TIMSS 2019 in Northern Ireland: Executive summary

This summary accompanies the national report for Northern Ireland (Burge *et al*, 2020). It summarises the attainment of Year 6 pupils in Northern Ireland in the TIMSS 2019 survey and explores the context of that attainment. TIMSS is a study of mathematics and science at ages 9-10 (and ages 13-14, although 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 so comparisons can be made with both the 2015 and 2011 cycles where appropriate.

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

The Northern Ireland national report compares Northern Ireland's pupils with all participating countries in TIMSS 2019 at ages 9-10. Within the report, 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 the summary and report as applicable.

Reported findings relate to Northern Ireland unless otherwise specified. Findings are based on the international TIMSS report (Mullis *et al*, 2020), available through the NFER website.[1]

[1] www.nfer.ac.uk/timss

NFER National Foundation for Educational Research

Department of Education
www.education-ni.gov.uk

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[2] 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 were 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[3] 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.
- 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.

[2] 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.

[3] 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 *Apply 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.*

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 has increased significantly (by nine scale score points) while performance in Measurement and Geometry and Applying skills has 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 that 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).

Education workforce (continued)

- Participation in two of the mathematics professional development topics has decreased since 2015: 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 who 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, principals reported that 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 was favourable compared with the other countries; they were ranked[4] eleventh for availability of computers in mathematics lessons and eighth for science lessons. However, the way in which pupils who had computers available to them for lessons accessed 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 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.

[4] 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.

Digital learning environment (continued)

- 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 *Safe and orderly* classroom (a decrease of ten percentage points since 2015).
- Northern Ireland is one of the top ten countries with regard to 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* academic emphasis scored higher in mathematics and science than those from schools with a *High* academic emphasis, with average scale scores of 590 and 569 in mathematics and 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. However, 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.