate increase (by six percentage points) in the percentage of pupils who were affected *A lot.* This suggests that this particular pupil factor has become slightly more of an issue since 2015.

In Northern Ireland, 76 per cent of pupils were taught by teachers who reported their teaching was *Not at all* affected by pupils lacking in basic nutrition (the most positive category), a similar percentage to that reported in 2015. This percentage was above the International Average by a large margin. This suggests that impact on teaching of pupils lacking basic nutrition was less of a problem in Northern Ireland than on average internationally.

Twenty-two per cent of pupils in Northern Ireland were taught by teachers who reported their teaching was *Not at all* affected by pupils suffering from not enough sleep, below the International Average for the most positive category (by a large difference of 19 per cent in mathematics and 21 per cent in science). This figure decreased by ten percentage points for mathematics and nine percentage points for science since 2015. This suggests that, pupils' lack of sleep was more of a problem in limiting the teaching of mathematics and science in Northern Ireland than in 2015.

All eight comparator countries reported more problems with a lack of sleep rather than a lack of nutrition. In terms of the impact of nutrition on limiting classroom teaching, the

pattern seen in Northern Ireland was similar to that in the Republic of Ireland. Of the comparator countries, Poland recorded the most positive picture with highest proportion of pupils in classes *Not at all* affected by this factor (95 per cent). Similarly, in terms of pupils' lack of sleep limiting teaching, the most positive results were in Poland (59 per cent in mathematics and 56 per cent in science) and Singapore (49 per cent in mathematics and 55 per cent in science) as the countries with the highest proportion of pupils whose teachers reported that teaching was unaffected by this issue. Northern Ireland was similar to Canada and England as the comparator countries with the lowest percentage of pupils *Not at all* affected.

12.3 Pupils' engagement with lessons

This section focuses on three elements of the question in Figure 12.1: teachers' perceptions of whether learning is limited by pupils' absence from the class, by disruptive pupils, or uninterested pupils in the class. These questions focus on the extent to which pupils are engaged in their lessons.

Table 12.2 Pupil engagement with lessons

Mathematics

The percentage of pupils whose teachers reported teaching was limited by the factor as indicated

Country	Pupils absent from class[55]			Disruptive pupils			Uninterested pupils		
2019	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**
Northern Ireland	18	73	9	36	50	14	23	72	5
International Average	37	52	11	30	52	18	25	61	15
2015	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**
Northern Ireland	-	-	-	44	47	9	26	68	6
International Average	-	-	-	27	54	19	23	62	15

[55] This question was not included in TIMSS 2015.

Science

The percentage of pupils whose teachers reported teaching was limited by the factor as indicated

Country	Pupils absent from class[56]			Disruptive pupils			Uninterested pupils		
2019	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**
Northern Ireland	18	73	9	36	50	14	23	72	5
International Average	37	53	10	30	52	18	25	61	14
2015	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**	**Not at all (%)**	**Some (%)**	**A lot (%)**
Northern Ireland	-	-	-	44	47	9	26	67	6
International Average	-	-	-	27	54	19	24	61	15

Sources: 2019 Mathematics and Science Teacher Context Data Almanacs, questions ATBG13D, ATBG13E and ATBG13F,

2015 Mathematics and Science Teacher Context Data Almanac, questions ATBG15D and ATBG15E.

[56] This question was not included in TIMSS 2015.

The extent to which teachers in Northern Ireland reported that teaching was limited by pupils being absent from class was much higher than that seen on average internationally. Table 12.2 shows that in Northern Ireland, only 18 per cent of pupils were taught by teachers who reported that teaching was *Not at all* limited by pupil absence, whereas internationally the figure was much higher at 37 per cent. This is a large difference and is seen in both subjects. The vast majority of pupils were categorised as having their teaching limited to *Some* extent by this factor (73 per cent), which exceeds the International Average by a large difference. Nine per cent of pupils were categorised as having been affected *A lot*, similar to the International Average. This suggests that a higher proportion of pupils in Northern Ireland, than is the picture internationally, were impacted by this factor to *Some* extent.

Compared with the comparator countries, Northern Ireland has the lowest proportion of pupils in the *Not at all* category and the highest proportion of pupils in the *Some* category. Hong Kong had the highest percentage of pupils *Not at all* affected in both subjects, with 60 per cent in mathematics and 59 per cent in science.

In terms of disruptive pupils, teachers in Northern Ireland reported that their teaching was limited to a lesser extent by this factor than was the case on average internationally. Thirty-six per cent of pupils were taught by teachers who reported their teaching was *Not at all* affected by disruptive pupils, compared with 30 per cent on average internationally. Twenty-three per cent of pupils were reported as not having teaching limited by uninterested pupils, similar to the International Average. In comparison to the findings from 2015, in Northern Ireland there was a moderate decrease in the percentage of pupils whose teaching was *Not at all* affected by disruptive pupils whereas the finding for uninterested pupils was similar to that seen in 2015. Therefore, this suggests that whilst neither of these factors was more of an issue in Northern Ireland than it is on average internationally, there is evidence that the impact of disruptive pupils on lessons has become more of an issue in Northern Ireland since 2015.

12.4 Factors limiting pupil engagement in lessons

Two elements of the question in Figure 12.1 focused on factors which may limit pupils' ability to engage constructively in their mathematics and science lessons. Teachers were asked to indicate the extent to which they felt teaching was limited by pupils with mental, emotional or psychological impairment, and pupils with difficulties understanding the language of the lesson[57].

[57] The question on language was not asked in 2015 and the question on mental, emotional or psychological impairment has been re-phrased from asking about mental, emotional or psychological disabilities in 2015. As such there will be no report on change over time for the responses to either of these questions.

Table 12.3 Factors limiting pupil engagement in lessons

Mathematics

The percentage of pupils whose teachers reported teaching was limited by the factor as indicated

Country	Pupils with mental, emotional or psychological impairment			Pupils with difficulties understanding the language of the lesson		
	Not at all (%)	Some (%)	A lot (%)	Not at all (%)	Some (%)	A lot (%)
Northern Ireland	32	63	5	53	45	3
International Average	40	48	12	52	40	9

Science

The percentage of pupils whose teachers reported teaching was limited by the factor as indicated

Country	Pupils with mental, emotional or psychological impairment			Pupils with difficulties understanding the language of the lesson		
	Not at all (%)	Some (%)	A lot (%)	Not at all (%)	Some (%)	A lot (%)
Northern Ireland	32	63	5	53	45	3
International Average	41	47	12	52	39	9

Sources: 2019 Mathematics and Science Teacher Context Data Almanacs, questions ATBG13G and ATBG13H.

A higher proportion of pupils in Northern Ireland than is the picture internationally were taught by teachers who considered teaching to be limited to *Some* extent by pupils with mental, emotional or psychological impairment, but teaching was less limited *A lot* than on average internationally. Specifically, Table 12.3 shows that only five per cent of pupils in Northern Ireland were taught by teachers who reported that their teaching was affected

A lot by pupils with mental, emotional or psychological impairment, compared with 12 per cent of pupils on average internationally (a moderate difference). The majority of pupils were categorised as having their teaching limited to *Some* extent by this factor (63 per cent), this was a large difference when compared to the International Average in mathematics (48 per cent), and in science (47 per cent). Compared with the International Average, a smaller proportion of pupils in Northern Ireland were taught by teachers who reported that their teaching was *Not at all* limited by this factor (a moderate difference).

Among the comparator countries, Northern Ireland had a similar percentage of pupils in the *Not at all* category as England and Finland, with Singapore recording the highest percentage of pupils in this category (56 per cent in mathematics and 59 per cent in science). Northern Ireland was one of the countries with the lowest percentage of pupils whose teachers indicated that teaching was limited *A lot* by pupils with mental, emotional or psychological impairment, this was similar to percentage seen in Hong Kong, the Republic of Ireland and Singapore.

In Northern Ireland, 53 per cent of pupils were taught by teachers who reported their teaching was *Not at all* affected by pupils with difficulties understanding the language of the lesson. This was similar to the International Average in both subjects. Only three per cent of pupils were reported as having teaching limited *A lot* by pupils with difficulties understanding the language of the lesson, a small difference compared with the International Average.

Among the comparator countries, Northern Ireland has one of the lowest percentages of pupils affected *A lot* by pupils with difficulties understanding the language of the lesson in both subjects. In terms of the percentage of pupils taught by teachers who reported that their teaching was *Not at all* affected by pupils with difficulties understanding the language of the lesson, the proportion of pupils in this category in Northern Ireland was similar to Canada, while Poland had the highest proportion of pupils in this category.

12.5 Impact on pupil achievement scores

As noted in Chapter 10, there was an association between the extent to which teaching was *limited by pupils not ready for instruction* and achievement in mathematics and science.

The questions discussed in this chapter contribute to the *Classroom teaching limited by pupils not ready for instruction* scale. Therefore exploring whether there is an association between these specific factors and achievement could provide further insights to inform teaching and learning. For each of the factors there was an achievement gap between pupils in the *Not at all* limited category and the limited *A lot* category, this was the case in both mathematics and science. The average achievement scores for pupils in each

category for the pupil factors are presented in Table 12.4 for mathematics and Table 12.5 for science.

Table 12.4 Average Mathematics achievement scale scores for Northern Ireland pupils recorded by teachers as being in classes where teaching is limited by each of the pupil factors

Pupil factor	Average mathematics achievement scale score for Northern Ireland pupils.			Average mathematics achievement gap[58] for each pupil factor
	Not at all	Some	A lot	
Pupils lacking the prerequisite knowledge and skills	589	566	546	43
Pupils suffering from a lack of basic nutrition	574	541	524	50
Pupils suffering from not enough sleep	580	567	532	48
Pupils absent from class	584	564	540	44
Disruptive pupils	573	563	555	18
Uninterested pupils	577	563	550	27
Pupils with mental, emotional or psychological impairment	570	565	546	24
Pupils with difficulties understanding the language of the lesson	572	559	567	5

Sources: 2019 Mathematics Teacher Context Data Almanacs, questions ATBG13A to ATBG13H.

[58] Calculated as the difference between average mathematics achievement scale score of pupils *Not at all* impacted by the pupil factor and the average mathematics achievement scale score of pupils impacted *A lot* by the pupil factor.

Comparing achievement scores in mathematics in Table 12.4, the first four questions all showed differences of more than 40 scale score points between pupils in the *Not at all* limited category and the limited *A lot* category. The mathematics achievement of pupils in the category for teaching limited *Not at all* by pupils lacking the prerequisite knowledge and skills scored 43 points higher than those in the *A lot* category (23 points higher than those in the *Some* category). This may be expected as this factor is linked to pupil subject ability, but this range was larger than the international average.

For the question on the impact of pupils suffering from a lack of basic nutrition, mathematics achievement of pupils in the *Not at all* category was 50 score points above those in the *A lot* category. Although the size of this difference may have been influenced by the small number of pupils (one per cent) in the *A* lot category, achievement was also 33 points above those in the *Some* category suggesting that this association is meaningful. Both of these differences were wider than the International Average achievement gaps.

The performance of pupils whose teachers reported that their teaching was *Not at all* limited by pupils suffering from lack of sleep was better than the performance of pupils whose lessons were limited *A lot* by this factor, a difference of 48 score points. (13 points between the *Not at all* and *Some* categories). The fourth question that saw an achievement gap in mathematics was that covering pupils absent from class. Here the achievement gap between pupils in the *Not at all* category and the *A lot* categories was 44 points (20 points between the *Not at all* and *Some* categories). None of the other questions addressed in this chapter showed an achievement gap of 30 points or greater.

Table 12.5 Average Science achievement scale scores for Northern Ireland pupils recorded by teachers as being in classes where teaching is limited by each of the pupil factors

Pupil factor	Average science achievement scale score for Northern Ireland pupils.			Average science achievement gap[59] for each pupil factor
	Not at all	Some	A lot	
Pupils lacking the prerequisite knowledge and skills	534	519	503	31
Pupils suffering from a lack of basic nutrition	524	501	494	30
Pupils suffering from not enough sleep	527	520	494	33
Pupils absent from class	529	518	501	28
Disruptive pupils	525	516	508	17
Uninterested pupils	525	517	506	17
Pupils with mental, emotional or psychological impairment	523	517	504	19
Pupils with difficulties understanding the language of the lesson	522	515	511	11

Source: 2019 Science Teacher Context Data Almanacs, questions ATBG13A to ATBG13H.

In science, there was a similar picture, but the impact of these factors on achievement was noticeably smaller. Nevertheless, the same four pupil factors showed the strongest associations with achievement as with mathematics. Differences in achievement scores were in excess of 25 scale score points between pupils in the *Not at all* limited category and the limited *A lot* category. The factor of pupils lacking prerequisite knowledge and

[59] Calculated as the difference between average mathematics achievement scale score of pupils *Not at all* impacted by the pupil factor and the average mathematics achievement scale score of pupils impacted *A lot* by the pupil factor.

skills produced an achievement gap of 31 points between the *Not at all* and the *A lot* categories, while the equivalent science achievement gaps for the factor of pupils suffering a lack of basic nutrition was 30 points (and 23 points between *Not at all and Some* categories). As for pupils suffering from not enough sleep, the gap across all of the categories for this factor was 33 points (and seven points between *Not at all and Some* categories). These achievement gaps were broadly similar to the International Averages except for the gap between the *Not at all* group and the *A lot* group for factors of pupils suffering from not enough sleep. The fourth question that saw an achievement gap in science was that covering pupils absent from class. Here the achievement gap between pupils in the *Not at all* category and the *A lot* categories was 28 points (11 points between the *Not at all* and *Some* categories).

For mathematics and science, the pupils factors with the largest association with pupil achievement were those related to pupils readiness for lessons: pupils lacking prerequisite knowledge and skills, suffering from a lack of basic nutrition, suffering from not enough sleep as well as, the engagement factor of pupils absent from class. These factors had a greater association with mathematics achievement than science achievement, which may be related to the differential in the teaching time allocated to the two subjects for Y6 pupils in Northern Ireland (see Chapter 11).

12.6 Conclusion

This chapter summarises teacher reports of pupils' readiness for instruction in mathematics and science lessons and the impact that has on teaching. This analysis looks at the reports of specific pupil factors that are linked to instructional readiness in three broad areas: pupils' readiness for lessons; pupils' engagement with the lessons and reasons pupils may not be able to engage with the lessons. The results from Northern Ireland are compared to the international picture for these factors and to changes over time. This should provide useful insights for teachers into the factors that impact instruction in Y 6 classrooms.

The impact of pupils' readiness for lessons on teaching in mathematics and science was assessed through three questions identifying different pupil-focused factors. The results indicated that the largest percentage of pupils (a majority in all cases) were taught in classes where the teacher had indicated that:

- The teaching was limited to *Some* extent by pupils lacking the prerequisite knowledge and skills.
- The teaching was limited to *Some* extent by pupils suffering from not enough sleep.
- The teaching was limited *Not at all* by pupils suffering from a lack of basic nutrition.

Teaching in Northern Ireland was less limited by pupils suffering from a lack of basic nutrition than on average internationally. However, a higher percentage of pupils' teaching was limited by pupils suffering from not enough sleep (both to *Some extent* and *A lot*) compared to the International Average. Additionally, the proportion of pupils whose lessons had been affected *Not at all* by not enough sleep decreased by ten percentage points from 2015 in Northern Ireland. There was also a moderate decrease in the percentage of pupils *Not at all* impacted by pupils lacking the prerequisite knowledge and skills (eight per cent), whilst the impact of a pupils lacking basic nutrition has remained more stable since 2015.

Taken together, these results suggest that pupils suffering from not enough sleep is a larger issue for teaching in Northern Ireland than it is internationally and that it has become a bigger issue over time. Pupils lacking the prerequisite knowledge and skills for lessons also appears to be an increasing issue for teaching, but to a lesser extent. In contrast, pupils lacking nutrition is less of an issue in Northern Ireland than it is internationally.

The results on the impact of pupils' engagement with lessons in mathematics and science on teaching indicated that the largest percentage of pupils for each of the questions were taught in classes where the teacher had reported that teaching was limited to *Some* extent by pupils absent from the class, disruptive pupils and uninterested pupils. Compared with the International average, the impact of disruptive pupils and, to a lesser extent, uninterested pupils was less of an issue for teaching in Northern Ireland. However, teaching limited by pupils absent from class had a reported larger impact on teaching in Northern Ireland than it did internationally. There was a moderate increase in the impact of disruptive pupils on teaching since 2015.

The results on the impact of factors limiting pupils' engagement with lessons on mathematics and science teaching indicated that the largest percentage of pupils were in classes where teaching was limited to *Some* extent by pupils with mental, emotional or psychological impairment and *Not at all* by pupils with difficulty understanding the language of the lesson. In comparison to the international picture, more pupils were in lessons where teaching was limited to *Some* extent by pupils with mental, emotional or psychological impairment, and this differed from the International Average by a large margin. This indicates that this is more of a low-level issue in Northern Ireland but less of a severe issue than is seen internationally. Similarly, a lower proportion of pupils were impacted *A lot* by pupils with language difficulties in Northern Ireland than internationally.

These results can also be compared to the mathematics and science achievement of the pupils in the different categories for each factor. Pupils lacking the prerequisite knowledge and skills, suffering from a lack of basic nutrition, or from not enough sleep, and pupils absent from class were most strongly associated with achievement in mathematics and science. These include all of the factors linked to pupils' readiness for

Y6 lessons. These factors had a stronger association with mathematics achievement than science achievement.

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Appendix A

Trends in International Mathematics and Science Study (TIMSS) 2019: Overview

A.1 TIMSS 2019: Introduction

The TIMSS 2019 survey is the seventh in the IEA's[60] series of comparative international surveys of mathematics and science achievement. TIMSS is administered on a four-yearly cycle, so the 2019 survey updates the picture of performance from 2015. The next TIMSS cycle is planned for 2023.

A brief description of the survey is given below.

A.2 TIMSS 2019: Transition to e-TIMSS

For TIMSS 2019, the IEA began the move to computer-based assessment and introduced eTIMSS. Half the countries participating in TIMSS 2019 chose to administer the new eTIMSS version, while the other half continued to administer the paper-based version. Northern Ireland was one of the countries that continued to administer the paper-based assessment.

The eTIMSS and paperTIMSS assessments have been developed to be as similar as possible, while introducing new item types, such as drag-and-drop, drop-down menus, and automated scoring for closed response items. In order to maintain consistency between cycles and participating countries the goal of item development was to ensure that eTIMSS and paperTIMSS measured the same mathematics and science constructs using the same assessment items, as far as possible.

To provide a bridge between eTIMSS and paperTIMSS, eTIMSS countries also administered the paperTIMSS trend items (items that had also been included in previous TIMSS cycles) to a separate sample of pupils, typically in the same schools. The bridge data form an intermediate link (or bridge) between eTIMSS countries' computer-based data in 2019 and their paper-based data in 2015 as well as to the paperTIMSS countries in 2019.

[60] International Association for the Evaluation of Educational Achievement (IEA): http://www.iea.nl/

A.3 TIMSS 2019 participants

TIMSS 2019 involved 72 participants: 64 countries and 8 benchmarking participants[61], 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)[62]. Participant numbers for fourth grade (the target grade in Northern Ireland) were: 64 participants (58 countries and 6 benchmarking participants).

Table A.1 below gives the list of participants in TIMSS 2019. This shows participants for both the fourth grade and eighth grade assessments and indicates the previous cycles in which each participant was involved.

TIMSS 2019 participants are varied, ranging from high income countries or regions through to low and middle income 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 (Kelly *et al.*, 2020).

[61] 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.
[62] Norway, South Africa and Turkey assessed at the fifth grade rather than fourth grade.

Table A.1 TIMSS 2019 participants

Country	Grade 4						Grade 8						
	2019	2015	2011	2007	2003	1995	2019	2015	2011	2007	2003	1999	1995
Albania	●												
Armenia	●	●	●	○	●			●	●	○	●		
Australia	●	●	●	●	●	●	●	●	●	●	●	○	●
Austria	●		●	●		●							●
Azerbaijan	●		●										
Bahrain	●	●	●				●	●	●	●	●		
Belgium (Flemish)	●	●	●		●						●	●	●
Bosnia and Herzegovina	●									●			
Bulgaria	●	●								●	●	●	●
Canada	●	●				○		○				●	●
Chile	●	●	●				●	●	●		●	●	
Chinese Taipei	●	●	●	●	●		●	●	●	●	●	●	
Croatia	●	●	●										
Cyprus	●	●			●	●	●			●	●	●	●
Czech Republic	●	●	●	●		●				●		●	●
Denmark	●	●	●	●									●
Egypt							●	●		●	●		
England	●	●	●	●	●	●	●	●	●	●	●	●	●
Finland	●	●	●				●		●			○	
France	●	●					●						●
Georgia	●	●	●	●			●	●	●	●			
Germany	●	●	●	●									●
Hong Kong SAR	●	●	●	●	●	●	●	●	●	●	●	●	●
Hungary	●	●	●	●	●	●	●	●	●	●	●	●	●
Iran, Islamic Rep. of	●	●	●	●	●	●	●	●	●	●	●	●	●
Ireland	●	●	●			●	●	●					●
Israel						○	●	●	●	○	○	○	○
Italy	●	●	●	●	●	○	●	●	●	●	●	●	○
Japan	●	●	●	●	●	●	●	●	●	●	●	●	●
Jordan		●					●	●	●	●	●	●	
Kazakhstan	●	○	●	○			●	○	●				
Korea, Rep. of	●	●	●			●	●	●	●	●	●	●	●
Kosovo	●												
Kuwait	●	●	○	○		○	●	●		○			○
Latvia	●			○	●	○					●	○	○
Lebanon							●	●	●	●	●		
Lithuania	●	●	●	●	●		●	●	●	●	●	●	●
Malaysia							●	●	●	●	●	●	
Malta	●		●					●		●			
Montenegro	●												
Morocco	●	●	●	○	○		●	●	●	○	○	○	
Netherlands	●	●	●	●	●	●					●	●	●
New Zealand	●	●	●	●	●	●	●	●	●		●	●	●
North Macedonia	●								●		●	●	
Northern Ireland	●	●	●										
Norway	●	●	○	○	○	○	●	●	○	○	○		○
Oman	●	●	●				●	●	●	●			
Pakistan	●												
Philippines	●				●						●	●	○
Poland	●	●	○										
Portugal	●	●	●			●	●						●
Qatar	●	●	●	○			●	●	●	○			
Romania			●				●		●	●	●	●	●
Russian Federation	●	●	●	●	●		●	●	●	●	●	●	●
Saudi Arabia	●	●	●				●	●	●	○	○		
Serbia	●	●	●							●	●		
Singapore	●	●	●	●	●	●	●	●	●	●	●	●	●
Slovak Republic	●	●	●	●							●	●	●
South Africa	●	●					●	●	●		○	○	○
Spain	●	●	●										●
Sweden	●	●	●	●			●	●	●	●	●		●
Turkey	●	○	○				●	●	●	○		○	
United Arab Emirates	●	●	●				●	●	●				
United States	●	●	●	●	●	●	●	●	●	●	●	●	●

● Indicates participation in that testing cycle

○ Indicates participation but data not comparable for measuring trends to 2019, primarily due to countries improving translations or to differences in population coverage.

Source: Exhibit A.1, International Results in Mathematics and Science

A.4 TIMSS 2019 in the UK

The countries which comprise the United Kingdom are regarded separately by the IEA and, of the four, Northern Ireland and England participated in the 2019 study. In 2019, Northern Ireland participated for the third time, so comparisons can be made with the 2015 and 2011 cycles 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 and 2015 surveys in Northern Ireland were administered by NFER. Outcomes from both cycles are available from the NFER website: www.nfer.ac.uk/timss

A.5 TIMSS 2019 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 and 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 stipulates that no more than five per cent of the population in total should be excluded across all stages of the study. See the technical report (Martin *et al*, 2020) and Appendix B of the international reports (Mullis *et al*, 2020) 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.[63] Each main sample school is then

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

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, 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 school, classroom, and pupil participation rate of 75 per cent, based on main sample schools (although classroom and pupil participation rates include matched replacement schools).

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.6 Northern Ireland’s TIMSS 2019 sample

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).

Northern Ireland's sample

The sample in Northern Ireland met the international sampling standards described above, with the inclusion of replacement schools. Of 156 schools sampled, a total of 134 primary schools took part (95 main sample schools and 39 replacement schools).

Class participation was 100 per cent and pupil participation 91 per cent (see Table A.2). Overall participation was 78 per cent, exceeding the combined target of at least 75 per cent of pupils and schools. Total exclusions for Northern Ireland were just 2.8 per cent.

Internationally, overall participation rates[64] at this grade ranged from 73 per cent in the Netherlands to 99 per cent in Iran, Khazakstan, Morocco and Turkey. For TIMSS 2019 the exclusion rates ranged from 0.8 per cent in Bahrain to 12.8 per cent in Singapore.

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 Italy) to 10.9 years in Denmark (TIMSS, grade 4)[65]. See Appendix B of the international reports for more information (Mullis *et al*, 2020).

Table A.2 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	156	156	95	39	134

Source: Exhibit B.3, International Results in Mathematics and Science

Country	Within-School Student Participation (Weighted Percentage)	Number of Students Sampled in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Students Eligible	Number of Students Absent	Number of Students Assessed
Northern Ireland	91%	3,877	21	23	3,833	336	3,497

Students attending a sampled class at the time the sample was chosen but leaving the class before the assessment was administered were classified as "withdrawn."
Students with a disability or language barrier that prevented them from participating in the assessment were classified as "excluded."
Students not present when the assessment was administered, and not subsequently assessed in a make-up session, were classified as "absent."

Source: Exhibit B.4, International Results in Mathematics and Science

[64] Combined school, classroom, and pupil participation rate
[65] Norway, South Africa and Turkey assessed at the fifth grade rather than fourth grade. The highest average age of participating pupils amongst these countries was 11.5 years for South Africa.

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
† Northern Ireland	60%	86%	100%	91%	55%	78%

TIMSS guidelines for sampling participation: The minimum acceptable participation rates were 85 percent of both schools and students, or a combined rate (the product of school and student participation) of 75 percent.
Participants not meeting these guidelines were annotated as follows:
† Met guidelines for sample participation rates only after replacement schools were included

Source: Exhibit B.5, International Results in Mathematics and Science

Country	International Target Population		Exclusions from National Target Population		
	Coverage	Notes on Coverage	School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
Northern Ireland	100%		2.2%	0.6%	2.8%

Source: Exhibit B.2, International Results in Mathematics and Science

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The Mere, Upton Park, Slough, Berks SL1 2DQ

T: +44 (0)1753 574123 • F: +44 (0)1753 691632 • enquiries@nfer.ac.uk

www.nfer.ac.uk

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