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PIRLS 2016 further analysis

Investigating pupil performance and attitudes in Northern Ireland across ILSA studies PIRLS, TIMSS and PISA

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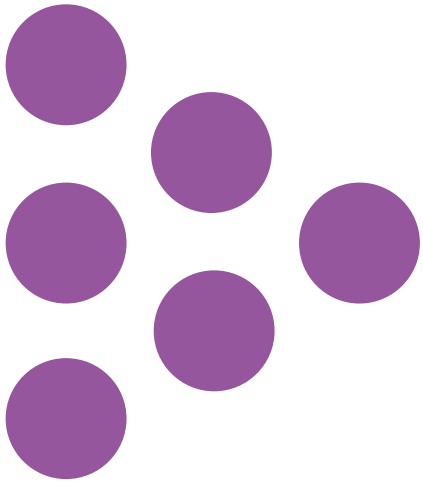

PIRLS 2016 further analyses: Investigating pupil performance and attitudes in Northern Ireland across ILSA studies PIRLS, TIMSS and PISA

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Executive Summary

Introduction and back ground

In International Large Scale Assessments (ILSAs) up to 2016, pupils in Northern Ireland were seen to perform very well at primary level but did less well at the post-primary level. At primary, Northern Ireland's pupils achieved mean scores significantly above the international averages in reading, maths and science (PIRLS and TIMSS). However, the performance of pupils at post-primary was much closer to the international averages in all three subjects (PISA). Similar patterns of performance at post-primary have been noted in other comparable countries, such as England, but the decline is less marked than in Northern Ireland, while others, such as the Republic of Ireland manage to maintain their position among the higher performing countries in some subjects.

This report investigates factors that may be underpinning this observed performance 'dip' in Northern Ireland, with a view to providing evidence to inform future policy. We examined evidence on pupil attitudes and learning environment across the primary (PIRLS and TIMSS) and post-primary (PISA) ILSAs, making relevant comparisons with England and the Republic of Ireland.

Methodology

For the analyses, we used the datasets from PIRLS 2016 (primary), TIMSS 2015 (primary) and PISA 2015 (post-primary)[1] to examine potential trends over time and used multilevel models to explore relationships and interactions between pupil background factors, attitudes, learning environments and pupil attainment.

Policy context

A number of policies designed to improve literacy and numeracy outcomes have been introduced in Northern Ireland since 2011, often focusing on pupils from disadvantaged backgrounds. For example: *Count, Read: Succeed – A Strategy to Improve Outcomes in Literacy and Numeracy* (Department of Education, 2011) was introduced to raise overall standards and close achievement gaps; *Delivering Social Change Signature Programme* (2012) was aimed at recruiting additional teachers to support pupils at risk of underachievement. The *Report on Improving Literacy and Numeracy Achievement in Schools* (Northern Ireland Assembly, 2013) made recommendations to improve educational outcomes and focused strongly on raising the attainment of pupils from disadvantaged backgrounds and the *Draft Programme for Government Framework 2016-21* (2016) included a number of indicators relating to education, such as: improve educational outcomes; and improve the quality of education and reduce educational inequality.

[1] When PISA 2018 results were published in December 2019, some additional observations were incorporated into this report.

What can Northern Ireland learn from International Large Scale Assessment studies?

Key findings and observations

Overview

ILSA studies provide independent evidence on the extent to which policy implementation has been successful over time. Results from PIRLS 2016, TIMSS 2015 and PISA 2015 confirm that Northern Ireland pupils achieved very high scores in reading and maths in primary but did less well in science. The high level of literacy and numeracy skills demonstrated by Northern Ireland's primary pupils were not maintained and more countries out-performed Northern Ireland in reading and maths at post-primary. Performance in science, however, was slightly better at post-primary, relative to other countries, and slightly fewer countries had significantly higher scores.

Our multi-level modelling analyses confirmed that socioeconomic status had by far the strongest effect on pupil scores on all ILSA assessments. Country of birth was one of the most significant factors linked to pupil performance at post-primary in Northern Ireland.

In both primary and post-primary schools, principals reported positively on aspects of the learning environment, but indicated concerns about the provision of science resources.

Higher levels of pupil confidence and enjoyment were associated with higher scores in general, while pupil engagement tended to be more associated with lower scores.

The findings in this report indicate that the existing focus in Northern Ireland on addressing educational under-achievement is supported by the evidence from the ISLAs, However, it will be important, going forward, to ensure that high attaining pupils are also stretched and challenged to their full potential, especially in post-primary.

Performance of different pupil groups in Northern Ireland

Proportions of high and low performing pupils

- At primary, compared to the international pattern, Northern Ireland had more high performing pupils in reading and maths and fewer working at the lower levels. For science the pattern of attainment in Northern Ireland was broadly similar to the pattern internationally.
- At post-primary, compared to the international pattern, Northern Ireland had fewer pupils working at the lowest proficiency levels across all subjects (reading, maths and science) but also fewer demonstrating the highest skills levels in each subject.

Gender gap

- In Northern Ireland, in both primary and post-primary school in 2015/6, the only gender difference that was statistically significant was for reading, in favour of girls.

- In maths and science, at both primary and post-primary levels the gender gaps were not significant.[2]

Socioeconomic gap

- Socioeconomic disadvantage remains the single most influential factor that impacts on educational achievement.
- Pupils in schools with the highest concentration of disadvantaged pupils had significantly lower scores, on average, than those in schools with the lowest proportion of disadvantaged pupils. This is consistent with previous research and, as the difference becomes much more pronounced in post-primary schools, possibly related to the academic selection process in Northern Ireland.

A continued focus on supporting lower-attaining pupils should be balanced with complementary support to ensure that higher-attaining pupils are stretched.

Disadvantaged pupils consistently score significantly lower than their peers from more advantaged homes and those who attend schools with lower concentrations of disadvantaged pupils. It will be important to maintain targeted support and continue with successful interventions.

The results from PISA 2015 show that Northern Ireland's policy focus on disadvantage and under-achievement is having an impact as the proportions of pupils working at the lowest levels have decreased. However, the proportions of high attaining pupils also decreased. The subsequent cycle of PISA in 2018 highlighted the difficulty in maintaining the gains made in 2015 in respect of disadvantage. The results from PISA 2022, when available, will provide more evidence on emerging trends. Foreign born pupils in post-primary schools scored, on average, 23 score points less than native born pupils.

Using ILSA results to support monitoring of attainment, re-assignment of resources and refreshed implementation guidance should help to ensure that the broadest range of pupils, and those who suffer from disadvantage in particular, can be best supported in their learning.

Performance over time

- In 2015/16 across all ILSAs, although there were some small increases and decreases in mean scores between cycles, none of the differences were statistically significant and scores had remained stable in Northern Ireland, with no significant improvement or decline, in any subject in primary or post-primary.
- However, PISA 2018 results showed that while reading and maths results at post-primary had not changed significantly since 2006, science results were significantly lower than they had been in 2006, 2009 and 2012.

[2] In PISA 2018 girls scored significantly higher than boys in science

- PISA 2018 also showed that the scores of high-performing pupils in reading had improved significantly since 2015.

The 2018 cohort of pupils in PISA are the first to experience the revised primary science curriculum 'The world around us', for the whole of their primary schooling, and the 2015 cohort would have had it for part of theirs. The results of TIMSS 2019 will shed some further light on science performance in primaries.

Detailed analyses of ILSA data over time provides independent evidence that can inform both curriculum and policy reviews.

Comparisons with England and the Republic of Ireland

At primary (PIRLS 2016/TIMSS 2015)**,** pupils in Northern Ireland scored significantly:

- higher than those in England in reading
- higher than both comparator countries for maths
- lower than both countries for science

At post-primary (PISA 2015)[3], pupils in Northern Ireland scored significantly:

- lower than those of Republic of Ireland for reading and maths
- lower than England for science

The Republic of Ireland maintained its position among the high achieving countries at post-primary for reading and math and England maintained its advantage in science.

It is notable that, at post-primary (PISA 2015), the Republic of Ireland had the lowest proportions of pupils working at the lowest proficiency levels in all three subjects, and Northern Ireland had the lowest proportions working at the highest levels with the exception of science.

- Across the three countries, the smallest gender gaps in reading were in the Republic of Ireland in both primary and post-primary.
- Across the three countries, the largest socioeconomic gap in reading scores was seen in Northern Ireland's primary schools, whereas at post primary, the socioeconomic gap in Northern Ireland was the smallest of the three.
- High attaining pupils, girls and higher SES pupils in Northern Ireland did, on average, slightly better than those in England and the Republic of Ireland at primary, but did least well among the three countries at post-primary; high attainers in Northern Ireland may benefit from more focused support at post-primary.

[3] PISA 2018 results show that the Republic of Ireland scores remained significantly higher than those in Northern Ireland and England for reading. England performed significantly better than Northern Ireland and the Republic of Ireland for science and better than Northern Ireland for maths. In PISA 2018, the Republic of Ireland had the smallest attainment gaps in all three subjects.

- Low attaining pupils, boys and lower SES pupils, did best in the Republic of Ireland both at primary and post-primary. In fact, in post-primary reading boys in the Republic of Ireland scored higher, on average, than girls in both Northern Ireland and England.
- England maintained higher levels of performance in science in both primary and post-primary.

Progress in reducing attainment gaps in the Republic of Ireland was greater at the primary level because of a significant reduction in the proportion of pupils working at the lower benchmark levels.

The Republic of Ireland's National Strategy: *Literacy and Numeracy for Learning and Life 2011-2020* (2011), included the allocation of additional time for literacy and numeracy in primary schools. Significant improvements in their TIMSS and PIRLS results in 2015/16 would suggest that the strategy has had a positive impact on the performance of their lower attaining pupils.

Areas for Consideration

Taking the evidence identified in this report into consideration indicates the following:

- SES is by far the most influential factor associated with pupil attainment, a focus on early intervention to address disadvantage and newcomer/foreign-born issues should be maintained.
- Establishing and supporting pupil confidence, in all subjects, should be explored and promoted. For example, it may be beneficial to research, develop and evaluate classroom practices that focus on meaningful learning, actionable feedback, collaboration and providing opportunities for pupil independence.
- Focus on stretching high attainers at post-primary, across all subjects, whilst maintaining support and development of lower-attaining pupils.
- Liaise with colleagues in the Republic of Ireland to explore how their recent policies have been implemented and evaluated. Consider some comparative case studies or process evaluations to explore classroom practice as well as detailed comparisons of inter-linked, system level policies.
- Further exploration into pupil attitudes in order to understand more about pupils' underlying beliefs, motivations and behaviours, to find out what makes pupils confident and enjoy a subject. At school level, further qualitative data could be collected around schools' focus on academic success and educational leadership to identify how these factors impact on pupil perceptions and attitudes.
- A review of policies on provision of science resources for schools.

1 Introduction

1.1 Background and research questions

International Large Scale Assessments (ILSAs) are designed to provide evidence to support and evaluate policy decisions over time and to provide a reliable, independent measure of the effectiveness of a country's education system in a global context. In Northern Ireland data from these studies form a strong foundation to support evidence-based policies such as *Every School A Good School, Count, Read: Succeed* and *Getting Ready to Learn*; and to provide advice for parents / guardians and actions they can take to support their child's learning at home and school.

Northern Ireland participates in three ILSAs:

- **TIMSS** – The Trends in International Mathematics and Science Study: an international study of maths and science at ages 9–10[4] (Year 6 in Northern Ireland), with a four year cycle. TIMSS is run by the IEA[5] and the first cycle was in 1995 and NI joined in 2011. In 2015, 50 countries participated in the Grade 4 (Year 6 in Northern Ireland) element of TIMSS.
- **PIRLS** – The Progress in International Reading Literacy Study: a study of reading at ages 9–10 with a five year cycle. PIRLS is run by the IEA and the first cycle was in 2001 with NI first participating in 2011. In 2016, 50 countries participated in PIRLS.
- **PISA** – The Programme for International Student Assessment: a study of reading, science and maths at age 15 with a three year cycle. PISA is run by the OECD[6] and NI has participated since it was first introduced in 2000. Reading, science and maths are included in all cycles, however, each cycle features one subject as a major focus, for example, in 2015 the main focus was science and in 2018 it was reading. In 2015, 72 countries participated in PISA; in 2018 there were 79 participants.[7]

The results from these studies show a disparity in performance between pupils in primary and pupils in post-primary in Northern Ireland. Pupils in Northern Ireland achieve mean scores significantly above the international average in reading, maths and science at primary level (PIRLS and TIMSS), and are outperformed by relatively few countries. However, pupils at post-primary level achieve mean scores much closer to the international averages in reading, maths and science (PISA), and more countries significantly outperform Northern Ireland, many of whom were significantly behind in the primary ILSAs.

A similar pattern of performance at post-primary has been noted in other comparable countries, such as England, but the decline is less marked than in Northern Ireland. In the Republic of Ireland the higher level of performance appears to be maintained at post-primary.

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[4] TIMSS also assesses 13– 14 year olds but Northern Ireland did not participate in the post-primary TIMSS assessment.

[5] International Association for the Evaluation of Educational Achievement.

[6] Organisation for Economic Co-operation and Development.

[7] The analyses in this report was conducted prior to the publication of PISA 2018. However, some references to PISA 2018 have been added subsequently where possible/relevant.

It should be noted that the aims of the studies are not identical. PIRLS and TIMSS aim to evaluate pupils' mastery of the curriculum and are therefore based on the curriculum content in the participating countries. PISA aims to measure the application of student learning and knowledge to real-life situations and is intentionally a more skills-based assessment. It is therefore possible that some of the difference in performance between primary and post-primary may be due to the nature of the assessments, or may relate to the GCSE specifications pupils need to work towards in post-primary.

In this report we examine Northern Ireland's results across different ILSAs and explore factors that may contribute to Northern Ireland's comparatively weaker post-primary performance, in order to inform future policy. We examine the evidence on pupil performance, attitudes and learning environments across the most recent primary and post-primary international studies (PIRLS 2016, TIMSS 2015 and PISA 2015) and make relevant comparisons with England and Republic of Ireland, in order to answer the following research questions:

1. How are Northern Ireland pupils performing in reading, mathematics and science at primary and post-primary?
2. What can we say about pupil attitudes and learning environments in Northern Ireland? Do they vary between primary and post-primary education? Is this variation consistent with that observed in England and the Republic of Ireland?
3. Are there aspects of pupil attitudes and the learning environment that could explain some of the differences seen in performance?

1.2 Policy context

This section summarises the main policy developments in recent years in Northern Ireland, England and the Republic of Ireland to provide context in which to interpret the findings that arise from our analyses.

1.2.1 Northern Ireland policy context

A number of policies designed to improve literacy and numeracy outcomes in Northern Ireland have been introduced since 2011, often focusing on pupils from disadvantaged backgrounds. For example:

- *Count, Read: Succeed – A Strategy to Improve Outcomes in Literacy and Numeracy* (Department of Education, 2011) was introduced to raise overall standards and close achievement gaps. Key areas of action included: an emphasis on literacy and numeracy; high-quality teaching, early intervention to support pupils experiencing difficulties; better links with parents and communities and more effective sharing of best practice.[8]

[8] For the cohort of pupils participating in PISA 2018, the Count, Read, Succeed strategy has been in place since mid-primary school. It will be important to review the results of that study with this in mind.

- *Delivering Social Change Signature Programme* (2012) was a temporary initiative launched to reduce poverty and social exclusion with interventions over two academic years. As part of the programme additional teachers were recruited to support pupils at risk of underachievement.[9]
- *Report on Improving Literacy and Numeracy Achievement in Schools* (Northern Ireland Assembly, 2013) made further recommendations to improve educational outcomes based on known features of schools achieving consistently high standards of literacy and numeracy. The recommendations focussed strongly on raising the attainment of pupils from disadvantaged backgrounds, including early identification and support for underachieving pupils, capacity building and rigorous target setting and monitoring. Underpinning these recommendations was the belief that all children can achieve regardless of background and that "high expectations can drive higher performance, but it is important that attainment targets are realistic"[10] (pp 2).
- *Draft Programme for Government Framework 2016-21* (2016)[11] includes a number of indicators relating to education, such as: improve educational outcomes; improve the quality of education and reduce educational inequality, the latter to be measured by the gap in attainment between pupils with and without Free School Meals Entitlement (FSME).

1.2.2 England policy context

In England there have been many changes in the educational landscape over the last ten years, particularly in primary schools. Following the introduction of a statutory phonics screening test in 2012 and an updated curriculum in 2014, new more rigorous Key Stage 2 tests were introduced in 2016, together with performance measures holding primary schools to account for both attainment and progress.

In secondary schools there have been changes to A-level and GCSE qualifications, together with the introduction of the Progress 8 accountability measure and the National Reference Test. Some of these more recent changes were set out in the white paper, Education Excellence Everywhere (2016) and in the subsequent DfE strategy 2015 to 2020: world-class education and care.

Mathematics has been a major focus in recent years, with new policies and funding in place to improve maths performance – particularly for girls and those from disadvantaged backgrounds. Initiatives and announcements include: up to £41 million of funding, to support more than 8000 primary schools to adopt the 'maths mastery' approach, which is used by some top-performing countries/jurisdictions, including Shanghai, Singapore and Hong Kong (2016); the Advanced Maths

[9] Announced in October 2012 by the then Office of the First Minister and deputy First Minister, aimed to employ an additional 230 recently graduated teachers, who were not currently in a permanent teaching post, on a two-year fixed-term contract to enable schools to provide support for children in primary and post-primary schools who were at risk of underachievement. Source: Department of Education Northern Ireland.

[10] This comment refers to the difference in % of FSME and non-FSME pupils achieving 5 GCSEs A*-C.

[11] The Programme for Government framework has been used as the basis for the Outcomes Delivery Plan which sets out the actions that departments will take during 2018-19 to give effect to the previous Executive's stated objectives of Improving wellbeing - by tackling disadvantage and driving economic growth. Source: The Executive Office Northern Ireland.

Premium, a new fund to help schools and colleges increase the number of pupils studying maths after GCSE (2018) and the mandatory multiplications tables check in Year 4 from 2020.

1.2.3 Republic of Ireland policy context

Following concerns about their performance in PISA 2009, the Republic of Ireland set out their plans for raising standards of achievement in the National Strategy: Literacy and Numeracy for Learning and Life 2011-2020 (2011). In September 2016, the Republic of Ireland published the Action Plan for Education 2016-2019. Following an interim review of the national strategy, looking at progress from 2011 to 2016, new targets for 2017 to 2020 were set (DoES, 2017). During the second half of the strategy, priority is being given to: numeracy, reducing educational disadvantage, challenging high attainers to reach their full potential and consolidating progress to date in literacy.

Priorities within the Republic of Ireland national strategy are linked to related policies including Digital Strategy for Schools 2015–2020; DEIS Plan 2017; and Further Education and Training Strategy 2014–2019.

In light of the changing policy landscape in all three countries, it will be particularly relevant to consider the results of the PISA 2018 study in future research.

Note: The analysis in this report was conducted prior to the publication of PISA 2018. However, some references to PISA 2018 have been added subsequently as footnotes where possible/relevant and in the text when trends over time are discussed.

2 Methodological approach

2.1 Data

In order to answer the research questions set out in section 1.1, we used the most recent datasets available at the time of our analysis: PIRLS 2016, TIMSS 2015 and PISA 2015. These datasets contain representative samples of pupils in Year 6 (PIRLS and TIMSS) and aged 15 (PISA) in Northern Ireland.

To examine trends over time, we compared the relevant variables with those of PIRLS 2011, TIMSS 2011 and PISA 2012.

In addition, we matched PIRLS 2016 data with selected pupil-level characteristics derived from Northern Ireland's School Census, which give additional background information, enabled some comparison with the PIRLS variables, and through those comparisons, with the other data sets.

2.2 Samples

The PIRLS, TIMSS and PISA datasets are designed to provide nationally representative samples in terms of pupil and school characteristics. They use a two-stage sampling process in which schools are first sampled. PIRLS and TIMSS then sample classes within participating schools. Intact classes of pupils are sampled rather than individuals from across the grade level or of a certain age because PIRLS pays particular attention to pupils' curricular and instructional experiences, and these typically are organised on a classroom basis. In PISA, pupils are randomly sampled from the population of pupils within each school whose birth dates fall within the PISA age range of 15.3 – 16.2 years, resulting in pupils in both Year 11 and Year 12 being within the target population for the PISA 2015 study.[12]

Table 2.1 ILSA sample sizes for Northern Ireland

ILSA	No. schools	No. of pupils
PIRLS 2016*	134	3693
TIMSS 2015	118	3116
PISA 2015[13]	95	2401
PIRLS 2011	136	3586
TIMSS 2011	136	3571
PISA 2012	89	2224

*School Census matched sample comprises 3610 pupils and 131 schools

[12] The PISA sample is age-based – drawing a random sample of students between 15.3 yrs and 16.2 yrs. The proportions from each year group may vary slightly from cycle to cycle and older pupils tend, on average, to score higher, but overall the sample is representative of the population as a whole.
[13] PISA 2018: 79 schools, 2413 pupils in the international dataset

2.3 Method

In the analysis for our first two research questions examining pupil attainment and attitudes across ILSAs, we looked at Northern Ireland's performance in reading, maths and science in primary and post-primary schools. We examined overall scores and scores split by gender and socioeconomic status and examined trends over time. We also made comparisons with pupil performance in England and the Republic of Ireland. These analyses were largely descriptive, although some significance tests were carried out. All statistics have been generated using the IEA's IDB Analyzer via a jack-knife repeated replication (JRR) method which takes into account the sampling design information to generate unbiased standard errors. The IDB Analyzer uses t-tests to calculate whether differences between means are statistically significant[14].

For the third research question we generated multilevel models to search for potential relationships and interactions between attitudes and performance. These multi-level models take account of the fact that pupils from the same school are more similar than pupils from different schools, thus allowing a more robust identification of the variance in performance attributable to specific pupil attitudes or learning environments. With regression analysis we can isolate the effect of pupil and home characteristics, such as gender and socioeconomic status (SES), to ascertain the impact of specific variables when all other variables (such as gender or SES) are taken into account. It is important to remember, however, that while the effect size of each variable can be compared, it is not possible to assume causality from significant associations between factors.

2.4 Structure of the report

The remainder of this report describes our analysis and findings:

- In Chapter 3 we examine the performance of Northern Ireland's pupils in reading, maths and science using data from PIRLS, TIMSS and PISA. We look in detail at primary and post-primary performance in each subject considering achievement gaps between different pupil groups and changes over time. We also make comparisons between performance in Northern Ireland, England and the Republic of Ireland across the ILSA studies and over time.
- In Chapter 4 we look at pupil attitudes and how they relate to attainment, and where possible compare pupil attitudes in primary and post-primary schools.[15] We also look at aspects of the school environment and make comparisons with England and the Republic of Ireland.
- In Chapter 5 we discuss our multilevel modelling analyses which identifies which factors have the strongest association with achievement when all other factors are taken into account.
- In Chapter 6 we look at recent strategies and policies in the Republic of Ireland and explore some further differences in the ILSA questionnaire responses.

[14] When statistical significance is reported, it indicates that the compared meas are significantly different at the 5% level.

[15] Attitudinal variables in PISA 2015 relate mainly to science learning so comparisons of attitudes to maths and reading at post-primary are not possible.

- In Chapter 7 we summarise our conclusions and make recommendations based on the key findings of this report.

3 How do pupils in Northern Ireland perform in reading, mathematics and science at primary and post-primary level?

Key findings and observations

Primary and post-primary in Northern Ireland

- In primary schools, Northern Ireland pupils achieved very high scores in reading and maths compared with their international peers. They performed less well in science, but were still significantly above the international average.
- In post-primary schools, Northern Ireland's performance was closer to the OECD average in all three subjects[16].
- At primary, very few countries outperform Northern Ireland in reading or maths. At post-primary, performance in reading and maths falls behind many other countries, and several others catch up.
- In science the number of countries outperforming Northern Ireland reduces slightly at post primary.

> The overall results indicate that the high levels literacy and numeracy skills demonstrated by Northern Ireland's pupils in reading and maths in primary are not maintained into post-primary. Performance in science, however is slightly better at post-primary, relative to other countries.

Performance of different pupil groups in Northern Ireland

Proportions of high and low performing pupils

- At primary, compared to the international pattern, Northern Ireland had more high performing pupils in reading and maths and fewer working at the lower levels. For science they were broadly similar to the pattern internationally.
- At post-primary, compared to the international pattern, Northern Ireland had fewer pupils working at the lowest proficiency levels across all subjects (reading, maths and science) but also fewer demonstrating the highest skills levels in each subject.

> A continued focus on supporting lower achieving pupils could be balanced with complementary support to ensure that higher achieving pupils are stretched.

Attainment gap

- At primary, the largest gap was seen in maths attainment (with many high attainers).

[16] In PISA 2018, although Northern Ireland was above the OECD average for reading for the first time since 2006, is, in part due to changes in which the OECD average was recalculated (to include more countries). There was no significant increase in scores since 2006.

- At post-primary, the largest spread of attainment was in science.

Gender gap

- In Northern Ireland, in both primary and post-primary schools in 2015/16, the only gender difference that was statistically significant was for reading, in favour of girls.
- There were no significant gender gaps in maths or science.[17]

Socioeconomic gap

- Significant differences were found relating to socioeconomic status in every subject and across all age groups (with score point differences ranging from 53 to 74)
- In primary school, the SES gap was smallest in science, whereas in post-primary the gap was the largest of all in science (74 score points) suggesting that disadvantaged pupils struggle particularly with science at post-primary.
- Parental education levels were also significantly linked with pupil attainment with the most pronounced advantage seen for primary maths.
- Pupils in schools with the highest concentration of disadvantaged pupils had significantly lower scores than those in schools with the lowest proportion of disadvantaged pupils. This difference becomes much more pronounced in post-primary schools (110 score points compared with 55 score points at primary). This is likely to be related to the selection process in Northern Ireland and is consistent with findings from previous research into school intake and pupil outcomes.

Disadvantaged pupils consistently score significantly lower than their peers from more advantaged homes and those in schools with lower concentrations of disadvantaged pupils.

It will be important to maintain targeted support and continue with successful interventions.

- Foreign born pupils scored significantly less than native born pupils at post-primary.

Trends over time

- In 2015, across all ILSAs, mean scores had remained stable over time, with no significant improvement or decline in any subject in primary or post-primary.
- However, PISA 2018 results showed that while reading and maths results at post-primary had not changed significantly since 2006, science results were significantly lower than they had been in 2006, 2009 and 2012.
- In primary schools, the attainment gap in reading increased in 2016 due to greater improvement among high attaining pupils.
- Post-primary, lower-attaining pupils showed improvement in all three subjects, but scores of high attaining pupils had also declined in all subjects between 2012 and 2015.
- Between PISA 2015 and PISA 2018, high attaining pupils had improved significantly in reading, but performance in maths and science remained unchanged.
- The improvements for lower-attainers in reading and maths seen in 2015 have not been maintained in 2018 and in science there was a general decline.

Northern Ireland's policy focus on disadvantage and under-achievement appeared to be having an impact in 2015, and scores increased as proportions of pupils working at the lowest levels

[17] In PISA 2018 girls scored significantly higher than boys for science (post-primary).

decreased. This may have been to the detriment of higher achieving pupils. The reversal of this trend in PISA 2018 highlights the difficulties faced by policy makers working to manage and sustain a holistic education policy that fully meets the needs of all pupils, and pupil groups.

> Using ILSA results to support monitoring, re-assignment of resources and refreshed implementation guidance could help to ensure that the broadest range of pupils, and those who suffer from disadvantage in particular, can be best supported in their learning.

In the light of declining science scores at post-primary, it is interesting to reflect that the 2018 cohort would have been the first to experience the revised primary science curriculum, 'The world around us', for the whole of their primary schooling, and the 2015 cohort would have had it for part of theirs. The results of TIMSS 2019 may shed some further light on science performance in primaries.

Comparisons with England and the Republic of Ireland

At primary (PIRLS 2016/TIMSS 2015)**,** pupils in Northern Ireland scored significantly:

- higher than those in England in reading
- higher than both comparator countries for maths
- lower than both countries for science.

At post-primary (PISA 2015)[18], pupils in Northern Ireland scored significantly:

- lower than those of Republic of Ireland for reading and maths
- lower than England for science
- It is notable that, at post-primary (PISA 2015), the Republic of Ireland had the lowest proportions of pupils working at the lowest benchmarks/proficiency levels in all three subjects, and Northern Ireland had the lowest proportions working at the highest levels with the exception of science. Across the three countries, the smallest gender gaps in reading were in the Republic of Ireland in both primary and post-primary.
- Across the three countries, the largest socioeconomic gap in reading scores was seen in Northern Ireland's primary schools, whereas at post primary, the socioeconomic gap in Northern Ireland was the smallest of the three.
- High attaining pupils, girls and higher SES pupils in Northern Ireland did, on average, slightly better than those in England and the Republic of Ireland at primary but did least well among the countries at post-primary - confirming that high attainers in Northern Ireland may benefit from focused support at post-primary.

[18] PISA 2018 results show that the Republic of Ireland scores remained significantly higher than those in Northern Ireland and England for reading. England performed significantly better than Northern Ireland and the Republic of Ireland for science and better than Northern Ireland for maths. In PISA 2018, the Republic of Ireland had the smallest attainment gaps in all three subjects.

- Low attaining pupils, boys and lower SES pupils, did best in the Republic of Ireland both at primary and post-primary. In fact post-primary boys in the Republic of Ireland scored higher, on average, than girls in both Northern Ireland and England.

  Progress in reducing attainment gaps in the Republic of Ireland was greater at the primary level because of a significant reduction in the proportion of pupils working at the lower benchmark levels.

The Republic of Ireland's significant improvements in their PIRLS and TIMSS results in 2015/16 would suggest that the national strategy for literacy and numeracy in 2011 has had a positive impact on the performance of their lower attaining pupils.

England maintained higher levels of performance in science in both primary and post-primary.

In this chapter, we look at Northern Ireland's performance in reading maths and science across all the most recent ILSAs, PIRLS, TIMSS and PISA, comparing performance at primary and post-primary in each subject. We compare Northern Ireland's overall performance, and the performance by proficiency levels, gender and socioeconomic status. We also compare the performance of Northern Ireland's pupils over time and with those in England and the Republic of Ireland.

3.1 Overall performance by subject in Northern Ireland: Primary and Post-primary

Northern Ireland's results in reading, maths and science at primary compared with post-primary suggests that, compared with other countries, there is a drop in performance between age 9/10 and age 15. This is evidenced when comparing the mean scores achieved by Northern Ireland's pupils, relative to the study averages, and when comparing the number of participating countries scoring significantly higher than Northern Ireland at primary and post-primary. In this section, we unpick the results to understand to what extent this is a 'true' drop in performance, and to what extent this is due to differences between the studies. We do this by analysing pupils' average (mean) scores in the ILSA studies and by comparing changes in Northern Ireland's relative position between primary and post-primary with that of other countries.

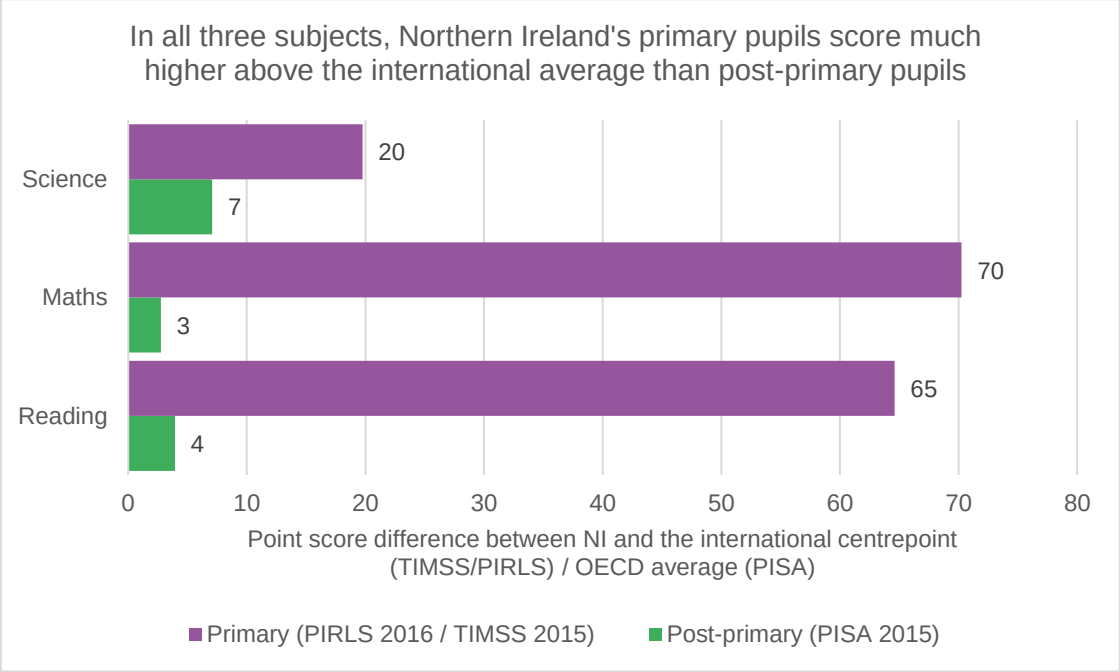
3.1.1 Comparison of Northern Ireland's mean scores relative to study averages

Figure 3.1 shows the mean scores of pupils in Northern Ireland against the international averages in reading, maths and science at primary and post-primary school.Primary pupils in Northern Ireland achieved mean scores significantly above the international centerpoint[19] in

[19] The TIMSS/PIRLS scores are scaled to have an international average value of 500 and a standard deviation of 100 points. The PIRLS scale centerpoint is set at 500 points and represents the mean of the overall achievement distribution in from the first study in 1995/2001. The TIMSS/ PIRLS scales are the same in each administration; thus, a value of 500 in 2015/16 equals 500 in 1995/2001.

PIRLS and TIMSS in all three subjects, very markedly so in maths and reading. At post-primary, the Northern Ireland mean scores tended to be much closer to, and not significantly different from, the OECD average[20].

Figure 3.1 Northern Ireland's performance in PIRLS 2016, TIMSS 2015 and PISA 2015[21]



Subject	Primary (TIMSS 2015/PIRLS 2016)			Post-primary (PISA 2015)		
	Northern Ireland mean	International centrepoint	Difference from international centrepoint	Northern Ireland mean	OECD Average	Difference from OECD Average
Science	520	500	+20*	500	493	+7
Maths	570	500	+70*	493	490	+3
Reading	565	500	+65*	497	493	+4

PISA 2018 results show that although, overall, scores in Northern Ireland had not improved significantly in any subject since 2015, post-primary performance in reading in Northern Ireland

Source: National Centre for Education Statistics

[20] The arithmetic OECD average is the unweighted average of the country estimates i.e. it does not take into account the absolute size of the population in each country; each participating country contributes equally. *Source: PISA Data Analysis Manual, Second Edition.*

[21] PIRLS/TIMSS Centrepoint for primary and OECD average for post-primary

had significantly improved against the OECD average (+14 score points), while maths and science scores remained statistically similar to the OECD average.

It is important to note that although the ILSAs provide a robust measure for international comparisons, the gaps between primary and post-primary are not directly comparable in terms of score points, as the scores for each are calculated slightly differently[22] and the range of participating countries varies in the different studies. For example, proportionally more lower-income countries participated in the first cycles of PIRLS and TIMSS than in any PISA study[23]. This is likely to have the effect of lowering the international centrepoint and making the differences in performance look much greater – which can be misleading. PISA averages are based only on OECD countries and do not include lower income countries, meaning the relative differences appear smaller. Note also that our analysis does not consider progress of individual pupils or cohorts between primary and post-primary but looks at different cohorts at different points in time. However, the purpose of ILSAs is to examine the performance of education *systems* as a whole, not individual pupils or cohorts, and therefore the relative comparisons made in this report remain valid in these terms.

In order to gain an understanding of the differences caused by the different ways of calculating the study means, we conducted a further analysis looking only at OECD countries that participated in both primary and post-primary studies[24]. When non-OECD countries were removed from the analysis of primary performance we found that the relative performance of Northern Ireland pupils is still much higher than the OECD average at primary than at post-primary in maths and in reading. However for science, pupils in Northern Ireland did comparatively less well in primary school – and would have scored below the OECD average. (Figure 3.2)[25].

The analysis throughout the current report will be based on the PIRLS/TIMSS international centrepoint for primary and the OECD average for post-primary, as the published figures for these are readily available. However, the exploratory exercise above demonstrates the need for some caution when interpreting details of Northern Ireland's performance against international/OECD means at primary and post-primary level. Primary science scores, for example, appear stronger when all TIMSS participants (including a number of low-income countries) are included and the centrepoint is 500, whereas against OECD countries they are

[22] PIRLS and TIMSS use a fixed centrepoint that is based on a standard defined in the first cycles of each study, whereas PISA results are typically compared to an average of participating countries' results that is re-calculated each cycle.

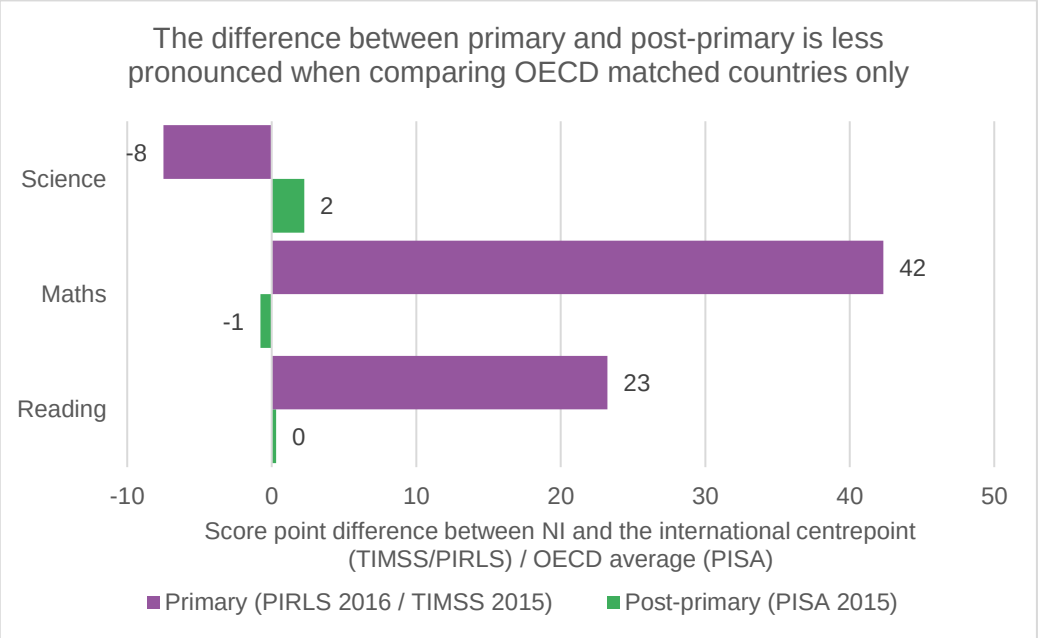
[23] The vast majority of OECD countries, from which the PISA OECD averages are calculated, are high or upper-middle income countries (See Appendix A2) , so we would expect this mean to be higher than the PIRLS centrepoint.

[24] We identified the OECD countries that participated in PISA 2015 and constructed an equivalent sample for both PIRLS 2016 and TIMSS 2015. We then computed the arithmetic average of these matching countries in the three subjects and compared it with Northern Ireland performance in primary and post-primary. The list of countries that took part in both assessments is in Appendix A2.

[25] Post-primary pupils in Northern Ireland scored close to the OECD average in all three subjects in 2015, whereas by 2018 the scores in reading were higher than the international average for the first time.

actually lower. Reading and maths scores, however, are still significantly higher than the OECD average at primary.

Figure 3.2 Primary and post-primary: Northern Ireland compared with matched OECD countries



	Primary (TIMSS 2015/PIRLS 2016)			Post-primary (PISA 2015)		
	Northern Ireland mean	OECD matched countries mean	Difference from matched. countries mean	Northern Ireland mean	OECD matching countries mean	Difference from matched. countries mean
Science	520	527	-8[26]	500	498	+2
Maths	570	528	+42	493	494	-1
Reading	565	541	+23	497	497	0

The way the mean scores are calculated in different ILSAs, and the variation in participating countries between studies, mean that direct comparisons cannot be made in terms of the exact number of score points difference, but the overall trend remains clear.

Another way of comparing primary and post-primary performance in Northern Ireland is to consider the number of countries that outperform Northern Ireland in the different ILSAs. This is discussed in Section 3.1.2.

[26] -7.502 rounded

3.1.2 Comparison of Northern Ireland's performance relative to other countries

A further way of comparing Northern Ireland's performance in the primary and post-primary studies is to explore how Northern Ireland's international position changes in relation to other participating countries. Table 3.1 shows the number of countries with significantly higher scores than Northern Ireland in the respective ILSA studies. This reflects the mean score data above and shows that for reading and maths, Northern Ireland's primary pupils are amongst the best internationally, but are outperformed by many more countries at post-primary. The table also shows that at post-primary, slightly fewer countries outperform Northern Ireland in science.

Table 3.1 How many countries score significantly higher than Northern Ireland?

Subject	The number of countries outperforming Northern Ireland		
	Primary – PIRLS/TIMSS	Post-primary PISA 2015	Post-primary PISA 2018
Reading	2	12	10
Maths	5	18	17
Science	22	17	16

Table 3.2 identifies countries which showed greater relative progress than Northern Ireland, with some catching up with and others overtaking Northern Ireland between primary and post-primary.

Northern Ireland's performance at primary level is very strong. However, there are some countries who performed similarly at primary level yet perform significantly better at post-primary level and several others that performed less well at primary level but at post-primary were either similar to Northern Ireland or scoring significantly better (Table 3.2).

In particular, we see that the Republic of Ireland significantly out-performed Northern Ireland at post-primary for reading and maths in PISA 2015, having been similar at primary for reading and significantly below in maths. England had been significantly lower than Northern Ireland for reading and maths at primary but had similar scores at post-primary.

For science, England remained significantly better than Northern Ireland at both primary and post-primary levels, whereas the Republic of Ireland changed from significantly better at primary to similar at post-primary.

Table 3.2 Countries that overtook or caught up with Northern Ireland from primary to post-primary in PISA 2015[27]

Subject	Countries **similar** to NI **at primary** but significantly **better at post-primary**	Countries **significantly lower** than NI **at primary but significantly better at post-primary**	Countries **significantly lower** than NI **at primary but** caught up to be **similar at post-primary**
	(more improvement)	(overtaken)	(caught up)
Reading	Hong Kong, Finland, **Republic of Ireland** and Norway	Canada, New Zealand, Germany and Macao (China)	Slovenia, Netherlands, Australia, Sweden, Denmark, **England**, France, Belgium, Portugal, United States, Spain, Latvia, Czech Republic.
Maths		Canada, Netherlands, Denmark, Finland, Slovenia, Belgium, Germany, Poland and **Republic of Ireland**	Norway, New Zealand, Sweden, Australia, **England**, France, Czech Republic, Portugal, Italy , Spain
Science	Canada, Australia and Netherlands	New Zealand	Belgium, Portugal France

No clear patterns emerge in terms of the education systems in countries where relative performance had improved. For example, Australia, Canada, New Zealand, France and Portugal all have non-selective education systems and improved their relative positions compared to Northern Ireland in all three subjects. Netherlands and Belgium have a similar selective education system to Northern Ireland, and also improved their positions in all three subjects, while other non-selective or partially selective countries also showed better relative improvement in some subjects.

It is possible that primary pupils in Northern Ireland develop some advantage because of the earlier age at which they start compulsory education. Most of the countries in the table begin compulsory schooling at age 5 or 7 so it may be that any early advantage is evened out by post-primary. However, pupils in the Netherlands, like those in Northern Ireland begin school at age four but still appear to make more relative progress than those in Northern Ireland.

[27] In PISA 2018, for reading, Republic of Ireland remained significantly better than Northern Ireland and England; England remained better than the other two countries in science. ROI was similar to NI for maths in 2018 having been significantly better in 2015.

It may be useful, therefore, to look more closely at the distribution of higher and lower performing pupils in Northern Ireland.

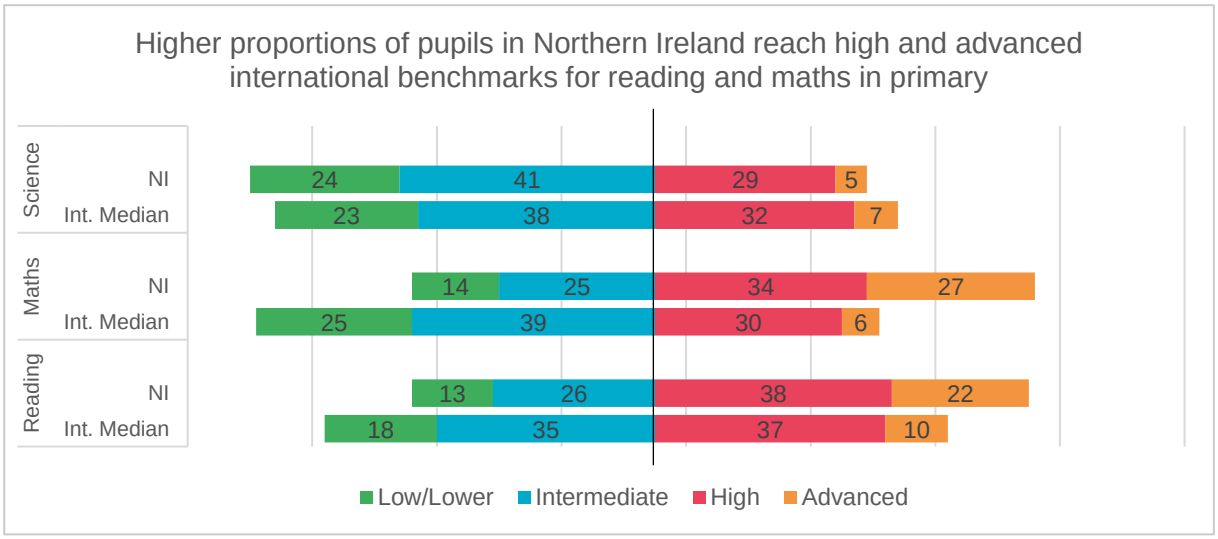
3.2 Proportions of high and low performing pupils in Northern Ireland

To understand more about differences in the distribution of performance, we can look at how Northern Ireland pupils are distributed across the internationally defined benchmarks (PIRLS and TIMSS) and proficiency levels (PISA). The benchmarks/proficiency levels describe the skills and strategies demonstrated by pupils at various points on the achievement scales in the ILSA assessments and are available in Appendix A1.

International benchmarks/proficiency levels remain constant within studies and between cycles and, therefore can be used to describe the population's performance at the different levels in a global context.

In PIRLS and TIMSS, pupils are categorised as performing at low, intermediate, high and advanced levels for each subject. Figure 3.3 shows the distribution of primary pupils reaching the IEA's international benchmarks[28] in Northern Ireland with data from PIRLS 2016 and TIMSS 2015.

Figure 3.3 Primary: Percentage of pupils reaching PIRLS/TIMSS international benchmarks[29]

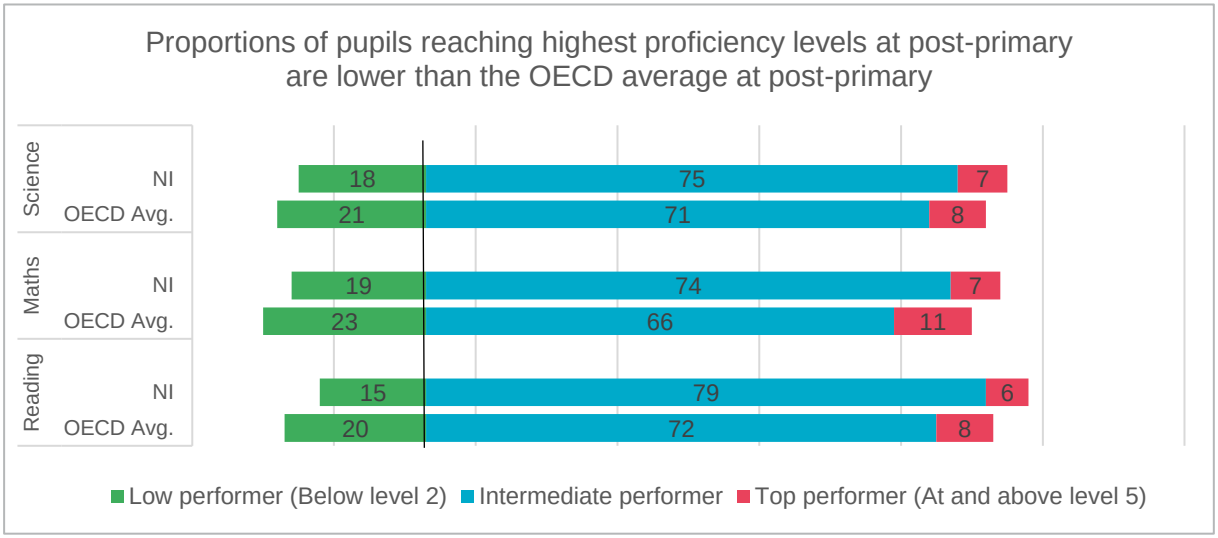


[28]PIRLS and TIMSS studies describe achievement at four points along the scale as international benchmarks: Advanced International Benchmark (625), High International Benchmark (550), Intermediate International Benchmark (475), and Low International Benchmark (400). Benchmarks are based on the skills and strategies demonstrated by pupils achieving each level of the scale. (NB the 'Low' category in the figures above includes a very few pupils not reaching the Low benchmark threshold)

[29] The bars are centered around the Intermediate international benchmark, which corresponds to a score of 475

The equivalent measures at post-primary are defined using PISA proficiency levels, which define the skills demonstrated by pupils working at high, medium and low levels of proficiency in each subject[30]. Figure 3.4 below shows the distribution of pupils working at the top, intermediate and lower levels of proficiency in Northern Ireland alongside the OECD average distribution in PISA 2015.

Figure 3.4 Post-primary: Percentage of pupils reaching PISA proficiency levels (PISA 2015[31]).



At post-primary, Northern Ireland had fewer pupils working at the lower proficiency levels at post-primary across all subjects than is seen across OECD countries.

However, Northern Ireland had similar or lower proportions of pupils demonstrating the higher level skills in each subject compared to the OECD population. This was a considerable contrast to performance in reading and maths at primary where the proportion of high achieving pupils was much greater than was seen internationally.

These findings mirror the patterns found in the analysis of mean scores at primary and post-primary.

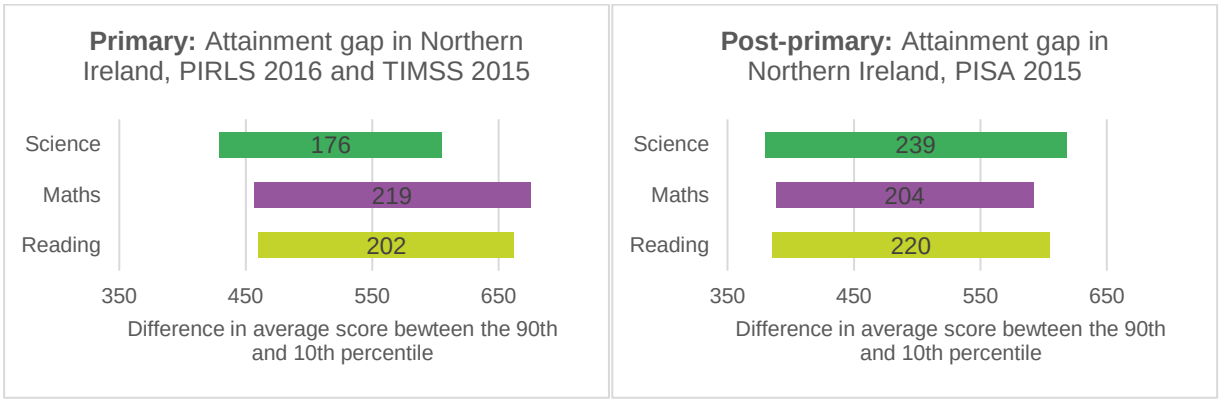
[30] PISA proficiency levels are based in six levels of achievement, for the purpose of the figure, we merged *low performers* to include those who perform below level two, *intermediate performers* those who reached levels two, three and four, and *top performers* those who reached levels five and six. Proficiency levels' score points for science are: 335, 410, 484, 559, 633 and 708. Proficiency levels' score points for maths are: 358, 420, 482, 545, 607 and 669. Proficiency levels' score points for reading are: 335, 407, 480, 553, 626 and 698.

[31] In PISA 2018 for reading, Northern Ireland had 2 per cent more pupils working at the highest proficiency levels but also had 4 per cent more pupils working at the lowest proficiency levels for reading. For maths and science the proportions for high and low performers were not significantly different,

3.3 The attainment gap in Northern Ireland

In Northern Ireland, in 2015/16, there were significant differences between the scores of the highest and lowest achieving pupils in all three subjects. Figure 3.5 shows that the attainment gaps were larger at post-primary for science and reading, but smaller for maths.

Figure 3.5 The attainment gaps in Primary and Post-primary by subject*



*the score point scales are not identical in primary and post-primary studies

At primary, the largest gap was seen in maths attainment, reflecting the high proportions of pupils working at the high and advanced benchmark levels.

At post-primary the largest attainment gap was in science.

3.4 Gender differences in Northern Ireland

In Northern Ireland, in both primary and post-primary schools in 2015/16, the only gender difference that was statistically significant was for reading, in favour of girls.

In maths and science, at both primary and post-primary levels the gender gaps were not significant[32].

In terms of PIRLS reading subdomains, the gender advantage of girls in primary school was even greater when reading for a *literary purpose*[33] (compared with reading for an *informational purpose*). For comprehension processes, the gender advantage of girls was greater when *interpreting, integrating and evaluating* (compared with the gender gap for *retrieving and straightforward inferencing*). These findings reflect the international patterns which indicate that girls demonstrate more advanced, higher-order reading skills than boys in both primary and post-primary phases.

International benchmark/proficiency level data reflect these findings and confirm that, in Northern Ireland, a much higher proportion of boys were performing at the lower levels, in

[32] However, in PISA 2018, girls also scored significantly higher in science.

[33] PIRLS achievement scales are divided in 1) Purposes of reading: 1.1. Reading for literary experience and 1.2. Reading to acquire and use information, and 2) Processes of comprehension: 2.1. Retrieving and straightforward inferencing and 2.2. Interpreting, integrating and evaluating

primary and post-primary, compared to girls in reading; whereas for maths and science the proportions were similar at all levels in 2015.

A focus on supporting low performing boys would therefore be likely to improve performance overall.

3.5 Socioeconomic differences in Northern Ireland

In many international studies, the number of books at home[34] (reported by pupils) and the level of parental education (reported by parents for PIRLS/TIMSS and by pupils in PISA) can be used as reasonable proxies for socioeconomic status (SES). Although these particular measures have limitations, they do allow comparisons across different ILSAs and will be used throughout this chapter.

3.5.1 Books in the home

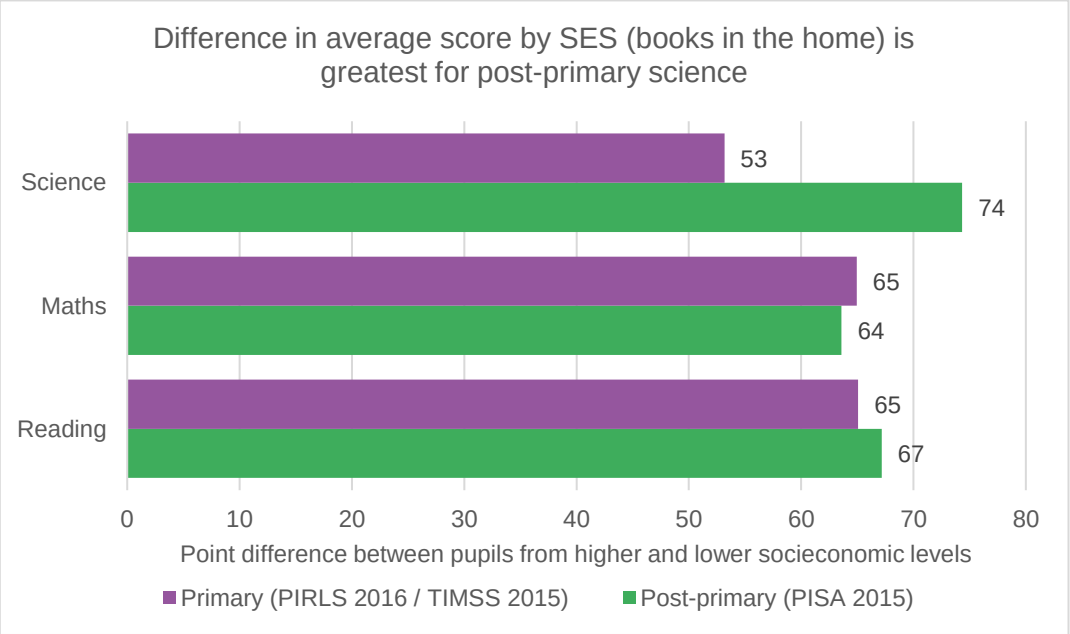
We compared the performance of pupils who have 0 to 25 books at home (a book shelf) with the performance of pupils who have 26 or more books at home (a book case or more). As in previous studies, the results confirmed that disadvantaged pupils, with fewer books in their homes, scored significantly lower in all subjects at both primary and post-primary.

Figure 3.6 shows that significant differences were found between pupils of higher and lower socioeconomic status at primary and post primary in every subject, with point score differences ranging from 53 to 74 points.

In primary school, the SES gap was smaller in science than in maths and reading, whereas in post-primary the gap was the largest of all in science (74 points) suggesting that disadvantaged pupils struggle particularly with science at post-primary.

[34] Books at home has been tested and shown to be a reasonably reliable proxy for SES if it cannot be obtained by other means.

Figure 3.6 Primary and post-primary: attainment by socioeconomic level in Northern Ireland by subject



	Primary (TIMSS 2015 / PIRLS 2016)		Post-primary (PISA 2015)	
	% Pupils	**Avg. Achievement**	**% Pupils**	**Avg. Achievement**
Science				
One bookcase or more	68%	**537***	65%	**528***
One bookshelf or less	32%	**484***	35%	**453***
Maths				
One bookcase or more	68%	**592***	65%	**517***
One bookshelf or less	32%	**527***	35%	**453***
Reading				
One bookcase or more	68%	**586***	65%	**522***
One bookshelf or less	32%	**521***	35%	**455***

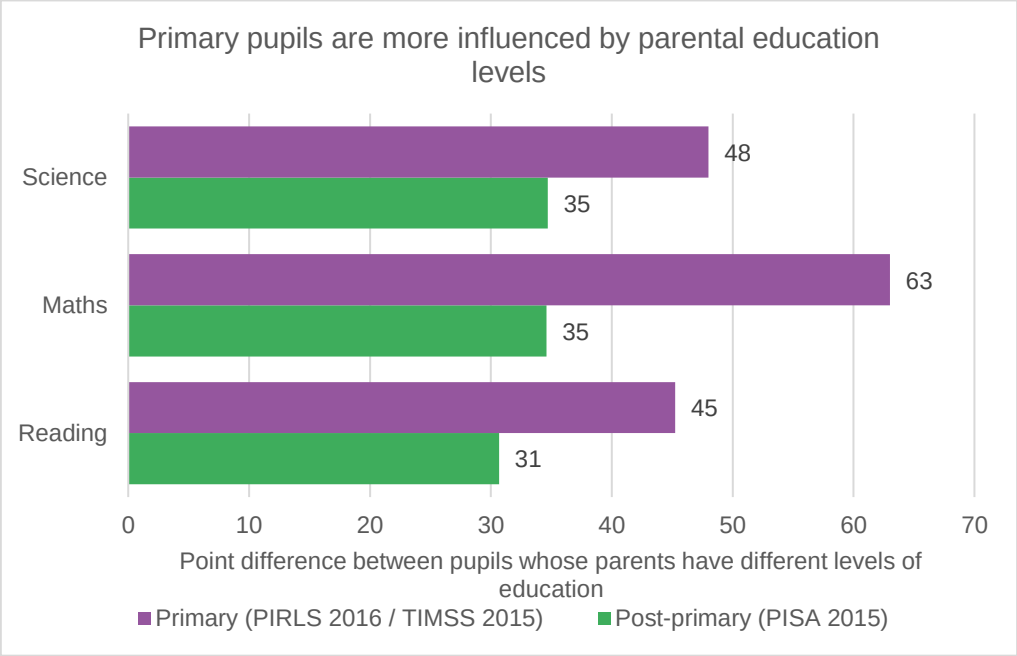
*Difference between groups is statistically significant in all subjects

3.5.2 Parental education

We also compared pupils with at least one parent that had completed a university education or higher with pupils whose parents had completed less than university level education[35]. As with SES, the difference was significant for every subject for both primary and post-primary pupils, in favour of pupils whose parents had completed university or higher education (Figure 3.7). It is to be expected that pupils whose parents have a higher level of education are also likely to have more books in their homes. It is not surprising, therefore, that the findings of this analysis were similar to that of the SES analysis. Across subjects, the difference was most pronounced in primary maths, suggesting that pupils of more educated parents may receive and benefit from more effective support in maths at home. In contrast to the 'books in home'/SES, we also found a lower performance gap at post-primary compared to primary, i.e. the level of parental education had a greater impact on primary pupils compared to post-primary. This is not surprising as we would expect post-primary pupils to work more independently; they are also more likely to be influenced by their peers.

[35] NB: The sample size for pupils with parental education data was much smaller in the primary school analysis, as the response rate of the parental questionnaire was below 40 per cent for PIRLS and below 60 per cent for TIMSS.

Figure 3.7 Primary and post-primary: achievement by level of parental education in Northern Ireland by subject



	Primary (TIMSS 2015 / PIRLS 2016)[36]**		Post-primary (PISA 2015)	
	% Pupils	**Avg. Achievement**	**% Pupils**	**Avg. Achievement**
Science				
Completed university or higher	42%	**559***	41%	**525***
Completed less than university	58%	**511***	59%	**490***
Maths				
Completed university or higher	42%	**623***	41%	**517***
Completed less than university	58%	**560***	59%	**482***
Reading				
Completed university or higher	50%	**611***	41%	**519***
Completed less than university	50%	**566***	59%	**488***

*Difference between groups is statistically significant in all subjects

[36] For primary school pupils, this question is included in the parental questionnaire, hence the sample sizes are reduced. Sample size for maths and science (TIMSS 2015) = 1,832. Sample size for reading (PIRLS 2016) = 1,454 .

3.5.3 Socioeconomic intake of schools

Previous research has found that not only the individual socioeconomic status of the pupil affects academic performance, but also the socioeconomic status of their peers in school (Caldas & Bankston, 1997).

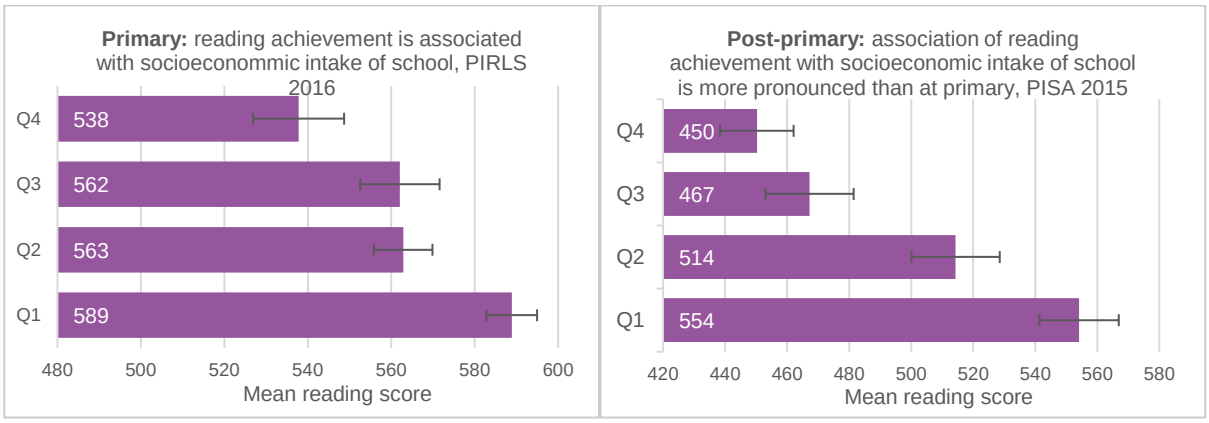
By linking PIRLS 2016 data with School Census data, we explored the difference in performance between primary schools with intakes of lower and higher proportions of pupils with socioeconomic disadvantage[37]. For post-primary reading, we constructed a school average SES measure from the PISA 2015 dataset. Using these measures, we were able to make comparisons between primary and post-primary schools.

Figure 3.8 shows the mean reading scores of pupils in schools grouped according to the proportion of socially and economically disadvantaged pupils. For PIRLS, Q4 represents one quarter (25%) of participating schools, those with the highest percentage of FSME pupils. Similarly, for PISA, Q4 represents the 25 per cent of schools with lowest average ESCS index[38].

[37] In PIRLS 2016, schools in each quartile have, on average, the following proportion of FSME pupils Q1: 12%; Q2: 22%; Q3 35%; Q4 59%

[38] The PISA index of Economic, Social and Cultural status (ESCS) is a composite score built by the indicators parental education (PARED), highest parental occupation (HISEI), and home possessions (HOMEPOS), including books in the home

Figure 3.8 Primary and post-primary: average reading achievement by school socioeconomic intake



Our findings confirmed that pupils in schools with the highest concentration of disadvantaged pupils (Quartile 4) had significantly lower scores, on average, than those in schools with the lowest proportion of disadvantaged pupils (Quartile 1).

This difference between Quartiles 1 and 4 becomes much more pronounced in post-primary schools. This is likely to be related to the selection process in Northern Ireland, which is consistent with previous findings in the literature (Shewbridge, C. *et al*., (2014)).

3.6 Trends in Northern Ireland's performance over time in PIRLS, TIMSS and PISA

Results of ILSA studies are used worldwide to monitor the performance of a country's education system over time, and to provide evidence of the impact of specific education policies as they are rolled out.

In 2013, the Northern Ireland Assembly's Report on Improving Literacy and Numeracy Achievement in Schools (Northern Ireland Assembly, 2013) made recommendations to improve educational outcomes based on known features of schools achieving consistently high standards of literacy and numeracy. The recommendations focussed strongly on raising the attainment of pupils from disadvantaged backgrounds, including early identification and support for underachieving pupils, capacity building and rigorous target setting and monitoring.

The following sections show trends in achievement in Northern Ireland in primary and post-primary schools between 2011/12 and 2015/16 and information from PISA 2018 has been added where relevant.

3.6.1 Mean scores over time in Northern Ireland

Table 3.3 shows the mean scores of Northern Ireland's pupils over the most recent cycles of PIRLS, TIMSS and PISA.

Table 3.3 Overall achievement in Northern Ireland over time

	Primary (TIMSS / PIRLS)		Post-primary (PISA)		
	2011	**2015/16**	**2012**	**2015**	**2018**
Reading	558	565	498	497	501
Maths	562	570	487	493	492
Science	517	520	507	500	491*

*NI's science score in 2018 was significantly lower than in 2012

Although there were some small increases and decreases in mean scores between 2011/12 and 2015, none of the differences were statistically significant in 2015.

However, PISA 2018 results showed that while reading and maths results at post-primary had not changed significantly since 2006, science results were significantly lower than they had been in 2006, 2009 and 2012.

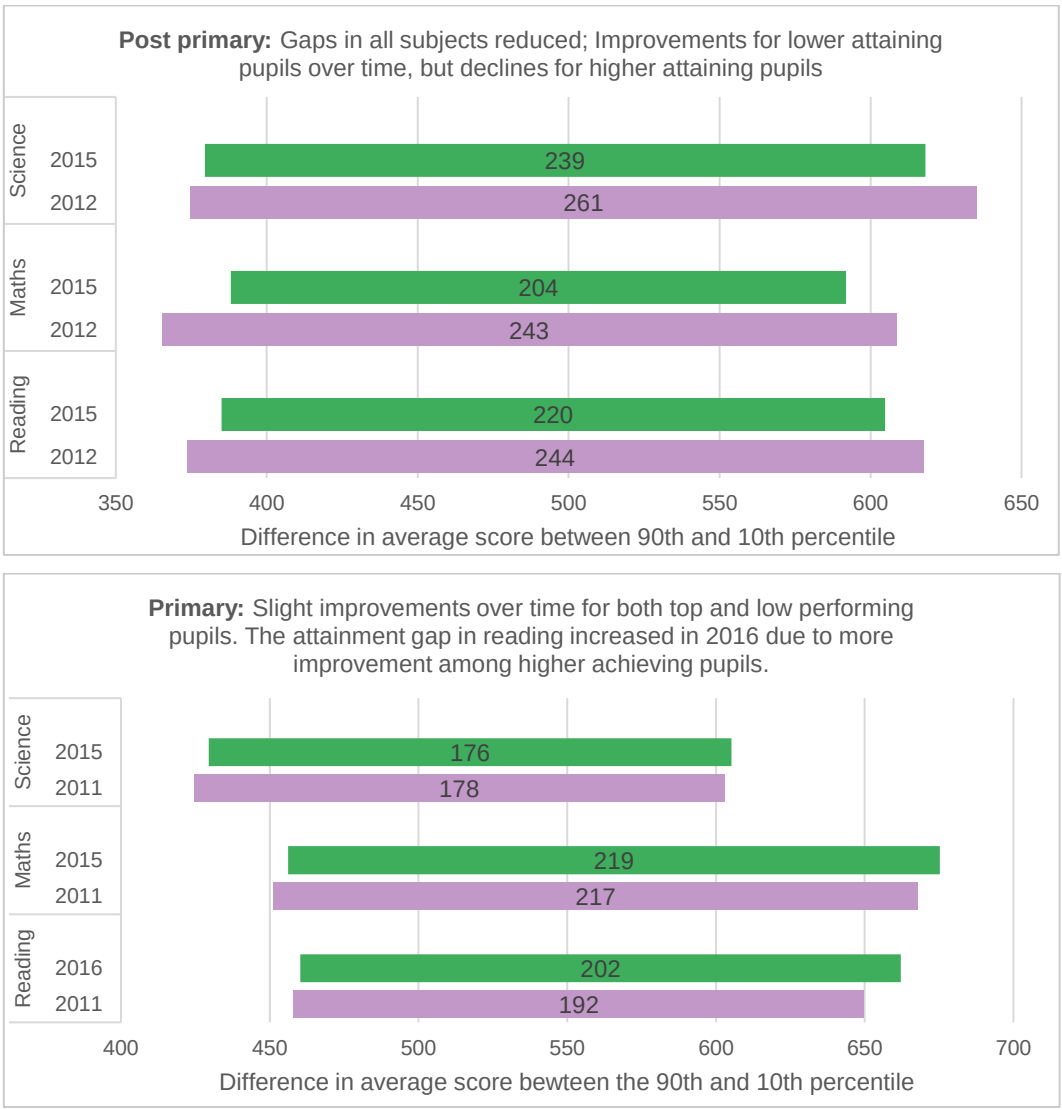
3.6.2 Attainment gaps over time in Northern Ireland

We looked at trends in achievement across subjects at primary and post-primary to explore the **gaps between higher and lower attaining pupils**.

Figure 3.9 shows that, in Northern Ireland, between 2011 and 2015/16:

- **In primary schools,** in all subjects, small improvements in performance were seen at both ends of the distribution. The gaps between higher and lower attaining pupils were broadly similar over time for maths and science, but the gap increased for reading due to greater improvements in the performance of high attaining pupils.
- **In post-primary**, the performance of lower attaining pupils improved in all three subjects over time to 2015. However, the performance of high attaining pupils declined in all subjects between 2012 and 2015. Between PISA 2015 and PISA 2018, the performance of high achieving pupils had improved significantly in reading, but in maths and science remained unchanged. The scores of lower achieving pupils had not changed significantly in any subject in PISA 2018.

Figure 3.9 Primary and post-primary: Gap between highest and lowest attainers (10th and 90th percentiles) over time



The only change that was statistically significant was the increase in the reading scores of high attainers in reading at primary. The charts do, however, reveal interesting and consistent patterns of change across subjects at primary and post primary.

The above analyses for 2015 suggest that Northern Ireland had made some progress in raising attainment for disadvantaged and lower attaining pupils while the attainment of high attainers was not seen to improve.

The results of PISA 2018 showed that the attainment gaps had changed as follows:

- Science: the attainment gap remained the same at 239, but overall scores had declined at both ends (-9 score points to 370 at the 10th percentile and -9 to 609 at the 90th percentile).
- Maths: the gap had increased by 19 score points to 223 (-11 to 377 at the 10th percentile and +8 to 610 at the 90th percentile).

- Reading: the gap had increased by 35 score points to 255 which is larger than in both previous cycles. (-17 at the 10th percentile to 368 and +18 at the 90th percentile to 623).

Overall, the attainment gaps in 2018 suggest a reversal of the previous progress towards greater equity from 2015. For reading and maths while high attainers showed improvement, low attainers scores declined, while for science both high and low attainers gained lower scores. Whilst these results give some broad indications of performance patterns, only the scores of the top performers in reading are significantly improved. There was some indication that high level performance in maths may also be improving, but the difference was not statistically significant.

The balance of achievement and equity is often a delicate one, and as one improves the other can get worse. Ideally the aim would be to improve scores for both groups, and indeed for all pupils. While PISA 2015 results suggested improvements among lower achieving pupils, and a decline for top performers, 2018 results indicate that the improvements for pupils working at the lower levels may not have been sustained over time. These questions should be closely monitored over future ILSAs.

Trends in Benchmark/proficiency levels

Primary: The trends of small but steady improvements across all ability levels at primary were mirrored in the PIRLS and TIMSS benchmark data for Northern Ireland which indicated that a slightly higher proportion of pupils reached the higher levels for reading and maths, and slightly fewer were seen at the lower levels in maths and science in 2015/16 compared with 2011. (Appendix A5).

Post-primary: In PISA 2015, the proportion of post-primary pupils reaching the higher proficiency levels decreased in all three subject areas, but there were also fewer pupils working at the lower proficiency levels in maths and reading than in 2012. This would suggest that in 2015 post-primary schools in Northern Ireland had some success in improving the performance of their lower attaining pupils in maths and reading, but perhaps at the expense of developing the higher attaining pupils. The pattern was different for science where there were fewer pupils at the highest proficiency levels in 2015 and slightly more at the lower levels than in 2012. (Appendix A5)

More details on trends in achievement over time in Northern Ireland can be found in Appendix A5.

PISA 2018 results reflect the attainment gaps described above.

- Science: slightly fewer pupils working at the highest proficiency levels and slightly more at the lower levels.
- Maths: slightly more pupils working at the highest proficiency levels and slightly more at the lower levels.
- Reading: more pupils working at the highest proficiency levels and more at the lower levels.

So while there have been some improvements for higher attaining pupils in reading, the improvements for lower attainers seen in 2015 have not been maintained. The pattern is similar, but less pronounced for maths while for science there was a general decline.

It should be remembered however, that while proportions of top and low performers can, like the attainment gap, fluctuate between cycles, the overall mean scores for maths and science have not changed significantly since 2006. Science scores in 2018, however, were significantly lower than they were in 2012, 2009 and 2006. The science score had also declined in 2015, but not significantly so. It is interesting to reflect that the 2018 cohort would have been the first to experience the revised primary science curriculum, 'The world around us', for the whole of their primary schooling, and the 2015 cohort would have had it for part of theirs. The results of TIMSS 2019 may shed some further light on science performance in primaries.

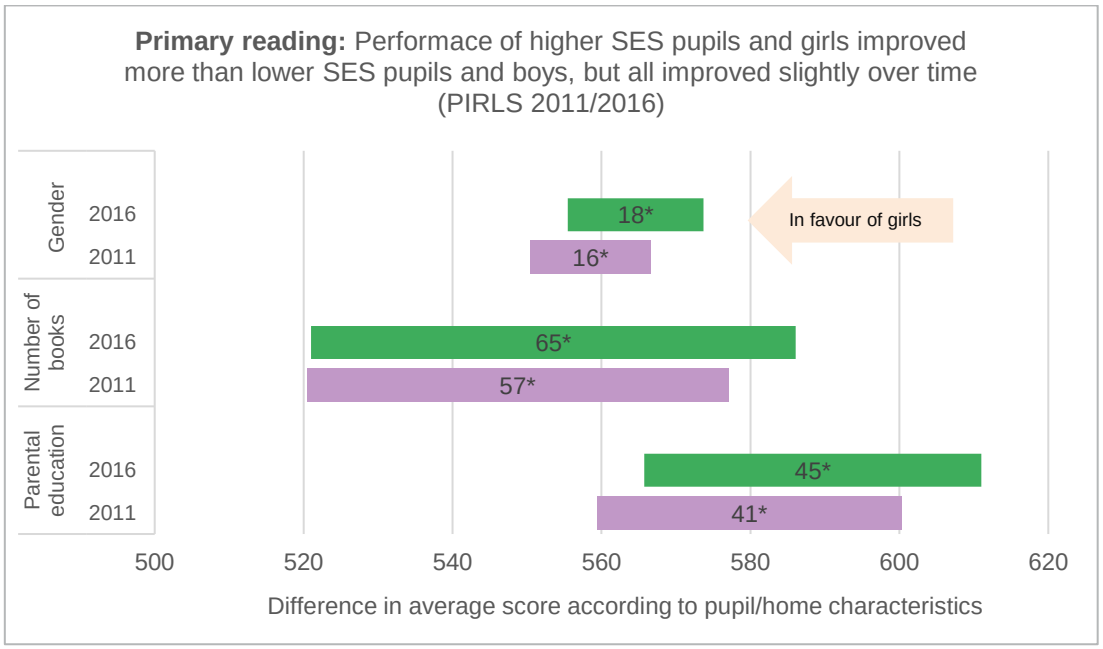
3.6.3 Gender and socioeconomic gaps over time in Northern Ireland

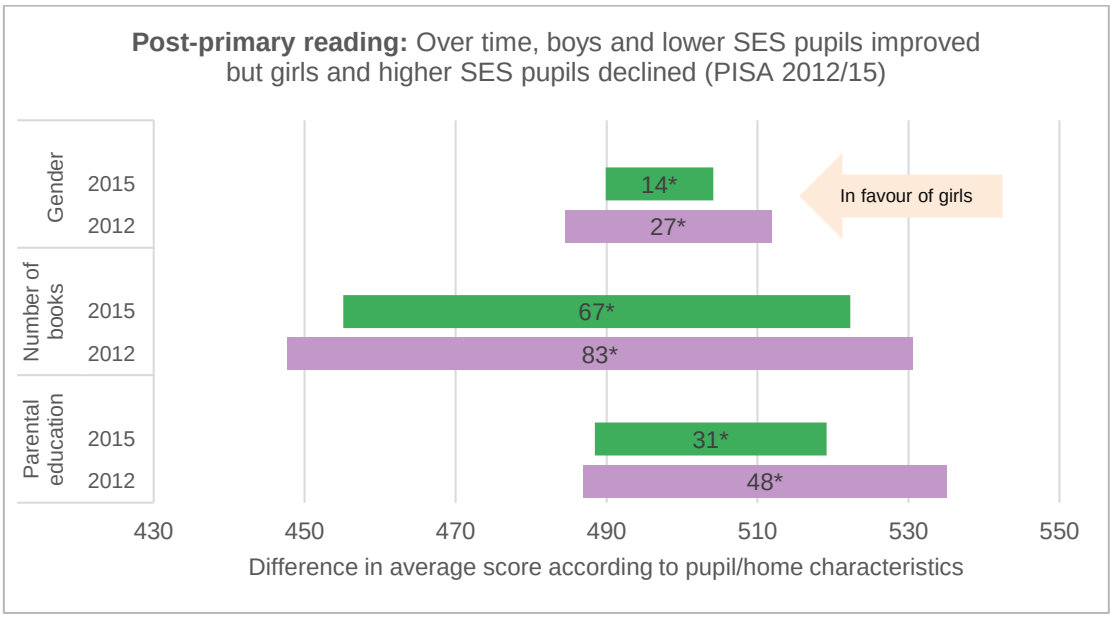
When we looked at **gender and socioeconomic gaps** over time (Figure 3.10) we found that:

For **reading**:

- In **primary**, the gaps for both increased in absolute terms from 2011 to 2016. This was due mainly to greater increases in the average scores at the top of the achievement range, i.e. girls, pupils with more books at home and pupils with more educated parents.
- In **post-primary**, gender and socioeconomic gaps reduced over time. Some of this was due to improvements among lower attaining pupils, but there was also a notable decline in scores among higher attaining pupils.

Figure 3.10 Primary and post-primary: gender and socioeconomic gaps in reading performance over time in Northern Ireland *





*The differences between average scores within years are statistically significant at the 5% level

For **maths and science** gender gaps were not significant and had reduced further over time.

In primary maths higher SES pupils showed improvements over time and lower SES pupils improved in science. At post-primary, maths scores in 2015 improved for lower SES pupils but, as with reading, the scores of higher SES pupils' had declined over time.

These findings again reflect the indication that in 2015 higher attaining pupils have may be experiencing less challenge at post-primary than in 2012.

Further information on socioeconomic and gender gaps from 2012 to 2015 for maths and science are provided in Appendix A5.

PISA 2018 results suggest significant improvements for higher achieving pupils in reading (only).

In 2018, the trend of more boys performing at lower proficiency levels continued for all subjects.

More girls were working at the highest levels for reading, and slightly fewer reached the highest levels for maths and science.

This is an interesting finding because although the mean science score for girls was significantly higher than for boys in PISA 2018, there was still a slightly higher proportion of boys working at the highest proficiency levels for science (6% boys and 5% girls). There were also many more boys working at the lowest proficiency levels for science (24% boys vs only 15% of girls were working below level 2).

Northern Ireland's policy focus on disadvantage and under-achievement appeared to be having some impact in 2015, and scores increased as proportions of pupils working at the lowest levels decreased. This may have been to the detriment of higher achieving pupils. By PISA 2018 the pendulum may have started to swing back a little highlighting the difficulties faced by policy makers as the work to manage and sustain holistic education policy that fully meets the needs of all pupils, and pupil groups. Using ILSA results to support continuous monitoring, re-assignment of resources and refreshed implementation guidance should help to ensure that the broadest range of all pupils, and those who suffer from disadvantage in particular, can be best supported in their learning.

3.7 Comparisons with England and Republic of Ireland

It is often useful to compare trends in similar countries and in this section we compare results in Northern Ireland with those in England and in the Republic of Ireland to provide more detailed and contextually relevant comparisons.

3.7.1 Mean scores across countries

Table 3.4 shows the mean scores for primary and post-primary pupils in Northern Ireland, England and Republic of Ireland in the most recent ILSAs (TIMSS 2015, PIRLS 2016 and PISA 2015).

Table 3.4 National average scores in Northern Ireland, England and Republic of Ireland by subject

	Primary (TIMSS 2015 / PIRLS 2016)				Post-primary (PISA 2015)			
	NI	**ENG**	**ROI**	**Int. Centrepoint**	**NI**	**ENG**	**ROI**	**OECD Avg.**
Reading	**565**	559*	567	500	**497**	500	521*	493
Maths	**570**	546*	547*	500	**493**	493	504*	490
Science	**520**	536*	529*	500	**500**	512*	503	493

*Significantly different from NI

Compared to England and the Republic of Ireland:

At primary (PIRLS 2016/TIMSS 2015)**,** pupils in Northern Ireland scored significantly:

- higher than those in England in reading
- higher than both comparator countries for maths
- lower than both countries for science.

The top performing countries were Russian Federation 581 reading, Singapore 618 maths, and Singapore 590 science.

At post-primary (PISA 2015)[39], pupils in Northern Ireland's scored significantly:

- lower than those of Republic of Ireland for reading and maths
- lower than England for science.

Singapore was the top performing country in all three subjects scoring 535 for reading, 564 for maths and 590 for science.

The Republic of Ireland maintained its position among the high achieving countries at post-primary for reading and maths while Northern Ireland and England fell behind. England maintained its advantage in science between primary and post-primary.

These patterns were reflected in the proportions of pupils achieving the higher international benchmarks/proficiency levels in each subject (See Appendix A4.2).

It is notable that, at post-primary (PISA 2015), the Republic of Ireland had the lowest proportions of pupils working at the lowest benchmarks/proficiency levels in all three subjects,

[39] PISA 2018 results show that the Republic of Ireland scores remained significantly higher than those in Northern Ireland and England for reading. England performed significantly better than Northern Ireland and the Republic of Ireland for science and better than Northern Ireland for maths.

and Northern Ireland had the lowest proportions working at the highest levels (although the Republic of Ireland has a similar proportion for science). [40]

3.7.2 Gender and socioeconomic gaps across countries

We examined the data to see if these findings might be explained in terms of the performance of particular groups.

The patterns show that gender gaps in the Republic of Ireland are the smallest both in primary and post-primary.

Figure 3.11 shows a comparison of reading performance across the three countries by gender and socioeconomic status at primary and post-primary, using 2016 PIRLS data and 2015 PISA data.

For **reading**:

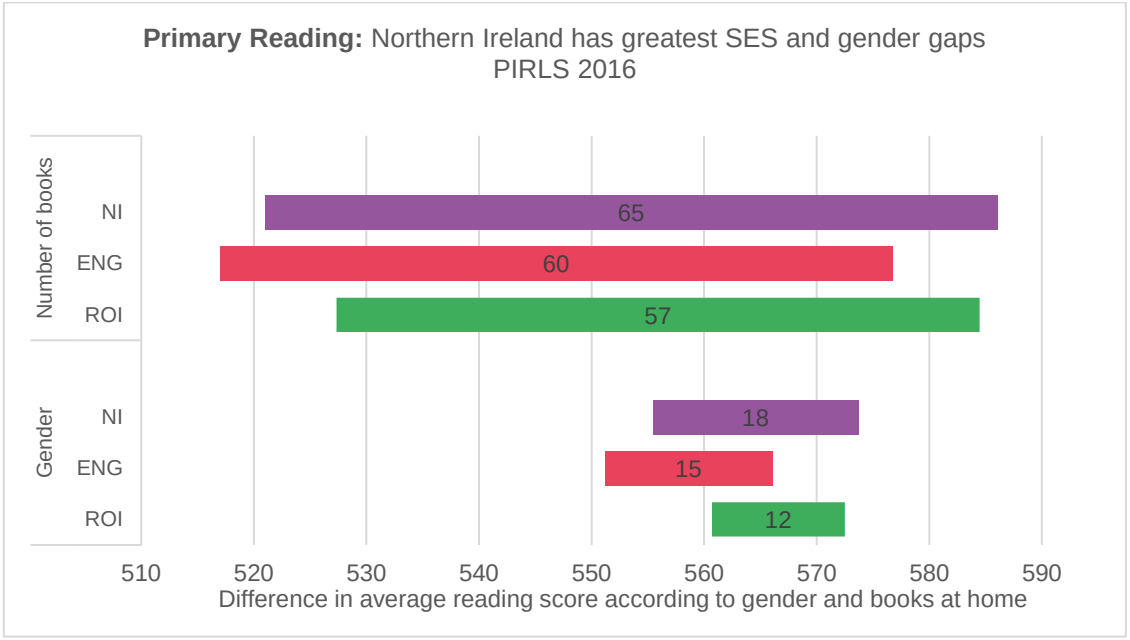
- High achieving pupils, girls and higher SES pupils in Northern Ireland did, on average, slightly better than those in England and the Republic of Ireland at primary but did least well among the countries at post-primary inferring that high attainers in Northern Ireland may benefit from focused support at post-primary.
- Low achieving pupils, boys and lower SES pupils, did best in the Republic of Ireland both at primary and post-primary. In fact post-primary boys in the Republic of Ireland scored higher, on average, than girls in both Northern Ireland and England.
- The gender gap in all three countries was, however, less than the international average which was 19 score points at primary school and 27 score points at post-primary.

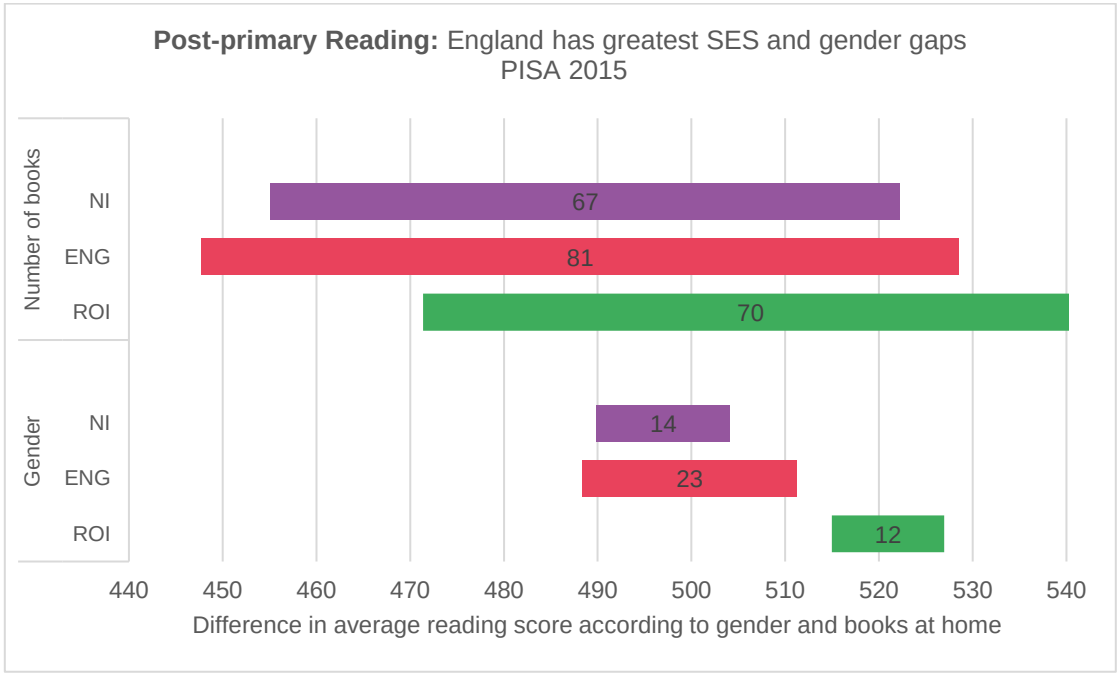
These are interesting results. The Republic of Ireland's literacy and numeracy strategy has a specific focus on identifying and supporting disadvantaged low achieving pupils.

- Across the three countries, gender gaps in reading in the Republic of Ireland were the smallest both in primary and post-primary.
- Across the three countries, socioeconomic gaps in reading were the largest in Northern Ireland's primaries and the smallest in Northern Ireland's post-primaries.

[40] in PISA 2018, the Republic of Ireland still had proportionally fewer pupils working at the lower proficiency levels than the other two countries for all three subjects, especially in reading. Compared with Northern Ireland, England had proportionally more pupils working at the higher proficiency levels in all three subjects, and the Republic of Ireland had proportionally more high performers for reading. The attainment gap was lowest in ROI for all three subjects.

Figure 3.11 Primary and post-primary: socioeconomic and gender gaps in reading across countries





For **science, at primary** Northern Ireland's higher and lower SES pupils had, on average, lower scores than their peers in England or the Republic of Ireland. Gender gaps were negligible within countries, but both boys and girls in Northern Ireland scored lower than in the other two countries. In **post-primary**, England had the highest scores for high and low SES pupils and for boys and girls across all three countries, but Northern Ireland's high and low SES pupils scored higher than those in the Republic of Ireland. The Republic of Ireland had the widest gender gap.

For **maths, at primary** Northern Ireland's higher and lower SES pupils had, by considerable margins, higher scores than their peers in England or the Republic of Ireland as did their boys

and girls. In **post-primary**, Northern Ireland's high achieving pupils, performed well below their peers in both other countries.

3.7.3 Trends by subject across the three countries

We looked at how scores in each subject had increased and decreased over time in Northern Ireland, England and the Republic of Ireland (Figure 3.12).

At primary between 2011 and 2015/16:

- pupils in the Republic of Ireland made significant improvements to their scores in all three subjects
- there were no significant changes in Northern Ireland's performance
- England had significant improvements in their reading scores only.

Progress in reducing attainment gaps in the Republic of Ireland was greater at the primary level because of a significant reduction in the proportion of pupils working at the lower benchmark levels. *(Appendix A4)*

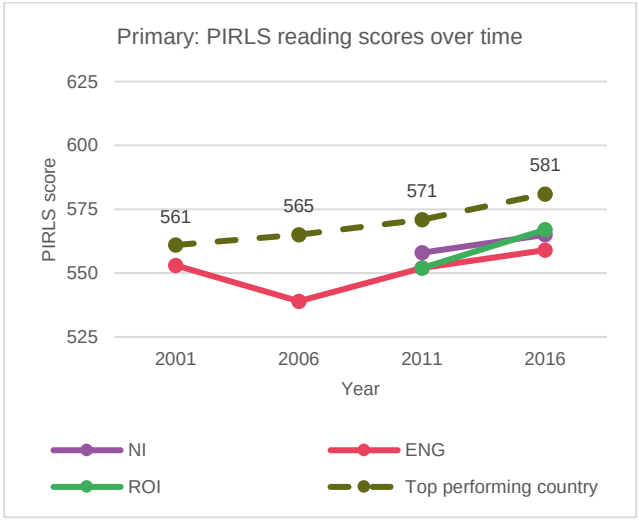
At post-primary:

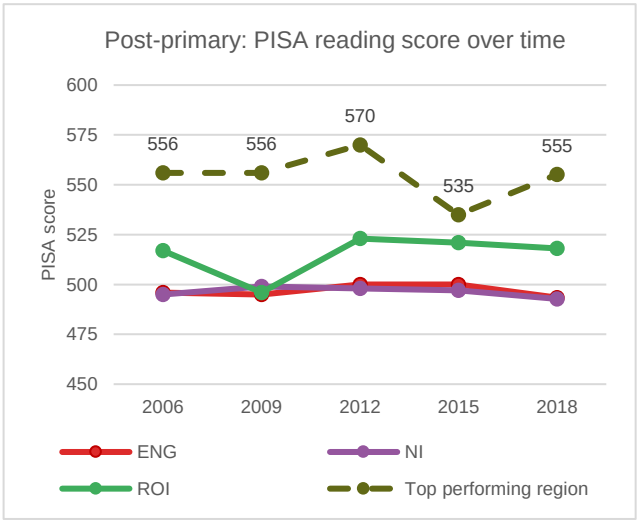
- Scores have remained relatively stable in all three countries, except for a dip in the Republic of Ireland's performance in 2009[41].
- Republic of Ireland's reading and maths scores were significantly higher than both England and Northern Ireland's in 2015.
- In contrast, post-primary science scores declined more steeply in the Republic of Ireland between 2012 and 2015.

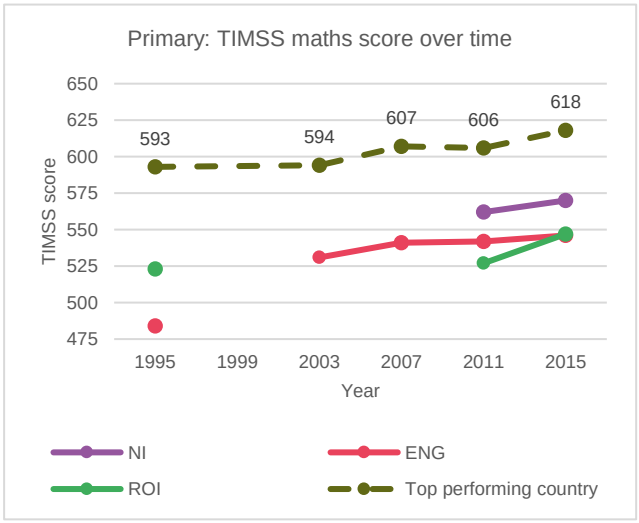
England maintained higher levels of performance in science in both primary and secondary.

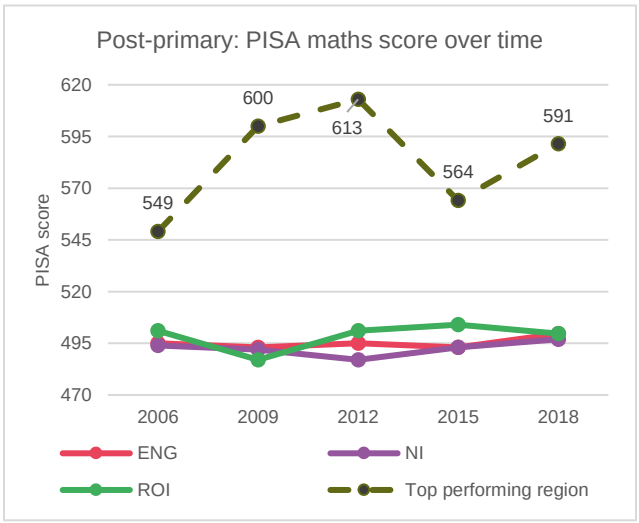
[41] In their 2014 report on Performance in National Assessments, ERC referred to this as a 'one off occurrence'.

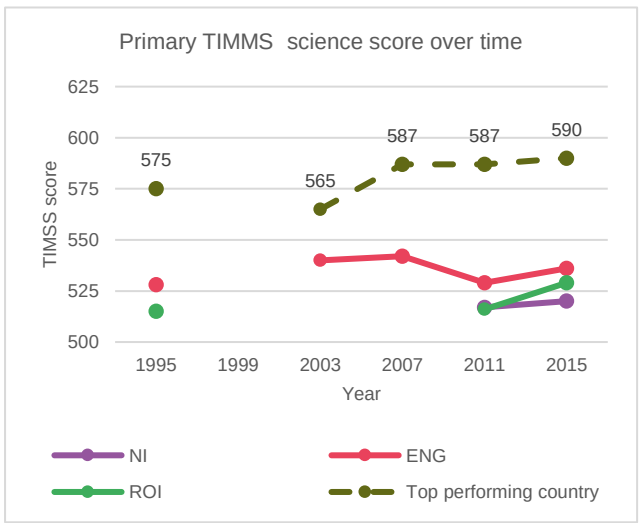
Figure 3.12 Mean scores over time in Northern Ireland, England and Republic of Ireland, PIRLS and PISA

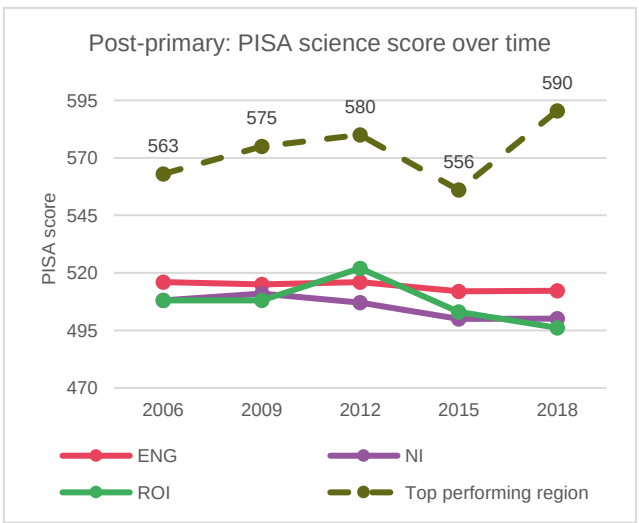












Scores in all three countries were closest to the top-performers in reading and maths in the primary phase, and furthest from the top performers in post-primary maths and science.[42]

The Republic of Ireland introduced a national strategy for literacy and numeracy in 2011, which included the allocation of additional time for literacy and numeracy in primary schools. Their interim review (2017) reported that, in practice, there had been a greater focus on literacy than numeracy but these results, and results in Republic of Ireland's own national assessments (2014) seem to suggest that this initiative has proved beneficial across primary attainment more broadly.

Their significant improvements in their PIRLS and TIMSS results in 2015/16 would suggest that the strategy has had a positive impact on the performance of their lower-attaining pupils.

[42] While it may appear that the post-primary scores of the top performing country in each subject appear to have declined in 2015, with the introduction of computerised delivery of PISA, this should be interpreted with caution. In 2012, the top performing country/jurisdiction was Shanghai China (which included only their top 4 urban provinces); by 2015 they had included some lower achieving provinces and by 2018 they included higher achieving provinces. OECD's overall assessment of performance across all countries was that it was not affected by the change of delivery mode. The curves for other top performing countries, e,g,Singapore, showed much less variation across cycles.

4 What can we say about pupil attitudes and learning environments in Northern Ireland

Key findings and observations

Attitudes in Northern Ireland

- Compared to their international peers, **primary pupils** in Northern Ireland:
  - *like* reading and maths less
  - *like* science slightly more
  - were more *engaged* but slightly less *confident* in maths and science
  - were slightly more *confident* in reading
  - reported a higher *sense of belonging* in school.
- Between 2011 and 2015/16, **primary pupils'**
  - *confidence* in maths decreased slightly
  - *confidence* and enjoyment in reading increased
  - *enjoyment* in science increased and was by far the most enjoyed subject overall.
- Compared to their international peers, **post-primary pupils** reported:
  - a lower *sense of belonging in school*
  - more *confidence* about their science learning
  - reported *high levels of teacher support* in science
  - *fewer opportunities for inquiry based* learning in science.

Pupils in Northern Ireland especially primary pupils would benefit from increased confidence in science learning.

Learning Environment in Northern Ireland

- Principals in both primary and post-primary sectors in Northern Ireland:
  - reported learning environments conducive to learning in each subject
  - gave higher ratings than internationally in all aspects relating to learning environment except for resource shortages for science lessons.
- Compared with international means primary school principals in Northern Ireland reported
  - fewer discipline problems
  - greater emphasis on academic success.
- Compared with international means, post-primary principals in Northern Ireland reported:
  - more shortages of educational materials in their schools
  - a stronger focus on educational leadership
  - that staff shortages and pupil behaviour problems were less of a hindrance to learning.

A focus on addressing shortage of (science) resources is likely to have a positive impact on attainment

Attitudes to science across comparator countries

- Pupils in Northern Ireland, England and the Republic of Ireland reported low confidence ratings for science at primary but higher than the international average at post-primary.
- Pupils in England reported less engagement and greater confidence in primary, than the other two countries. They were also the most confident in science at post-primary.
- Pupil confidence levels are related to their scores.

Learning Environment across comparator countries

- **Primary** principals:
  - in Northern Ireland and Republic of Ireland, reported greater emphasis on academic success than headteachers in England
  - in Republic of Ireland reported greater shortage of (science) resources than the International average[1]
  - all three countries reported few discipline problems
- **Post-primary** principals:
  - in Northern Ireland and headteachers in England reported considerably higher focus on educational leadership than the international average, while principals in the Republic of Ireland indicated less than the other two countries.

We recommend liaising with colleagues in the Republic of Ireland to explore how their recent policies have been implemented and evaluated. Consider some comparative case studies or process evaluations to explore classroom practice as well as detailed comparisons of inter-linked, system level policies.

In addition to attainment data, ILSA studies collect a range of questionnaire data from pupils and principals, and sometimes parents. These include a number of pupil attitudinal factors as well as background information about their school.

In this section we report pupil attitudes in primary schools in Northern Ireland from TIMSS 2015 and PIRLS 2016.

For post-primary we examine pupil attitudes to science using data from PISA 2015[43]. Since the main domain in PISA 2015 was science, the pupil questionnaires were largely focussed on attitudes to science learning and, therefore, all comparisons between primary and post-primary also relate to science learning[44]. We compare primary and post-primary in sections 4.1.4 and 4.2.2.

4.1 Pupil attitudes and attainment

In the IEA publication from PIRLS 2016 *What makes a good reader?*, a number of attitudes and aspects of the learning environment were identified that were most strongly associated with

[43] Details of the questions pupils were asked and the elements of the composite scales are provided in Appendix D

[44] Primary/post-primary comparisons for reading will be possible with further analysis from PISA 2018.

higher levels of performance. We looked at these selected scales on enjoyment, confidence, engagement and sense of belonging (or equivalents in other ILSAs) and at school variables such as the emphasis on academic success, discipline problems and resource shortages, to examine how they relate to pupil scores in Northern Ireland.

4.1.1 Pupil attitudes in Northern Ireland primary schools

Based on pupils' responses to a series of statements, attitudinal scales were developed to measure the extent to which they liked learning a particular subject, how confident they felt and how engaging they found the lessons in each subject. A further scale was used to measure the pupils' sense of belonging in school and included statements about classmates and teachers as well as general attitude to school (See Appendix D). Table 4.1 shows the percentage of pupils in Northern Ireland who gave positive ratings on these scales.

Primary pupils in Northern Ireland reported liking reading and maths less than their international peers, and science slightly more. They also reported being more engaged but less confident in maths and science compared to pupils internationally, whereas for reading they were slightly more confident.

Primary pupils in Northern Ireland reported liking science best of the three subjects and 72 per cent of pupils were classified as having very engaging teaching. They were most confident in reading and least confident in maths, which they also like least despite reporting very engaging lessons.

Higher proportions of primary pupils in Northern Ireland reported a high sense of school belonging than their international peers.

Table 4.1 Primary: pupil attitudes to learning in Northern Ireland by gender and SES, TIMSS/PIRLS 2015/16

			NI by gender		NI by SES[45]	
	Overall NI	**Int. Avg.**	**Girls**	**Boys**	**Lower SES**	**Higher SES**
Pupils like learning science/maths/reading - % classified as 'very much'						
Science	**59%**	56%	58%	60%	56%	60%
Maths	**35%**	46%	31%	40%	32%	37%
Reading	**39%**	43%	45%	32%	26%	45%
Pupil confidence in science/maths/reading - % classified as 'very confident'						
Science	**36%**	40%	35%	36%	32%	38%
Maths	**31%**	32%	26%	36%	23%	35%
Reading	**50%**	45%	53%	48%	35%	58%
Pupil engagement in science/maths/reading lessons - % classified as having 'very engaging teaching'						
Science	**72%**	69%	73%	70%	73%	71%
Maths	**74%**	68%	77%	71%	74%	75%
Reading	**61%**	60%	66%	57%	61%	62%
Pupils' sense of school belonging - % classified as having 'high sense of school belonging'						
Science & Maths	**71%**	66%	80%	63%	68%	73%
Reading	**63%**	59%	73%	53%	55%	67%

When split by gender, girls reported liking and feeling confident in reading whereas boys gave more positive ratings for maths, broadly reflecting differences in attainment. Science was rated similarly by both genders in terms of liking and confidence. Boys were generally less engaged.

Disadvantaged pupils gave lower ratings for enjoyment and confidence in reading and, to a lesser extent, in maths and science. Levels of engagement were broadly similar across SES groups.

Girls and more advantaged pupils had a higher sense of school belonging, compared with boys and more disadvantaged pupils.

[45] SES proxy = number of books at home, reported by the pupil. Lower SES correspond to houses with 0 to 25 books (one bookshelf or less), Higher SES to houses with 26 or more books *one bookcase or more)

4.1.2 Attitudes and attainment in Northern Ireland's primary schools

In this section we look at whether pupil attitudes, as classified on the TIMSS/PIRLS scales, might be associated with pupil performance.

We took the average scores for reading, maths and science for pupils classified as having different levels of enjoyment, confidence, and engagement in each subject areas and for sense of school belonging. These are shown in Figure 4.1.

Figure 4.1 Primary: Pupil attitudes and attainment in reading, maths and science in Northern Ireland (TIMSS 2015/PIRLS 2016)

Pupil attitudes appear to be more closely associated with reading and maths performance than with science.

Pupil confidence was the attitudinal variable most associated with performance, i.e. very confident pupils scored on average 105, 95 and 42 points more than their least confident peers in reading, maths and science, respectively.[46]

Better performance was also seen among pupils who gave more positive ratings on liking a subject, regardless of relative levels of overall performance across different subjects, scores increased the more enjoyment pupils reported. The same was true of pupils' sense of belonging.

Interestingly, pupil engagement brought the smallest differences in average score for maths and reading (23 and 28 points respectively), and higher engagement was associated with poorer science performance. This probably reflects the fact that more low attaining pupils report liking science and finding science lessons engaging (see Table 4.1). This is a pattern found in other ILSA analyses and across subjects where enjoyment and confidence have positive association and, counterintuitively, engagement is often negatively related.

4.1.3 Attitudes over time in Northern Ireland's primary schools

Table 4.2 shows changes in pupils' reported liking and confidence in science, maths and reading in Northern Ireland between 2011 and 2015/16. (The engagement scale changed substantially between cycles and, as a result, comparisons over time cannot be made.)

We found that primary pupils' confidence in maths had decreased slightly between 2011 and 2015/16, but that confidence in reading increased considerably. More pupils also reported enjoying reading in 2016 than in 2011, an increase of 10 per cent.

Science was by far the most 'liked' subject and there was an increase in enjoyment between the most recent TIMSS cycles. Maths enjoyment remained about the same over time and, because of the increase in reading enjoyment, became the least popular subject among primary pupils.

[46] Please note that the wording of the categories in PIRLS 2016 and TIMSS 2015 change slightly. E.g. the categories for PIRLS 2016 are: "Very confident / Somewhat confident / Not confident", while in TIMSS 2015 the categories are: "Very confident / Confident / Not confident". For more detail see Appendix D.

Table 4.2 Pupils' liking and confidence of subjects over time in Northern Ireland, TIMSS/PIRLS 2011 - 2015/16

Subject and assessment year	% pupils in the highest **"liking learning"** category	% pupils in highest **confidence** category
Science		
2011	51%	37%
2015	59%	36%
Maths		
2011	36%	35%
2015	35%	31%
Reading		
2011	29%	35%
2016	39%	50%

4.1.4 Primary and post-primary attitudes to science learning in Northern Ireland

For comparing attitudes in primary and post-primary, the majority of PISA attitudinal data related to science learning, as that was the major domain in PISA 2015. The comparisons that follow, therefore, compare PISA variables with attitudinal variables relating to science learning from TIMSS 2015.

We selected scales that were reasonably closely matched and designed to measured similar criteria for comparing primary and post-primary pupils' liking/enjoyment of science and confidence/self-efficacy. In order to compare engaging teaching element we combined the PISA scales on teacher support in a science class and inquiry based teaching methods.

Table 4.3 summarises the correspondence between scales analysed in the following sections. The detailed list of the items in each scale is provided in Appendix D.

Table 4.3 Pupil attitudes scales in TIMSS 2015 and similar scales in PISA 2015[47]

Scales in TIMSS 2015	Similar scales in PISA 2015
Students like learning science (ASBGSLS) Based on pupils' degree of agreement with nine statements, including *I enjoy learning science*, *science is one of my favourite subjects*, etc. Higher values of this scale correspond to liking learning science more.	**Enjoyment of science (JOYSCIE)** Based on pupils' degree of agreement with five statements, including *I generally have fun when I am learning science, I am interested in learning about scienc*e, etc. Higher values of this scale correspond to higher enjoyment of science.
Students confident in science (ASBGSCS) Based on pupils' degree of agreement with seven statements, *including I usually do well in science*, *science is harder for me than any other topic*, etc. Higher values of this scale correspond to higher levels of confidence.	**Science self-efficacy (SCIEEFF)** Pupils were asked how well they would perform in eight different science tasks, using a four-point answering scale from "I couldn't do this" to "I could do this easily". Higher values of this scale correspond to higher levels of science self-efficacy.
Students views on engaging teaching in science lessons (ASBGESL) Based on pupils' degree of agreement with ten statements, including *my teacher lets me show what I have learned*, *my teacher gives me interesting things to do*, *my teacher does a variety of things to help us learn*, etc. Higher values of this scale correspond to more engaging teaching.	**Teacher support in a science class (TEACHSUP)** Based on pupils' answers about the frequency in which five activities occur in science lessons, including *the teacher gives extra help when students need it, the teacher shows an interest in every student's learning*, etc. Higher values of this scale correspond to more teacher support in science classes.
	Inquiry-based science teaching and learning practices (IBTEACH) Based on pupils' answers about the frequency in which nine activities occur in science lessons, including *the teacher explains how a science idea can be applied to a number of different phenomena*, *students are given opportunities to explain their ideas*, etc. Higher values of this scale correspond to more opportunities for inquiry-based science teaching and learning practices.
Students sense of school belonging (ASBGSSB) Based on pupils' degree of agreement with seven statements, including *I like being in school, I feel safe when I am at school, I feel like I belong at this school*,	**Sense of belonging to school (BELONG**) Based on pupils' degree of agreement with six statements, including *I feel like I belong at school, I feel awkward and out of place in my school, I feel lonely at school*, etc. Some items were reverse-coded

[47] Each PIRLS/TIMSS context questionnaire scale variable is a Rasch score with an international centerpoint of 10 and an internationally set standard deviation of 2. Each PISA regular scale is a Weighted Likelihood Estimate (WLE) score with an OECD mean of zero and an OECD standard deviation of 1.

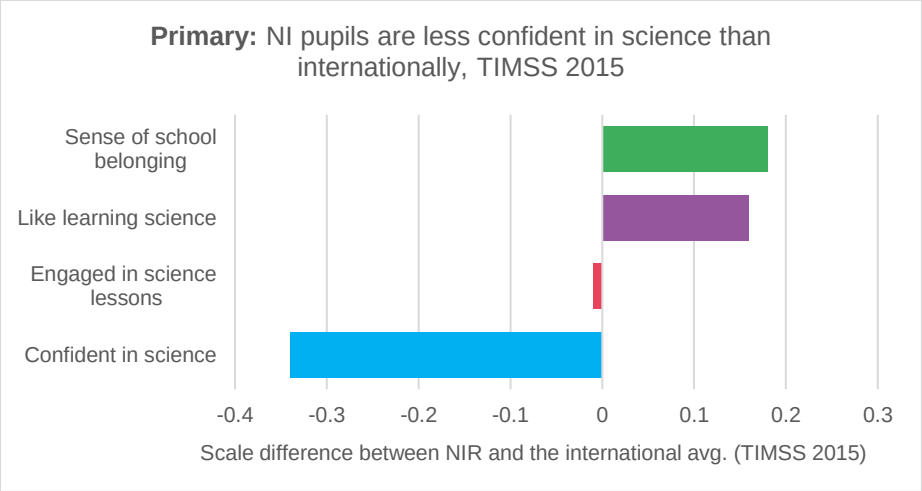
etc. Higher values of this scale correspond to higher sense of belonging.	so that higher values of this scale correspond to higher sense of belonging.

Figure 4.2 shows the difference between the average scale scores of Northern Ireland's pupils and the international mean (for TIMSS) and the OECD average (for PISA). Although we cannot make direct comparisons in the magnitude of the difference between primary and post-primary, we can draw conclusions about how positive or negative are pupils' attitudes in similar topics in the different school sectors.

Primary pupils in Northern Ireland have a stronger sense of belonging than the international average, but this reverses in post-primary where pupils' sense of belonging is more negative than that seen internationally.

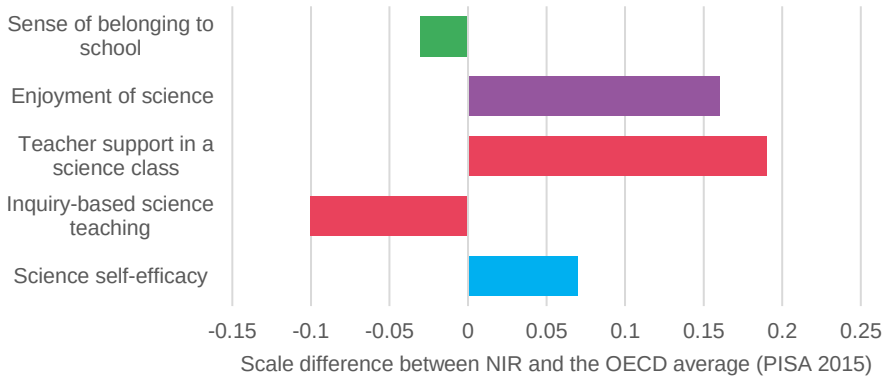
Pupils in both sectors reported enjoying science more than was seen internationally.

Figure 4.2 Primary and post-primary: pupils' attitudes to science in Northern Ireland compared with International and OECD averages, TIMSS 2015 and PISA 2015[48]



[48] A similar comparison would be possible on pupil attitudes to reading using PISA 2018 but these analyses did not fall within the scope of this report.

Post-primary: NI pupils more confident in science than internationally and have less sense of belonging, PISA 2015



Northern Ireland's primary pupils gave similar engagement ratings to the international average. Response patterns suggest that lower ability pupils tend to find science lessons more engaging than other subjects. Pupil engagement at post-primary is not directly comparable, because of the scale differences. Northern Ireland's post-primary pupils gave more positive ratings on teacher support in science classes, but reported fewer instances of enquiry based lessons compared with their international peers.

Primary pupils have less confidence in science than the international average, but confidence in science increases considerably in post-primary pupils who reported feeling greater self-efficacy than the OECD average. This is an interesting finding given that confidence has been shown to relate to attainment and these differences in confidence reflect the findings in Chapter 3 where the performance of post-primary pupils' was, in relative terms, slightly better that that of primary pupils in science.

4.1.5 Attitudes to Reading (PIRLS 2016 and PISA 2018)

For primary pupils, the proportion of Northern Ireland's pupils that liked reading was lower than the international average while levels of engagement were similar to the international average (PIRLS 2016). Pupil confidence in reading was higher than the international average.

Overall, pupils in Northern Ireland who were classified in the 'Very Much Like Reading' and 'Very Confident' categories in reading had the highest average attainment. The association between liking the subject and achievement was apparent in most countries participating in PIRLS 2016. The difference in attainment was not as great for pupils who differed in their engagement in reading lessons.

Post-primary pupils in Northern Ireland were less likely to read books, had more negative attitudes towards reading, and were less likely to read for enjoyment than pupils in the OECD countries (PISA 2018). Despite these comparatively negative attitudes, pupils in Northern Ireland performed above the OECD average in reading.

4.1.6 Attitudes to Maths (TIMSS 2015 and PISA 2012)

Direct comparisons relating to attitudes to maths in TIMSS 2015 and PISA 2012 were not possible because the measurement scales were substantially different. Generally though, in primary maths liking and confidence were linked with higher achievement. Engaging teaching was not linked with higher scores in maths in primary.

In post-primary, pupils indicated moderate interest and confidence. Whilst not reporting high levels of enjoyment, they recognised that learning maths was important/useful and pupils in Northern Ireland showed greater motivation to learn mathematics than pupils across the OECD countries on average.

4.2 School learning environment in Northern Ireland primary schools

Aspects of the school learning environment have been identified in PIRLS and TIMSS studies as being supportive of learning. Most notably pupils in schools that have a high emphasis on academic success, few discipline problems and are not affected by resource shortages tend to have higher scores than pupils in schools with lower emphasis on academic success or those with discipline or resource issues.

School principals were asked to report on these three learning environment variables in PIRLS 2016 and TIMSS 2015. (Full details of the scales are provided in Appendix D.)

4.2.1 School learning environment in Northern Ireland primary schools

Table 4.4 shows how primary principals in Northern Ireland compare with the international average in their reporting of specific aspects of the learning environments of their pupils.

In almost all of the positive aspects of school learning environment, the percentage of Northern Ireland primary principals was considerably higher than the international average, i.e. they reported learning environments conducive to learning in each subject.

The one exception to this pattern was in relation to resource shortages for science lessons, where the proportion of principals who reported that teaching was affected by science resource shortage was higher than the international norm (i.e. the percentage in the table of positive responses was lower than the international average). This may be an issue that merits further investigation.

Table 4.4 Primary: learning environment in Northern Ireland, TIMSS/PIRLS 2015/16

	Northern Ireland	International Avg.
% pupils in schools with **"very high emphasis" on academic success**		
Science	15%	7%
Maths	15%	7%
Reading	23%	8%
% pupils in schools with **"hardly any discipline problems"**		
Science	78%	61%
Maths	78%	60%
Reading	85%	62%
% pupils in schools that are **"not affected" by resource shortages**		
Science	20%	25%
Maths	33%	27%
Reading	44%	31%

4.2.2 Primary and post-primary learning environment factors in Northern Ireland

As with the pupil attitude scales, the PISA scales were slightly different from the PIRLS and TIMSS measures. Nevertheless, we were able to select scales measuring similar features of learning environment in TIMSS and PISA so that some broad comparisons across primary and post-primary schools in Northern Ireland can be made.

These comparison scales are summarised in Table 4.5, with full information on the components of each scale provided in Appendix D.

Table 4.5 Learning environment scales in TIMSS 2015 and similar scales in PISA 2015

Scales in TIMSS 2015	Similar scales in PISA 2015
Instruction affected by science resources shortages (ACBGSRS) Based on principals' responses concerning twelve school and classroom resources, both general and for science lessons, including *instructional material, supplies, technologically competent staff*, etc. Higher values of the scale indicate that the science instruction is **less affected** by shortage.	**Shortage of educational material*** (EDUSHORT) Based on teachers' answers about the extent to which the school capacity is hindered by four issues, including *lack of educational material, lack of physical structure*, etc.
	Shortage of educational staff* (STAFFSHORT) Based on teachers' answers about the extent to which the school capacity is hindered by four issues, including *lack of teaching staff*, *lack of assisting staff*, etc.
School discipline problems (ACBGDAS) Based on principals' responses concerning ten potential school problems among fourth-grade students, including *arriving late at school, cheating, vandalism*, etc. Higher values of the scale indicate that the school **has less discipline problems.**	**Student behaviour hindering learning*** (STUBEHA) Based on principals' answers about the extent to which the learning of pupils is hindered by five pupil related phenomena, including *truancy, skipping class, use of alcohol or drugs*, etc.
School emphasis on academic success (ACBGEAS) Based on principals' responses characterizing thirteen aspects on a five-point scale from "very low" to "very high", including *teachers' understanding of the school's curricular goals, expectations and working together to improve student achievement; parental involvement in school activities, students' desire to do well in school*, etc. Higher values of the scale correspond to higher emphasis of the school on academic success.	**Educational leadership** (LEAD) Based on principals' answers about the frequency in which thirteen activities occurred in the school during the last year, including *I ensure that teachers work according to the school's educational goals, I promote teaching practices based on recent educational research, I praise teachers whose students are actively participating in learning*, etc. Higher values of the scale indicates higher levels of educational leadership.

* In these PISA scales, higher values reflect more hindrance to learning. For the purposes of these analyses, we have reversed some scales so that higher values, in all variables, correspond to a more positive rating.

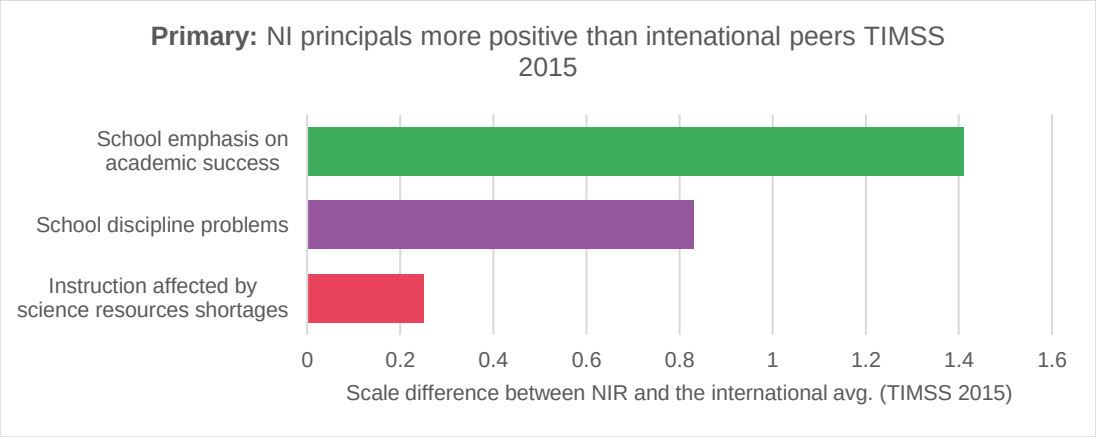
Figure 4.3 shows the differences between Northern Ireland's average and the international mean (for TIMSS) and the OECD average (for PISA). As mentioned above, the scales are not

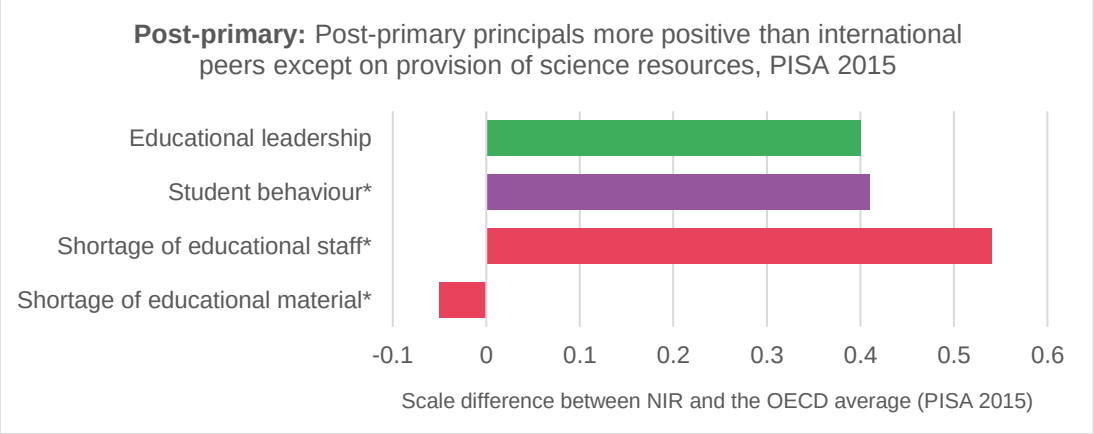
directly comparable but they allow us to make reasonable comparisons between primary to post-primary.

In primary schools, principals in Northern Ireland report a much higher emphasis on academic success than their international peers, fewer discipline problems and fewer instances of lessons affected by shortages. Overall, they gave more positive responses on each of the scales.

Post-primary principals also gave more positive responses than were seen internationally except in relation to educational materials for science where more principals in Northern Ireland reported that their teaching was limited by lack of scientific materials. As with the specific reports at primary level (Section 4.2.1) shortage of materials for science has been highlighted by post-primary principals and further investigation may be beneficial.

Figure 4.3 Primary and post-primary: learning environment in Northern Ireland compared with International and OECD averages, TIMSS 2015 and PISA 2015





*Student behaviour, shortage of staff and shortage of material have been reversed so that higher values reflect more positive environments.

4.3 Pupil attitudes and learning environment across countries

Next we compared questionnaire responses in Northern Ireland with those in England and the Republic of Ireland to ascertain whether any notable differences could be identified.

4.3.1 Pupil attitudes across countries

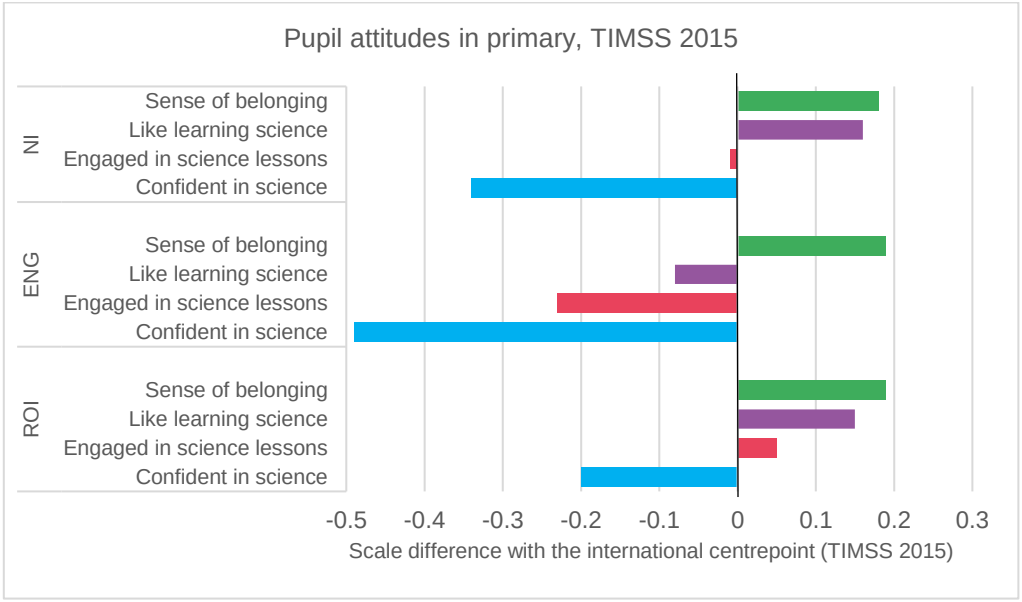
In PIRLS 2016, attitudes to reading **in primary** (engagement in reading lessons and confidence in reading) were broadly similar in Northern Ireland to those reported in England and Republic of Ireland. The only attitudinal difference among primary pupils' attitudes to reading across the three countries was in the percentage of pupils who *'very much like reading'* which in England and Northern Ireland was below the international average of 43 per cent (at 39 per cent and 35 per cent respectively), whereas pupils in the Republic of Ireland enjoyed reading more (46 per cent).

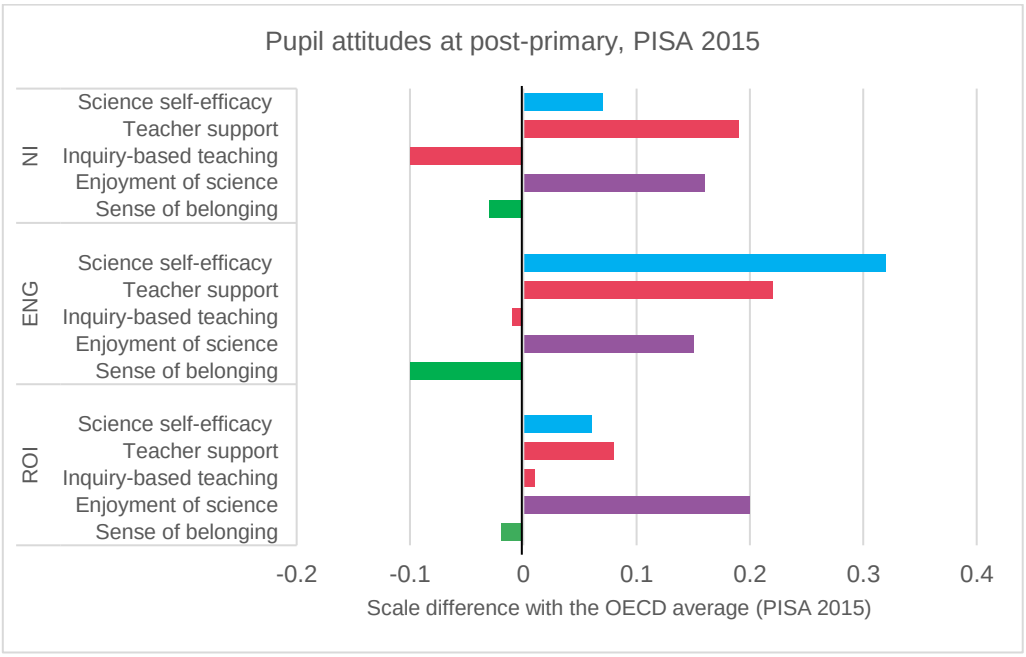
In order to compare attitudes between primary and post-primary, we looked at pupil attitudes relating to science learning across countries.

In primary, confidence means (for science) were lower than the international average in each country, and lowest in England. The main differences between countries was that pupils in Northern Ireland and the Republic of Ireland liked learning science, while those in England gave more negative ratings and reported less engagement in science lessons (see Figure 4.4). These finding are quite surprising, given that pupils in England had significantly higher scores for science. Pupils in all three countries gave high ratings in terms of sense of belonging compared to the international average.

In post-primary, pupils in all countries reported being much more confident in science than at primary, especially in England. Pupils in England reported much less sense of belonging than pupils in the other two countries, and all three were below the international average for this. Northern Ireland's pupils reported fewer opportunities to take part in enquiry based science lessons, but pupils in all countries reported higher levels of teacher support for science learning than their international peers.

Figure 4.4 Primary and post-primary: pupils' attitudes to science across countries, TIMSS 2015 and PISA 2015





4.3.2 Learning environment factors across countries

In PIRLS 2016, principal and teacher reports on the learning environment factors described in Table 4.5 were very similar across the three countries, with the Republic of Ireland reporting just a few more issues relating to discipline.

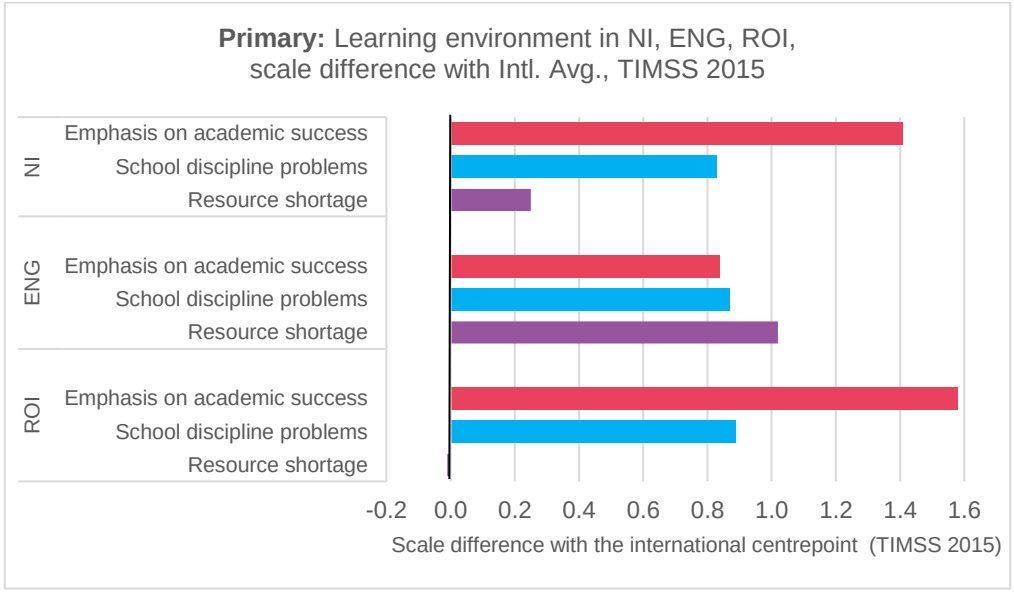
For primary/post-primary comparisons, we used TIMSS and PISA datasets. The questionnaire elements used to construct these scales are provided in Appendix D.

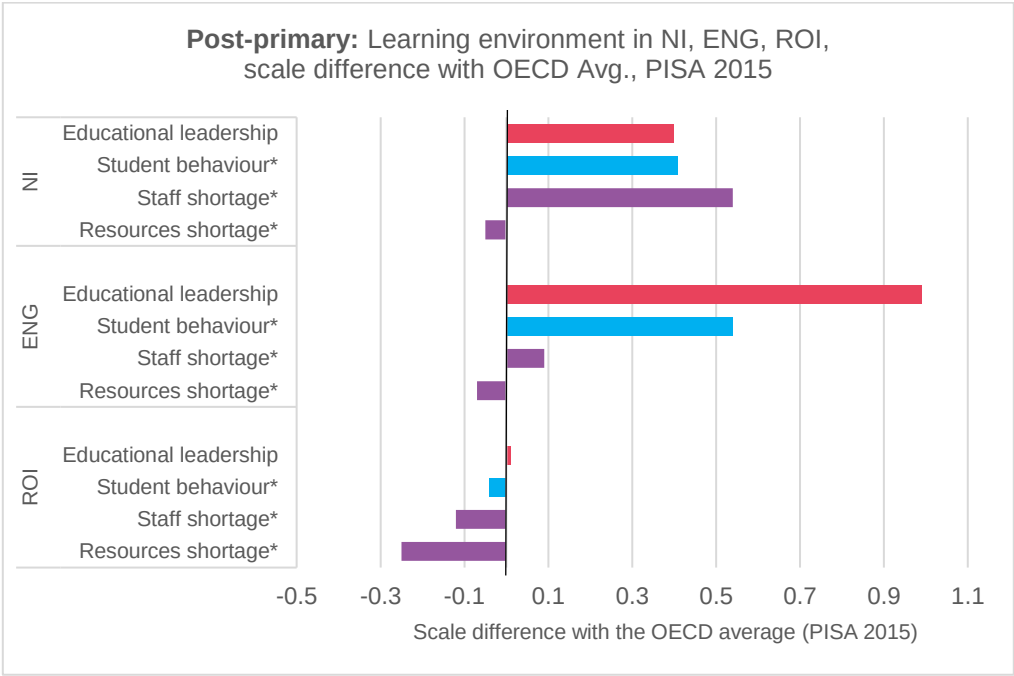
In Northern Ireland and Republic of Ireland, **primary** principals' reported greater emphasis on academic success than headteachers in England. All three countries reported few discipline problems, and only Republic of Ireland reported greater shortage of (science) resources than the international average[49].

In **post-primary schools**, principals in Northern Ireland and England reported considerably higher focus on educational leadership than the international average, whereas in the Republic of Ireland principals reported a less active leadership role. Republic of Ireland principals were more likely to report instances of teaching being affected by staff and resource shortage and by discipline problems than in Northern Ireland and England, although principals in all three countries indicated issues with resource shortages. Northern Ireland was least affected by a shortage of science teachers.

[49] *Student behaviour, shortage of staff and shortage of material have been reversed so that higher values reflect more positive environments higher scores relate to more positive environment.

Figure 4.5 Primary and post-primary: learning environment across countries, TIMSS 2015 and PISA 2015





5 Are there aspects of pupils' backgrounds, attitudes and the learning environment that could explain some of the differences seen in performance?

Key findings and observations

Multilevel models allow us to isolate the effect of pupil and home characteristics, such as gender and socioeconomic status (SES), to ascertain the impact of specific variables when all other variables are taken into account. [50]

Background factors and attitudes in relation to science scores

At primary

- The strongest effect on scores, by far, was associated with SES, with almost 40 score points of difference in favour of pupils from higher SES backgrounds.
- Higher levels of confidence, enjoyment and sense of belonging were also associated with higher scores, but to a much lesser extent.
- Pupil engagement in science was associated with lower scores.
- Gender, age, and country of birth, were not significantly related to primary science scores.

At post-primary

- SES, again, had the strongest effect on scores with 25 score points of difference in favour of pupils from higher SES backgrounds
- Country of birth had the second strongest (negative) association with pupil scores. Foreign born pupils scored, on average, 23 score points less than native born pupils.
- Enjoyment and age had stronger links than confidence (self-efficacy) at post-primary, but each of these were significantly associated with higher scores.
- Higher ratings for inquiry based teaching and sense of belonging were related to lower science scores.

Background factors and attitudes - reading and maths performance (primary only)

- As with science, the strongest effects on both reading and maths scores were associated with SES, particularly so for maths.
- Confidence, age and sense of belonging were also significantly linked to higher scores.
- Again, for both reading and maths (as for science), engagement in lessons was found to be associated with lower scores
- For maths, liking learning the subject also appeared as negative when other factors such as gender and SES were taken into account.
- Gender and country of birth were not found to be significant at primary.

[50] It is important to remember, however, that while the effect size of each variable can be compared, it is not possible to assume causality from significant associations between factors.

As SES is by far the most influential factor associated with pupil attainment, the focus on early intervention to address disadvantage and newcomer/foreign born issues should be maintained and stepped up where possible.

Ways of establishing and supporting pupil confidence, in all subjects, should be explored and promoted. For example, it could be beneficial to research, develop and evaluate classroom practices that focus on meaningful learning, actionable feedback, collaboration and providing opportunities for independence, perhaps as part of teacher action research projects. A review of current literature is recommended.

Learning environment in relation to science scores

In primary science

- Good school discipline/pupil behaviour was the school environment factor most associated with higher science scores.
- Higher levels of emphasis on academic success were associated with lower science scores.
- Reports of resource shortages had no significant effect.

In post-primary science

- Good school discipline/pupil behaviour was the school environment factor most associated with higher science scores.
- Pupils in schools where principals reported no shortage of staff or educational materials were, counterintuitively, associated with lower science scores.
- A focus on educational leadership was not significantly associated with science scores.
- SES, age, gender and country of birth were again shown to be significantly related to science scores.

Learning environment - reading and maths (primary only)

- For reading and maths results in primary schools, school discipline was strongest learning environment factor, but only significant for maths, not for reading.
- School emphasis on academic success and resource shortages were not significant.

Further exploration into pupil attitudes would be of value in order to understand more about pupils' underlying beliefs, motivations and behaviours. This would apply in relation to counter-intuitive findings such as lesson engagement, sense of belonging and enquiry based learning, but also to investigate positive factors, to find out what makes pupils confident and enjoy a subject. At school level, further qualitative data could be collected around schools' focus on academic success and educational leadership to identify how these factors impact on pupil perceptions and attitudes. School surveys followed by interviews/school visits could provide valuable evidence that may help explain some of the findings reported here.

The combined analyses described in previous chapters highlighted a number of school and pupil factors that appear to be associated with pupil achievement. We know, for example that SES has a significant impact on pupil performance in all subjects and that gender has a significant impact on reading performance. Some preliminary explorations also suggested that pupils' country of origin was an important factor, especially at post-primary level[51]. These overarching pupil factors can make it difficult to assess the extent to which other variables may or may not play a significant part in a pupil's overall score and, in turn, the country's average score.

In order to explore more fully the extent to which pupil attitudes and learning environment were associated with pupil performance, we conducted a series multi-level modelling analyses. This kind of regression analysis allows us to "cancel out" pupil characteristics (such as gender, socioeconomic status and age) when drawing conclusions about our outcomes of interest. Regression estimates are used to isolate the differences due any specific factor (such as pupil attitudes or school level learning environment factors) by taking all other characteristics into account.

5.1 Multilevel models

Multilevel models (or random effects models) recognise the hierarchical nature of data, for example in the way that pupils in the TIMSS, PIRLS and PISA samples are nested within schools. It takes account of the fact that pupils from the same school are more similar than pupils from different schools, hence the estimation of the effects and their statistical significance are more robust than simply looking at group means or correlational data.

This type of modelling also enables the measurement of the proportion of the variance in academic performance that is explained by school characteristics that are common to pupils within same schools (e.g. school leadership) and the proportion of the variance that is due to pupil characteristics, which are individual.

5.1.1 Multilevel models to measure the impact of pupil background factors and attitudes on science achievement in primary and post-primary

In order to continue the primary post-primary comparison, our first set of models looked at pupil level variables in science achievement. Post-primary models can only be related to science achievement as no pupil attitudinal data was gathered for reading or maths in PISA 2015. We do, however, look at primary level achievement in reading and maths to explore whether there are notable differences across subjects.

[51] Language spoken at home was also a significant factor, but was not included in the model because of its high correlation with country of origin (which could distort the results).

Interpreting the multilevel modelling charts

Each chart shows the impact of individual variables when all the others have been taken into account. The effect of each variable (in score points) is represented by its distance from the horizontal axis. Above the axis shows a positive impact and below indicates a negative impact. The vertical bar through each variable point shows the confidence intervals. If the confidence intervals do not cross the horizontal axis the impact of the variable is statistically significant.

Note: The direction of causality cannot be determined by these models. For example pupils may enjoy science because they get high scores, or they may get high scores because they enjoy science, nevertheless the different background and attitudinal characteristics shown to be significant in the model are reliable predictors of pupils' scores in science.

Figure 5.1 shows the effect of pupil attitudinal variables, SES and gender on pupils' science scores. Socioeconomic background, as measured by the number of books in the home[52], had the largest significant relationship with pupil performance, both in primary and post-primary.

At **primary** the strongest effect on scores, by far, was associated with SES, with almost 40 score points of difference in favour of higher SES pupils. Pupil confidence, enjoyment of learning and sense of belonging were also associated with higher scores, but to a much lesser extent. Pupil engagement in science was associated with lower scores. It seems probable that more lower-achieving pupils reported that they found science lessons engaging, they may perceive it as being 'less-academic', or they may feel less pressure in 'The worlds around us' lessons if they feel there may be less focus on science in the Transfer tests. Gender, age and country of birth were not significantly related to primary pupils' science scores.

At **post-primary**, after SES (still the variable with the greatest effect), enjoyment and age were each found to have stronger links at post-primary than confidence (self-efficacy) but all of these were significantly associated with higher scores. Higher pupil ratings for inquiry based teaching and sense of belonging were associated with lower science scores at post-primary. It is possible that the pupils less inclined to independent learning/less mature pupils gave higher ratings on these variables, hence the association with lower levels of performance.

The variable most strongly associated with lower scores at post-primary was being foreign born[53]. While at primary, country of birth had no significant effect on science achievement, in post-primary it was associated with, on average, 23 score points less when compared with pupils born in Northern Ireland. It is possible that foreign born post-primary pupils (18 per cent overall)[54] do not have the language skills to fully participate in the post-primary curriculum, or

[52] We chose to use this measure of SES because it allowed direct comparisons between primary and post-primary.

[53] These pupils form part, but not all, of the group of pupils assigned 'newcomer' status in Northern Ireland.

[54] In the sample of the pupil attitudes' regression, 16 per cent of pupils were foreign born.

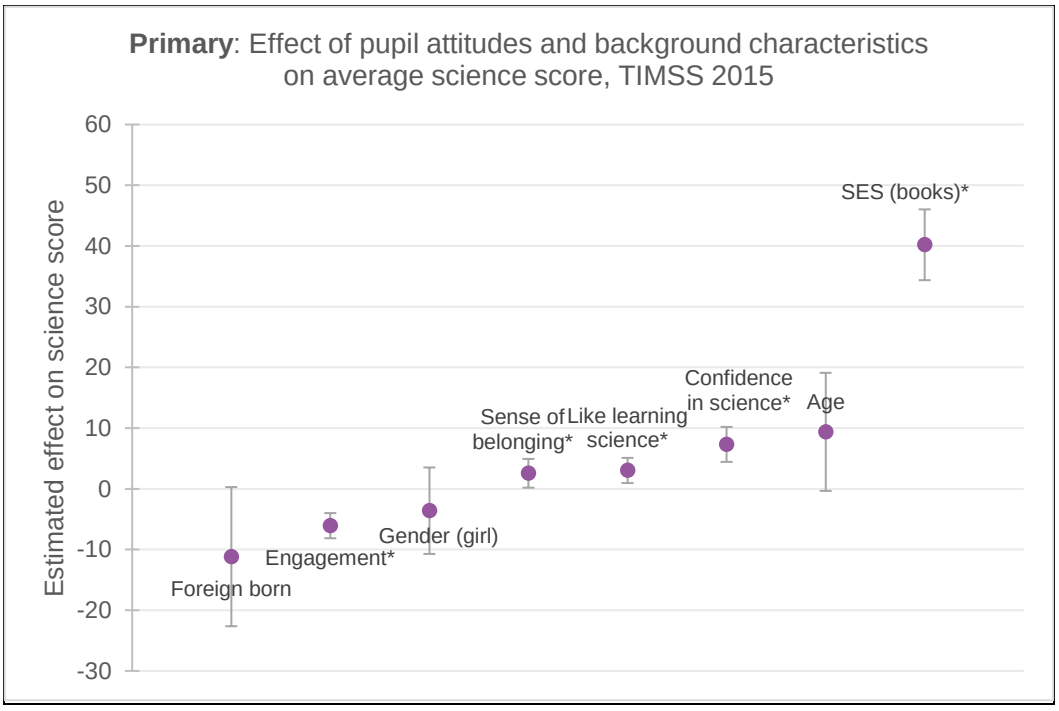
indeed to access the PISA assessment, hence the large negative effect[55]. Whereas, at primary level, all pupils are learning the basic skills together and are on a more equal footing.

Sense of belonging is an interesting variable which was significantly associated with lower scores at post-primary school. It is possible that this reflects changing values as pupils mature, and higher attainers become more independent learners, less concerned about the views of teachers and other pupils. It is interesting to note that pupils in England, on average, reported a much lower sense of belonging and scored significantly higher in science than Northern Ireland and the Republic of Ireland. Further, in a previous report[56] on PISA performance we found that 'resilient' pupils, defined as disadvantaged pupils who performed well in PISA, also reported a lower sense of belonging. It is possible that higher achieving learners are more self-motivated and have learned not to rely as much on support from staff as other pupils and therefore their sense of belonging is lower.

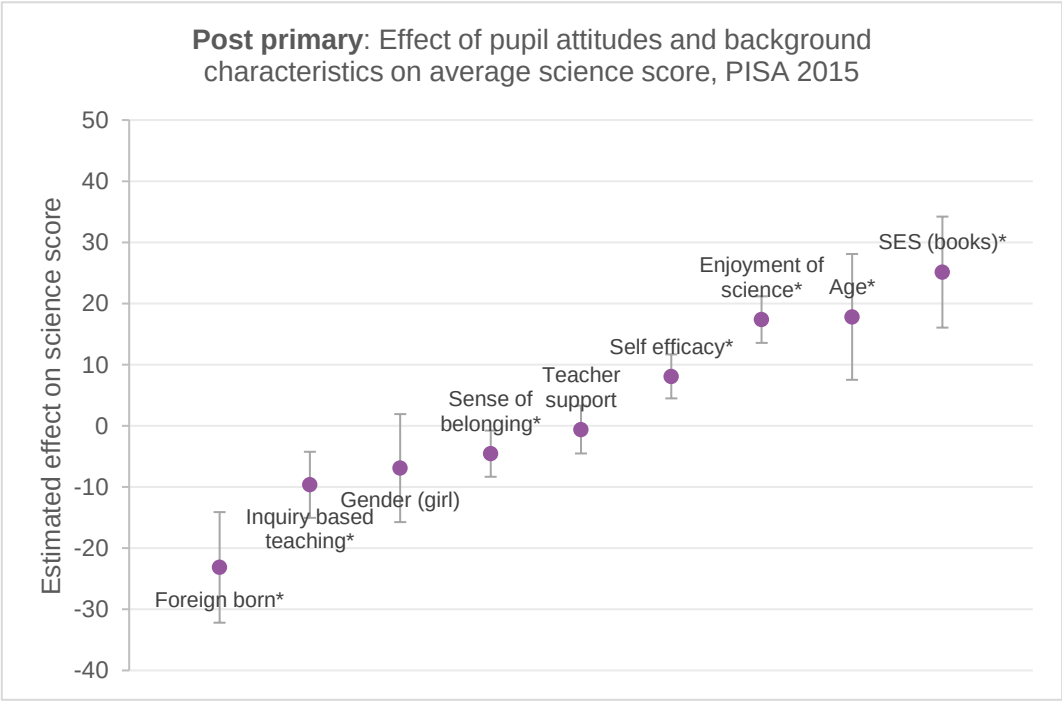
[55] We also looked at the reported use of language at home: among the 18 per cent foreign born pupils, 19 per cent of them reported that they spoke a language other than English most of the time.

[56] https://files.eric.ed.gov/fulltext/ED574365.pdf

Figure 5.1 Effect of pupil background factors attitudes on average science scores in Northern Ireland, primary and post-primary[57] (TIMSS 2015 and PISA 2015)



*Statistically significant at the 5% level



*Statistically significant at the 5% level

[57] Regression coefficients

5.1.2 Multilevel models to measure the impact of pupil background and attitudes on reading and maths achievement in primary (only)

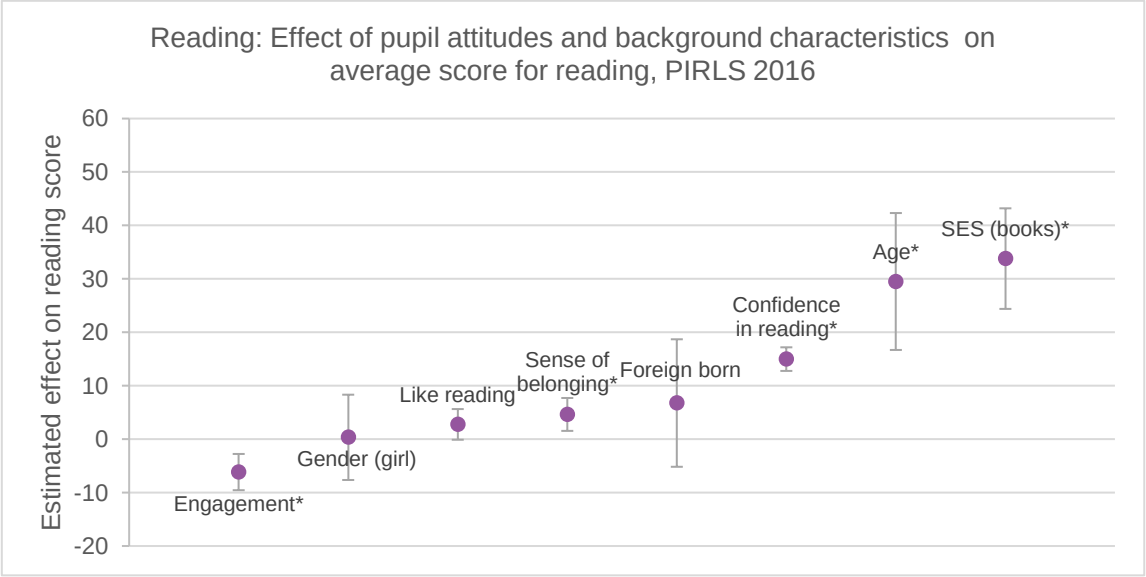
We next examined the same variables for primary reading and maths to see whether there were any differences across subjects. (Figure 5.2)

As with science, the strongest effects on both reading and maths scores were associated with SES, particularly so for maths. Confidence in the subject came next for both subjects and had a much larger effect for both maths and reading than it did for science (it may be that higher attaining pupils give lower confidence ratings for science).

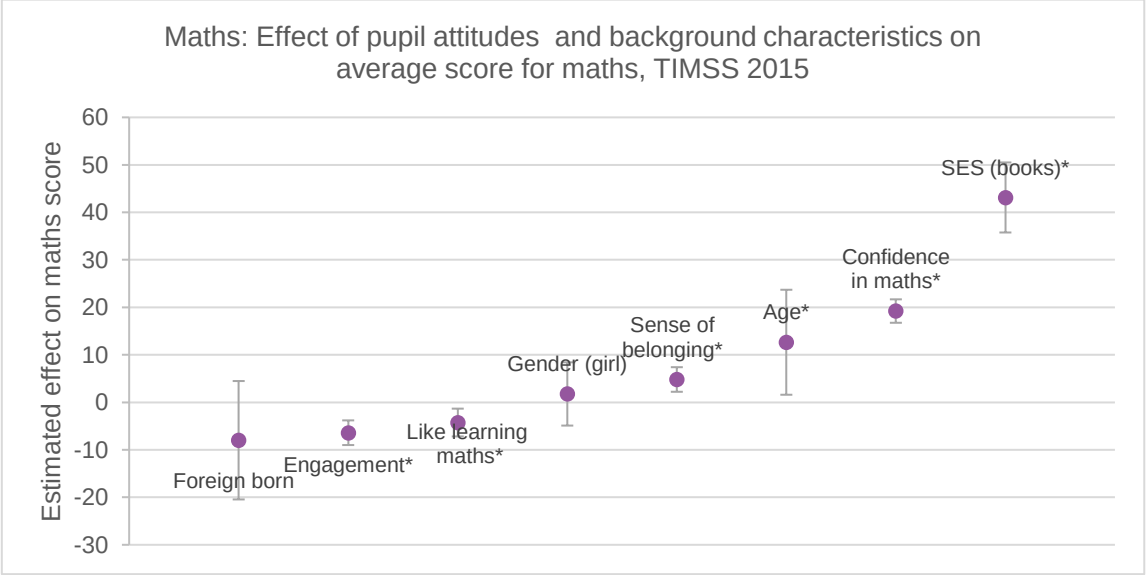
Interestingly. age was significant for reading and maths but not for science at primary level. The effect of age in reading scores is more than twice the effect on maths scores. It seems likely that younger pupils are still developing their basic skills in both subjects, and reading skills may take longer to become firmly established. Basic literacy skills are built and strengthened through flexible usage and increasingly complex challenge, whereas much maths and science learning depends on specific aspects of the curriculum having been taught and absorbed. Gender was not significant for any subject at primary when other variables were taken into account, and neither was country of origin. Sense of belonging was associated with a small, but significant, positive effect on scores for reading and maths, but not for science.

Again for both reading and maths (as for science), engagement in lessons was found to be associated with lower scores and, for maths, liking learning the subject also appeared linked to lower scores. It is possible that lower achieving pupils give higher ratings for lesson engagement, they also appear to 'like' maths more than reading. It may also be that higher-attaining pupils are more 'critical'. Further investigation would be needed to understand these differences.

Figure 5.2 Effect of pupil background factors and attitudes on average reading and maths scores in Northern Ireland in primary. (PIRLS 2016 and TIMSS 2015)



*Statistically significant at the 5% level

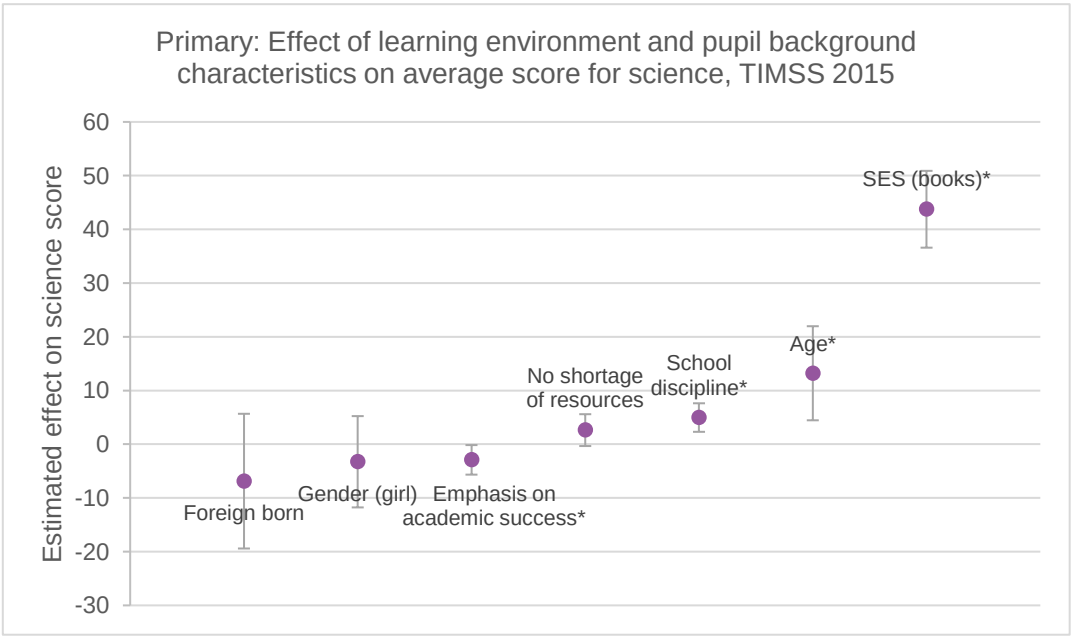


*Statistically significant at the 5% level

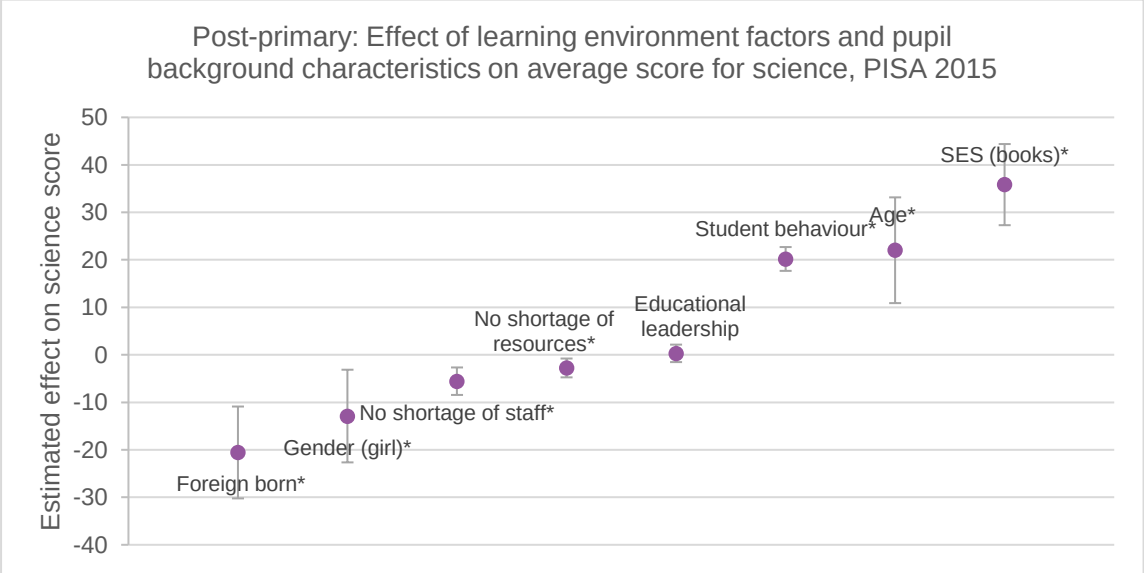
5.1.3 Multilevel models to measure the impact of learning environment on science achievement in primary and post-primary

In a further set of regressions, the effect of school-level learning environment factors were calculated. Figure 5.3 shows the impact of school environmental factors on science scores.

Figure 5.3 Effect of learning environment in average science scores in Northern Ireland, primary and post-primary school (TIMSS 2015/PISA 2015)



*Statistically significant at the 5% level



*Statistically significant at the 5% level

Note: school discipline/student behaviour, shortage of resources/educational material/staff scales have been reversed so that higher values of the scale reflect more positive learning environment

In terms of learning environment, in **both primary and post-primary**, school discipline/student behaviour were the factors that had the largest effect on pupil performance after SES and age (when all the other factors were taken into account). This effect was consistent across different models, both in primary schools (where fewer behaviour problems were reported) and in post-primary.

Counterintuitively, primary schools with a higher level of emphasis on academic success were associated with lower science scores. We cannot attribute causality here. It may be that, in Northern Ireland, principals in schools with more low attaining pupils place more emphasis on academic success. An alternative perspective might be that some schools place less emphasis on the importance of teaching science because it no longer forms a substantial part of the Northern Ireland Transfer tests. In post-primary, a focus on educational leadership was not found to be a significant factor. It may be that post-primary principals delegate a lot of the leadership tasks to their subject leads and heads of department, and play a less direct role in supporting teachers in their schools. Further research would be needed to explain these findings.

In post-primary, lower scores were associated with principals' reports that shortages of staff and shortage of educational material did not hinder instruction. This is an unexpected finding and difficult to explain. The shortage measures are self-reported and subjective, so it is possible that principals in higher-achieving schools have higher expectations. In primary, reported resource shortage was not significantly associated with science scores.

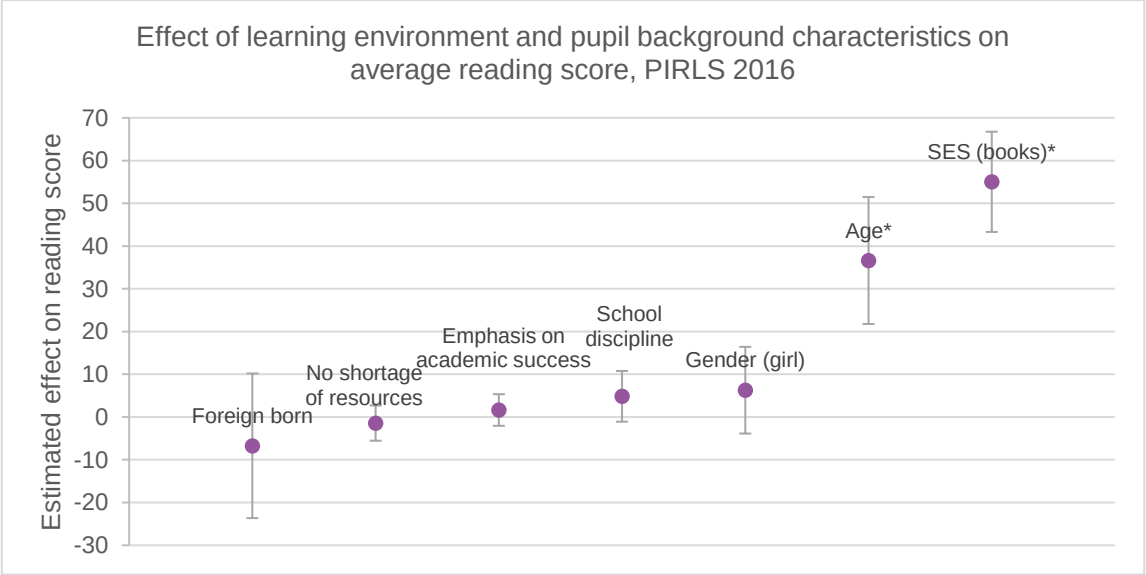
In terms of pupil level variables, SES remains one of the strongest related factors, alongside age. As with the pupil attitude models, being foreign born was not found to affect scores significantly at primary, but at post-primary it was associated with a reduction of approximately 20 score points, when all other variables were taken into account. In this model, gender was found to be significant in post-primary science, in favour of boys.

5.1.4 Multilevel models to measure the impact of learning environment on reading and maths achievement in primary (only)

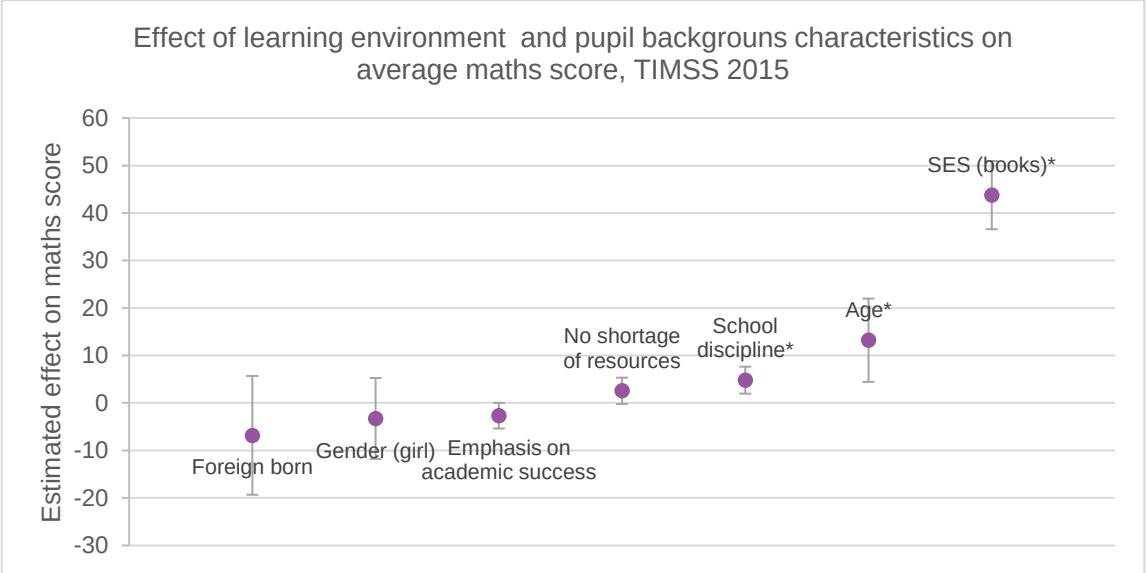
Figure 5.4 shows the equivalent analyses for reading and maths results in primary schools. Again we see school discipline as the strongest of the learning environment factors, but only significant for maths, not for reading. School emphasis on academic success and resource shortages were not significant for reading or maths at primary.

In the context of school environment factors, SES again has the strongest significant effect, age is significant both for reading and maths, while the gender effect disappears. Country of birth had no significant effect at primary.

Figure 5.4 Effect of learning environment on average reading and maths scores in Northern Ireland in primary. (PIRLS 2016 and TIMSS 2015)



*Statistically significant at the 5% level



*Statistically significant at the 5% level

5.1.5 Variance in science performance

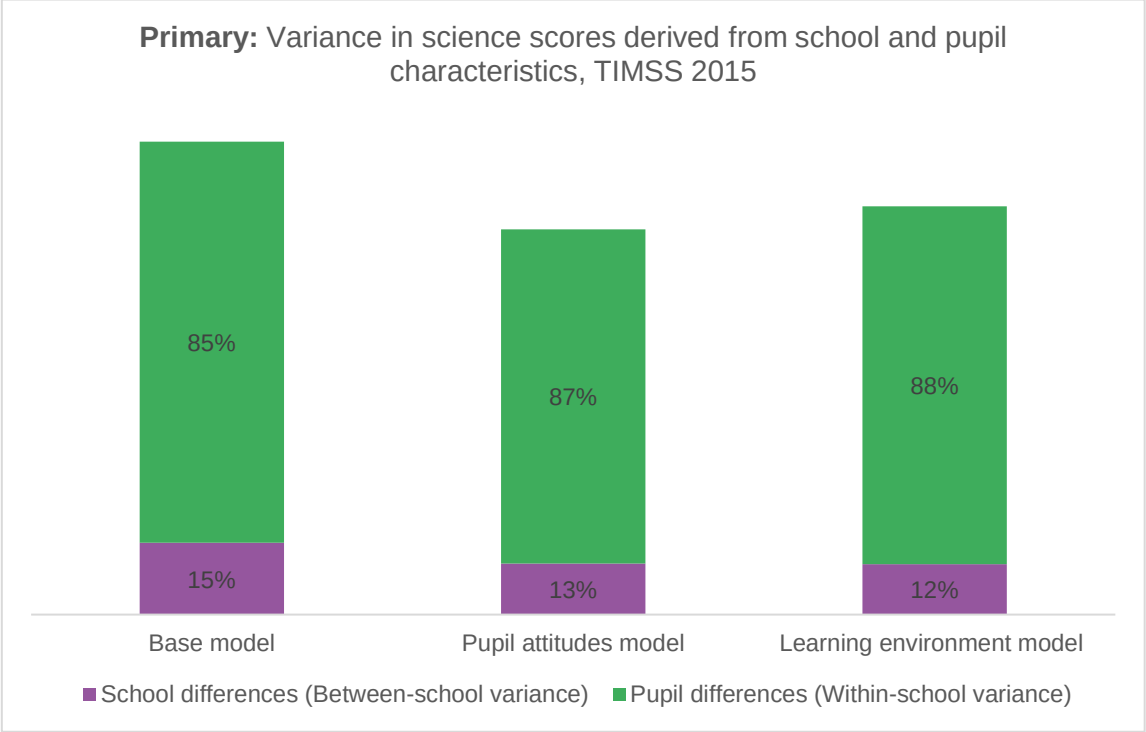
Multilevel modelling allows us to understand more about the source of the variance in pupil scores. These variances can be explained by differences in school features, which are common to all pupil within a school (between-school variance), and differences in pupil characteristics and background (within-school variance).

The percentage of difference in scores explained by between-school variance (Intra Cluster Correlation (ICC)) is a measure of the relatedness or similarity of pupils who attend the same school, so it tells us the degree to which school features determine the changes to pupil science scores.

Our models were designed to explain some of this variation in scores by controlling for pupil characteristics (age, gender, SES) and adding explanatory variables of pupil attitudes and learning environment.

In Figures 5.5 and 5.6, the height of the bars represent the amount of variance on science scores at primary and post-primary. The base model bar depicts the variability of the science scores in our sample, and shows the proportion attributable to school characteristics (between-school variance) and the proportion attributable to pupil characteristics (within-school variance). In order to explain some of this variance, we added pupil attitudes and learning environment variables to the model, shown graphically as shorter bars two and three. (The height of the bars reflect the overall unexplained variance in scores. As we add variables to the models, our aim is to reduce the amount of unexplained variation overall.)

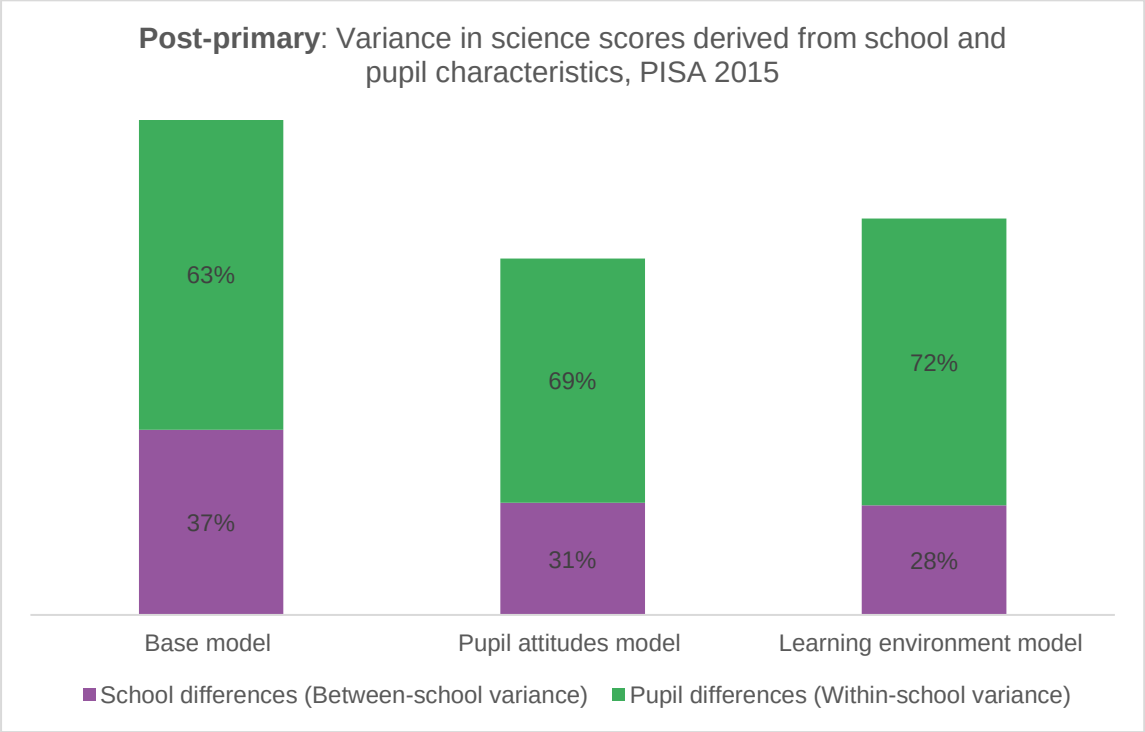
Figure 5.5 Primary: percentage of variance in science scores derived from school and pupil characteristics in Northern Ireland, TIMSS 2015



In **primary** school, 15 per cent of the overall variance in science score corresponds to school characteristics that are common to all pupils in the same school (between-school variance) e.g.

teaching and leadership practices. The remaining 85 per cent of the variation in achievement was attributable to individual pupil and home characteristics.

Figure 5.6 Post-primary: percentage of variance in science scores derived from school and pupil characteristics in Northern Ireland, PISA 2015



In **post-primary** school, the proportion of the overall variation in science score explained by school level factors was much greater, at 37 per cent, than at primary. This reflects previous findings that post-primary schools tend to have pupils with more similarities in terms socioeconomic background i.e. higher between-school variance has been associated with more selective school systems.

The figures confirm that pupil level differences explain much more of the overall variance than school level differences in both primary and post-primary schools. However, school factors play a much bigger role in post-primary than in primary in explaining the variation in scores.

In terms of the extent of variance explained by pupil attitude and learning environment:

- The pupil attitudes included in the model (engagement, confidence, enjoyment of learning and sense of belonging) explained 17 per cent of the difference between pupils' scores in primary school and 22 per cent in post-primary school.
- Given that the learning environment variables were common to all pupils within each school, these variables, consequently, explained a higher proportion of between-school variance in pupil performance: 30 per cent and 41 per cent for primary and post-primary school, respectively.

Table 5.1 Percentage of the variation in scores in Northern Ireland explained by the multilevel models, primary and post-primary

	TIMSS 2015	PISA 2015
	% of variation in scores explained by pupil attitudes	% of variation in scores explained by pupil attitudes
Pupil differences (Within-school variance)	17%	22%
	TIMSS 2015	**PISA 2015**
	% of variation in scores explained by learning environment factors	% of variation in scores explained by learning environment factors
School differences (Between-school variance)	30%	41%

6 Further reflections on the Republic of Ireland

We have seen that pupils in the Republic of Ireland perform significantly better than those in Northern Ireland in the PISA assessments at post-primary, despite Northern Ireland's primary pupils being among the best in the world. To help us understand why this might be the case, we looked at recent strategies and policies in the Republic of Ireland to see if they might shed some light on this discrepancy.

6.1 Strategies to improve standards in the Republic of Ireland

From 2011, the Republic of Ireland have developed and implemented a new set of strategies to improve standards in literacy and numeracy (partly due to poor performance in PISA 2009). These are detailed in the *National Strategy: Literacy and Numeracy for Learning and Life 2011 – 2020*[58]*.* By 2014, the National Assessments (NA) were the first since 1980 which showed statistically significant increases in English reading and maths performance.[59]

Initiatives to improve the performance of low and high attainers

Analysis of international and national assessments since 2014 have isolated a cohort which represents a gap in achievement between the most disadvantaged schools and other schools. This is known as the DEIS (Delivering Equality of Opportunity in Schools) urban band 1 and comprises the most disadvantaged schools. A new strategy, the DEIS Plan 2017, details numerous supports for these schools and other schools which have lesser levels of disadvantage. Examples of the support provided includes a School Meals Programme, Home School Community Liaison services and additional funding under the School Book Grant Scheme. The link between disadvantage and low SES and lower attainment has been well established, so it will be most interesting to look in detail at the results of PISA 2018, to see whether any impact of the various strategies to improve outcomes can be detected.

Other areas of focus in the Republic of Ireland have been:

- **EAL pupils** – A move to more inclusive education, which encompasses SEN, multiculturalism and SES disadvantage, was part of the curriculum reforms introduced in the 2012/13 school year. A specific element of this comprised learning and language support. PISA 2015 findings identified a "significant difference in reading performance between native and immigrant pupils who speak a language other than English or Irish at home, with native pupils scoring some 25 points higher". Again further analysis of PISA 2018 results will be of particular interest to evaluate the impact of this strategy.
- A renewed and greater focus on **high-achieving pupils**, to ensure that they are challenged to reach their full potential. It was noted that top pupils did not achieve as highly as their

[58] National Strategy: Literacy and Numeracy for Learning and Life 2011 – 2020. Interim review 2011-2016. New targets 2017 – 2020

[59] The 2014 National Assessments of English Reading and Mathematics. Volume I: Performance Report: This report focuses on the progress of primary schools since the National Strategy for Literacy and Numeracy 2011 was introduced.

international peers. However, efforts in this area appear to be patchy, with a lack of focus on higher attainers being flagged by the Chief Inspector as a weakness and, in particular, that insufficient national attention is given to exceptionally gifted pupils.

Efforts to improve general performance

Further strategies introduced in the Republic of Ireland include:

- A number of curriculum and assessment reforms which have prioritised literacy and numeracy. The high reading performance in PISA 2015 suggests the focus on literacy has been successful, but numeracy was thought to need more work. However, both management and teaching staff in schools have raised the issue of curriculum overload so this may hinder progress.
- Facilitating adults to improve their literacy skills, so that they can support their children and grandchildren. This includes, working with the National Adult Literacy Agency, a range of newly developed resources to help achieve this aim and the development of partnerships with literacy and numeracy stakeholders. These strategies were driven by evidence from the OECD's Programme for the International Assessment of Adult Competencies (PIAAC) which identified poor literacy and numeracy levels in a significant minority of adults, with 17 per cent and 25 per cent of adults scoring at or below Level 1 in literacy and numeracy respectively.
- Addressing gender gaps – in PISA 2015, girls performed better in reading and boys in maths.
- Introducing a specific focus on digital skills, and on the Irish Language in tandem with learning English.
- The introduction of the Junior Cycle in 2015. This is a three year programme for pupils generally aged 12-15, leading to the award of the Junior Certificate. (This is a national examination overseen by the State Examinations Commission.) With effect from 2017, the title of this award has been changed to a Junior Cycle Programme of Achievement, combining both school based and State examinations assessment. There are eight key skills in this framework, with literacy and numeracy being two of these. Higher level maths is being taken up significantly more frequently, although this would not have impacted on PISA 2015, it may be reflected in PISA 2018 results.

Other points/possible factors to consider

Curriculum and teaching/ learning issues, at primary and/or post-primary levels may contributeto disparities in PISA performance. Although international assessments allow for international comparisons, the test content may not fully align with national curricula.

Pupils in the Republic of Ireland are given the option of choosing to complete a 'transition year', which is a one-year programme taken after Junior Cycle (2nd year) and before the two-year Leaving Certificate programme[60]. It is effectively a 'gap year' and includes elements of work experience and community service, with each school designing its own transition programme within set guidelines, to suit the needs and interests of its pupils and taking into account the possibilities offered by local community interests. Around 550 schools offer this programme that

[60] DES page

it doesn't lead to any public exams, but the nature of the transition programme, applying learning to real life situations, may be more aligned to PISA type assessment than more curriculum based learning. Its voluntary nature means that PISA eligible pupils are distributed across a number of school years. For example when PISA 2015 was implemented in the Republic of Ireland in March 2015, pupils were distributed over four grade levels, with around a quarter (25%) of them in the transition year programme (Second year (1.9%), Third year (60.5%), Transition year (26.7%), and Fifth year (10.9%)) and a proportion of fourth year pupils might have also have completed a, more practical, transition year.

Some observations from the Republic of Ireland's analyses of their performance on ILSAs include:

- In PIRLS: "Higher level questions in general were found to be more challenging for Irish pupils, compared with questions requiring more basic thinking"
- Reasons thought to have contributed to poor performance in PISA 2009 and improved results of PISA 2012 include a greater numbers of immigrants and students who spoke a first language other than English
- The National Strategy started in 2011 and performance had significantly improved in TIMSS 2015 and PIRLS 2016.
- The response to the PISA 2009 dip may have led to a more skill-specific focus on application of knowledge in post-primary, rather than the PIRLS/TIMSS mastery approach[61].
- There have also been initiatives to improve outcomes in primary schools, for example, a higher proportion of the timetable spent on literacy and numeracy, although recent ILSAs suggest these are still less than in other countries.
- There have also been concerted efforts to improve early years education, including more highly-qualified early years practitioners and a state-funded ECCE programme, however the effect of these would not yet have filtered through to recent ILSAs.

Overall, the Republic of Ireland has introduced a wide range of targets and initiatives, not all of which will have been fully implemented or have had time to take effect. Better overall outcomes in reading and maths in PISA 2015 are being attributed to some of the interventions that resulted from the analysis of ILSA evidence. Maths now is receiving a greater focus and specific strategies, for increasing girls' confidence in maths, to help increase their achievement are being rolled out. Focused attention to lower, and in particular, higher attaining pupils have also intensified more recently, so the results of PISA 2018 and subsequent TIMSS and PIRLS cycles will be of particular interest in evaluating the impact of the strategies introduced.

6.2 Some differences in questionnaire responses between Northern Ireland and the Republic of Ireland

In order to explore differences more widely, we examined selected responses from the PIRLS questionnaires in detail, to identify any ways in which pupils, principals or teachers in Northern Ireland gave significantly different responses from those in the Republic of Ireland (or England).

[61] NFER is conducting a review of policy implementation in the Republic of Ireland to be published late in 2020.

For many of the questionnaire variables in PIRLS 2016, responses across the three countries were similar, but we found significant differences on the following variables:

Pupils in the Republic of Ireland were significantly **more** likely than those in Northern Ireland to report that:	**Pupils in the Republic of Ireland** were significantly **less** likely than those in Northern Ireland to report that:
• they liked reading • their teacher asked in class about what they had read • they read for fun every day (or almost every day) • they read every day (or almost every day) to find about things they wanted to learn when not in school • they liked talking to other people about what they had read • they liked reading things that made them think • they would be happy to receive a book as a present • they were confident in reading • they ate breakfast every day on school days • they were almost never bullied.	• they thought reading was boring • they didn't enjoy reading • they found reading harder than other subjects • they arrived at school feeling tired • they arrived at school feeling hungry • the behaviour of other pupils in their school was good • they were bullied often, called names, left out of games, had lies spread about them, been hit/hurt, forced to do things against their will, had embarrassing information about them shared or been threatened by other children at their school. (Although the percentage of pupils reporting these behaviours was less than 10 per cent in both countries, the differences were all significant and often reported twice as much in Northern Ireland, and significantly fewer pupils in Northern Ireland reported that these things *never* happened).

Pupils in England generally reported more negative attitudes on almost all variables, except significantly more said that they said they found reading easy than in Northern Ireland.

Principals in Northern Ireland did not differ significantly from those in the Republic of Ireland or in England in terms of their reports on emphasis on academic success, their pupils' desire to do well in school, ability to reach their academic goals, respect for classmates who excel academically, school discipline, absenteeism, swearing, vandalism, theft, intimidation or verbal abuse among pupils or towards staff (including texting, emailing, etc.) or physical conflict among pupils. In all of these categories, principals in all three countries gave similar responses. The only significant differences were that principals in Northern Ireland reported fewer instances of pupils arriving late, and those in England reported fewer instances of cheating than those in the other two countries.

Teachers' reports were also very similar across the three countries with no significant differences between Northern Ireland and the other two countries in terms of emphasis on academic success, their pupils' desire to do well in school, ability to reach their academic goals, respect for classmates who excel academically, having a safe and orderly school, pupils behaving in an orderly manner and respecting their teachers and school property, the extent to which teaching was perceived as being hindered by pupils lacking prerequisite knowledge or

skills, suffering from lack of basic nutrition or insufficient sleep, absences, disruptive or uninterested pupils. The only significant differences on the teacher reports were that teachers in the Republic of Ireland were more likely to report that their teaching had not been at all hindered by pupils lacking the prerequisite skills than those in England and that teachers in England were more likely to report that their teaching was limited by pupils being absent from class than those in Northern Ireland.

Whilst linking all of these variables to attainment is beyond the scope of this report, it does appear that the main differences at primary school between countries, particularly between Northern Ireland and the Republic of Ireland, are to be found in pupil attitudes rather than between schools or teachers.

We made further comparisons on a range of other teacher variables identifying anywhere teachers in the Republic of Ireland gave substantively different responses to those in Northern Ireland (e.g. differences of more than 10 per cent). It should be noted, however, that for these particular variables, the notes that follow are simply observations based on the questionnaire data – no significance test or links to attainment data have been conducted as yet, but could form the basis of future analyses or case studies.

We noted that in primary (PIRLS 2016):

- More teachers in Northern Ireland have more than 20 years of experience than in the Republic of Ireland or England and report feeling content as a teacher.
- Teachers in the Republic of Ireland report more whole class teaching and less ability grouping than in Northern Ireland and assign daily homework more often.
- In 2011, teachers in the Republic of Ireland reported much more professional development for teaching reading than those in Northern Ireland, and in 2016 a higher proportion still reported more than 35 hours CPD per year. Teachers in England reported less reading related CPD than the other two countries.
- Teachers in England generally fell between the other two countries on most teacher variables, except that they assign less homework and feel less content that teachers in Northern Ireland or the Republic of Ireland.

In post-primary (PISA 2015):

Principals in the Republic of Ireland reported:

- that truancy hindered learning more than those in Northern Ireland or England (even though their pupils reported less truancy than those in the other two countries)
- less teacher absenteeism hindering learning than those in Northern Ireland
- less CPD for their teachers than those in Northern Ireland or England
- fewer instances of extra-curricular activities/clubs than England and Northern Ireland (The extra-curricular activities that Northern Ireland's higher attainers take part in are volunteering and chess club.)
- fewer instances of staff supported homework than in England and Northern Ireland and less availability for teacher-aides/teaching assistants to support struggling pupils

- In terms of educational leadership, principals in the Republic of Ireland describe a less target driven, more collaborative approach[62], they make much less use of non-mandatory standardised assessment and slightly more use of teacher judgement when assessing 15 year olds. They also tend to use test results more formatively both for pupil learning and for school improvement.
- Although there is more learning time overall in the Republic of Ireland (1-2 hours more pre week) lower proportions are dedicated to English, maths and science than in other countries. It is possible they focus more on cross-curricular activities which may be more aligned to PISA style assessment than a subject based curriculum.

[62] Principals in ROI reported lower frequency than those in NI in all questions relating to 'educational/school/teaching goals' and higher frequency of staff participating in decision making processes, reviewing managing practices, and solving problems together.

7 Conclusions and further areas for consideration

The key findings outlined this report confirm that Northern Ireland pupils achieved very high scores in reading and maths in primary but did less well in science. The high levels of attainment compared to other countries were not maintained and other countries have shown more relative progress between primary and post-primary in terms of average scores and the number of countries significantly outperform Northern Ireland.

In 2015, average scores in ILSA studies had not improved significantly over time in any subject either at primary or at post-primary. The gap between the highest and lowest attainers had widened at primary for reading and maths due to the improved performance of high attaining pupils, while at post-primary the performance of high attaining pupils had declined in all three subjects[63].

At post-primary, Northern Ireland pupils performed less well than those in the Republic of Ireland for reading and maths and less well than England for science. The Republic of Ireland maintained its position among the high achieving countries at post-primary for reading and maths and England maintained its advantage in science.

The Republic of Ireland had lower proportions of pupils working at the lowest proficiency levels in all three subjects at post-primary, and Northern Ireland had the lowest proportions working at the highest levels (although ROI has a similar proportion for science).

Our multi-level modelling analyses confirmed that socioeconomic status had by far the strongest effect on pupil scores on all ILSA assessments.

Higher levels of confidence and enjoyment were associated with higher scores in general, while pupil engagement tended to be more associated with lower scores. Country of birth was one of the most significant factors linked to pupil performance at post-primary.

These findings indicate that the existing focus in Northern Ireland on addressing educational under-achievement should be continued, with the aim of reducing the number of pupils working at the lowest levels in both primary and post-primary schools. However, it will be important, going forward, to ensure that high achieving pupils are also stretched and challenged to their full potential, especially in post-primary. Preparing, and maintaining, strong foundations at primary remains an important priority as is maintaining the current focus on disadvantage.

Taking the evidence identified in this report into consideration indicates the following areas for further consideration:

- SES is by far the most influential factor associated with pupil attainment, a focus on early intervention to address disadvantage and newcomer/foreign-born issues should be maintained.
- Establishing and supporting pupil confidence, in all subjects, should be explored and promoted. For example, it may be beneficial to research, develop and evaluate classroom

[63] By 2018, the performance of higher attainers in reading was beginning to improve but there was no change in maths or science.

practices that focus on meaningful learning, actionable feedback, collaboration and providing opportunities for pupil independence.

- Focus on stretching high attainers at post-primary, across all subjects, whilst maintaining support and development of lower-attaining pupils.
- Liaise with colleagues in the Republic of Ireland to explore how their recent policies have been implemented and evaluated. Consider some comparative case studies or process evaluations to explore classroom practice as well as detailed comparisons of inter-linked, system level policies.
- Further exploration into pupil attitudes in order to understand more about pupils' underlying beliefs, motivations and behaviours, to find out what makes pupils confident and enjoy a subject. At school level, further qualitative data could be collected around schools' focus on academic success and educational leadership to identify how these factors impact on pupil perceptions and attitudes. A review of policies on provision of science resources for schools.
- Continuation of measures to encourage parental involvement in their child's learning.

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Appendix A: PIRLS data

Appendix A1 Skills defined at international benchmarks and proficiency levels

The PIRLS and TIMSS achievement scales summarise pupil performance on a scale with a centrepoint of 500 and a standard deviation of 100, and reports achievement at four points along the scale as 'International Benchmarks'.

PIRLS and TIMSS International Benchmarks

The Advanced International Benchmark for both studies 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 PIRLS International Benchmark typically know and can do in the target subject.

Summaries of the PIRLS and TIMSS benchmarks are provided in Tables A1.1 to A1.3 below.

Full details can be found:

PIRLS: http://timssandpirls.bc.edu/pirls2016/international-results/pirls/performance-at-international-benchmarks/pirls-2016-international-benchmarks/

TIMSS: maths: http://timssandpirls.bc.edu/timss2015/international-results/timss-2015/mathematics/performance-at-international-benchmarks/item-map-and-summary-of-international-benchmarks/

TIMSS: science: http://timssandpirls.bc.edu/timss2015/international-results/timss-2015/science/performance-at-international-benchmarks/

PISA Proficiency levels

The post-primary equivalents in PISA are called Proficiency Levels. These are shown in Tables A1.4 to A1.6 below

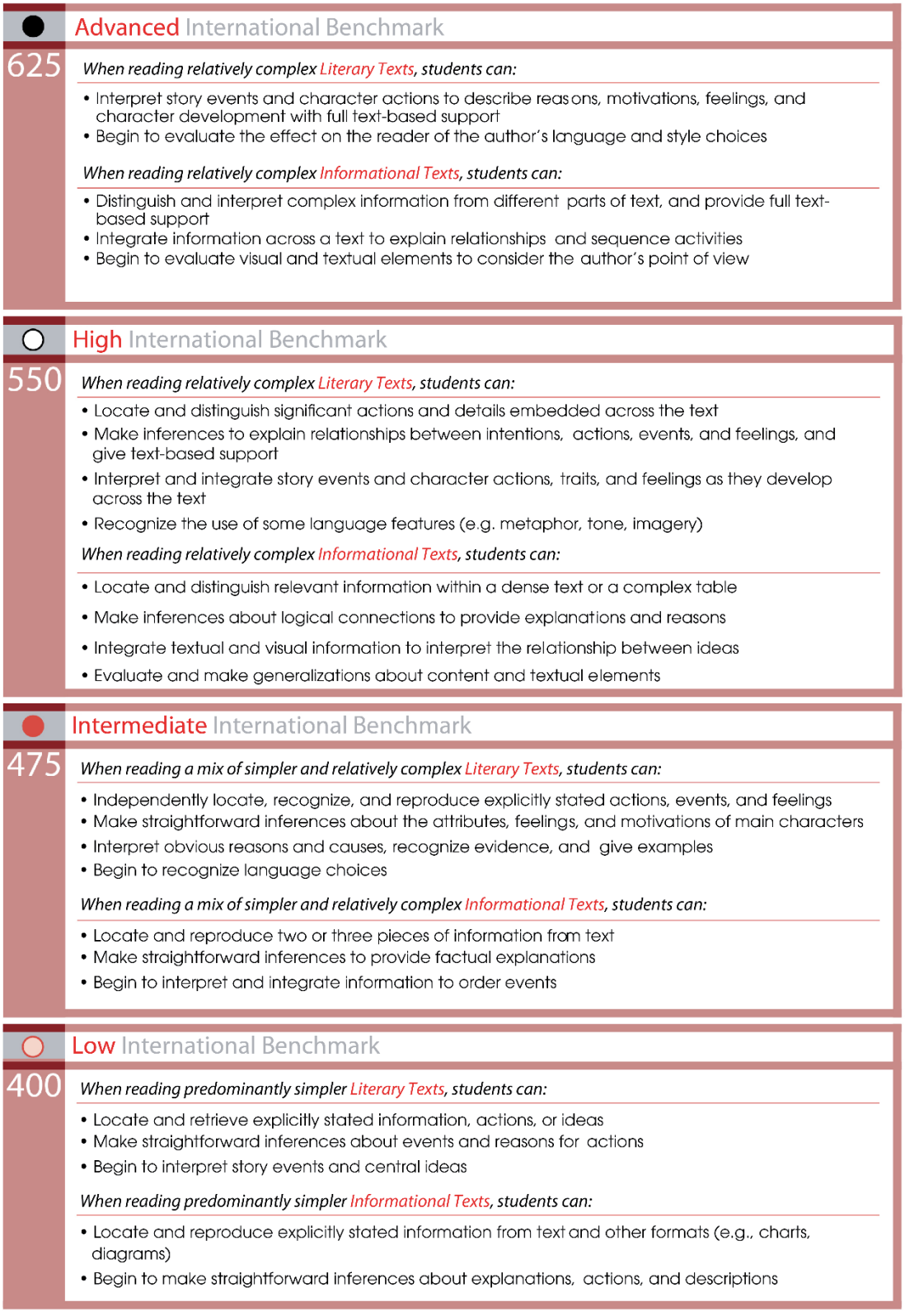
Full details can be found:

Reading: https://nces.ed.gov/surveys/pisa/pisa2015/pisa2015highlights_2b.asp

Maths: https://nces.ed.gov/surveys/pisa/pisa2015/pisa2015highlights_2c.asp

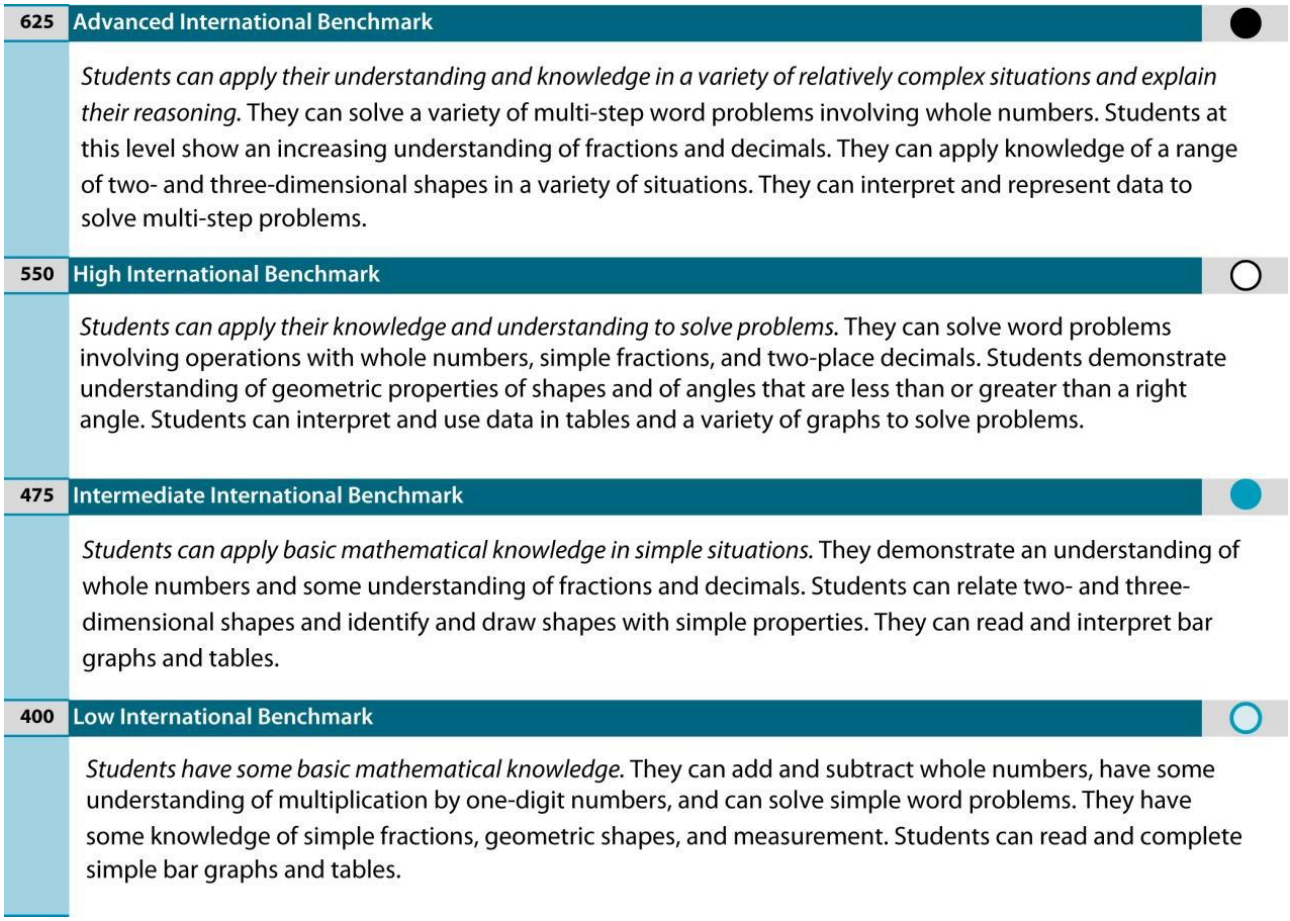
Science: https://nces.ed.gov/surveys/pisa/pisa2015/pisa2015highlights_2a.asp

Figure A1.1 Summary of PIRLS International Benchmarks for reading (Grade 4/Year 6 NI)



Source: Exhibits 2.3, 2.4, 2.5 and 2.6, International reading report (Mullis *et al*., 2017a).

Figure A1.2 Summary of TIMSS International Benchmarks for maths (Grade 4/Year 6 NI)



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

Figure A1.3 Summary of TIMSS International Benchmarks for science (Grade 4/Year 6 NI)

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

Figure A1.4 Summary of PISA Proficiency levels for reading

Proficiency level and lower cut score	Task descriptions
Level 6 698	At level 6, tasks typically require the reader to make multiple inferences, comparisons, and contrasts that are both detailed and precise. They require demonstration of a full and detailed understanding of one or more texts and may involve integrating information from more than one text. Tasks may require the reader to deal with unfamiliar ideas, in the presence of prominent competing information, and to generate abstract categories for interpretations. *Reflect and evaluate* tasks may require the reader to hypothesize about or critically evaluate a complex text on an unfamiliar topic, taking into account multiple criteria or perspectives, and applying sophisticated understandings from beyond the text. A salient condition for *access and retrieve* tasks at this level is precision of analysis and fine attention to detail that is inconspicuous in the texts.
Level 5 626	At level 5, tasks that involve retrieving information require the reader to locate and organize several pieces of deeply embedded information, inferring which information in the text is relevant. Reflective tasks require critical evaluation or hypothesis, drawing on specialized knowledge. Both interpretative and reflective tasks require a full and detailed understanding of a text whose content or form is unfamiliar. For all aspects of reading, tasks at this level typically involve dealing with concepts that are contrary to expectations.
Level 4 553	At level 4, tasks that involve retrieving information require the reader to locate and organize several pieces of embedded information. Some tasks at this level require interpreting the meaning of nuances of language in a section of text by taking into account the text as a whole. Other interpretative tasks require understanding and applying categories in an unfamiliar context. Reflective tasks at this level require readers to use formal or public knowledge to hypothesize about or critically evaluate a text. Readers must demonstrate an accurate understanding of long or complex texts whose content or form may be unfamiliar.
Level 3 480	At level 3, tasks require the reader to locate, and in some cases recognize the relationship between, several pieces of information that must meet multiple conditions. Interpretative tasks at this level require the reader to integrate several parts of a text in order to identify a main idea, understand a relationship, or construe the meaning of a word or phrase. They need to take into account many features in comparing, contrasting or categorizing. Often the required information is not prominent or there is much competing information; or there are other text obstacles, such as ideas that are contrary to expectation or negatively worded. Reflective tasks at this level may require connections, comparisons, and explanations, or they may require the reader to evaluate a feature of the text. Some reflective tasks require readers to demonstrate a fine understanding of the text in relation to familiar, everyday knowledge. Other tasks do not require detailed text comprehension but require the reader to draw on less common knowledge.
Level 2 407	At level 2, some tasks require the reader to locate one or more pieces of information, which may need to be inferred and may need to meet several conditions. Others require recognizing the main idea in a text, understanding relationships, or construing meaning within a limited part of the text when the information is not prominent and the reader must make low level inferences. Tasks at this level may involve comparisons or contrasts based on a single feature in the text. Typical reflective tasks at this level require readers to make a comparison or several connections between the text and outside knowledge, by drawing on personal experience and attitudes.
Level 1a 335	At level 1a, tasks require the reader to locate one or more independent pieces of explicitly stated information; to recognize the main theme or author's purpose in a text about a familiar topic, or to make a simple connection between information in the text and common, everyday knowledge. Typically, the required information in the text is prominent and there is little, if any, competing information. The reader is explicitly directed to consider relevant factors in the task and in the text.
Level 1b 262	At level 1b, tasks require the reader to locate a single piece of explicitly stated information in a prominent position in a short, syntactically simple text with a familiar context and text type, such as a narrative or a simple list. The text typically provides support to the reader, such as repetition of information, pictures, or familiar symbols. There is minimal competing information. In tasks requiring interpretation the reader may need to make simple connections between adjacent pieces of information.

Source: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015

Figure A1.5 Summary of PISA Proficiency levels for maths

Proficiency level and lower cut score	Task descriptions
Level 6 669	At level 6, students can conceptualize, generalize, and utilize information based on their investigations and modeling of complex problem situations, and can use their knowledge in relatively non-standard contexts. They can link different information sources and representations and flexibly translate among them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply this insight and understanding, along with a mastery of symbolic and formal mathematical operations and relationships, to develop new approaches and strategies for attacking novel situations. Students at this level can reflect on their actions, and can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments and the appropriateness of these to the original situations.
Level 5 607	At level 5, students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare, and evaluate appropriate problem-solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriate linked representations, symbolic and formal characterizations, and insight pertaining to these situations. They begin to reflect on their work and can formulate and communicate their interpretations and reasoning.
Level 4 545	At level 4, students can work effectively with explicit models for complex concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic, linking them directly to aspects of real-world situations. Students at this level can utilize their limited range of skills and can reason with some insight, in straightforward contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments, and actions.
Level 3 482	At level 3, students can execute clearly described procedures, including those that require sequential decisions. Their interpretations are sufficiently sound to be a base for building a simple model or for selecting and applying simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They typically show some ability to handle percentages, fractions and decimal numbers, and to work with proportional relationships. Their solutions reflect that they have engaged in basic interpretation and reasoning.
Level 2 420	At level 2, students can interpret and recognize situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures, or conventions to solve problems involving whole numbers. They are capable of making literal interpretations of the results.
Level 1 358	At level 1, students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are almost always obvious and follow immediately from the given stimuli.

Source: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015

Figure A1.6 Summary of PISA Proficiency levels for science

Proficiency level and lower cut score	Task descriptions
Level 6 708	At Level 6, students can draw on a range of interrelated scientific ideas and concepts from the physical, life and earth and space sciences and use content, procedural and epistemic knowledge in order to offer explanatory hypotheses of novel scientific phenomena, events and processes or to make predictions. In interpreting data and evidence, they are able to discriminate between relevant and irrelevant information and can draw on knowledge external to the normal school curriculum. They can distinguish between arguments that are based on scientific evidence and theory and those based on other considerations. Level 6 students can evaluate competing designs of complex experiments, field studies or simulations and justify their choices.
Level 5 633	At Level 5, students can use abstract scientific ideas or concepts to explain unfamiliar and more complex phenomena, events and processes involving multiple causal links. They are able to apply more sophisticated epistemic knowledge to evaluate alternative experimental designs and justify their choices and use theoretical knowledge to interpret information or make predictions. Level 5 students can evaluate ways of exploring a given question scientifically and identify limitations in interpretations of data sets including sources and the effects of uncertainty in scientific data.
Level 4 559	At Level 4, students can use more complex or more abstract content knowledge, which is either provided or recalled, to construct explanations of more complex or less familiar events and processes. They can conduct experiments involving two or more independent variables in a constrained context. They are able to justify an experimental design, drawing on elements of procedural and epistemic knowledge. Level 4 students can interpret data drawn from a moderately complex data set or less familiar context, draw appropriate conclusions that go beyond the data and provide justifications for their choices.
Level 3 484	At Level 3, students can draw upon moderately complex content knowledge to identify or construct explanations of familiar phenomena. In less familiar or more complex situations, they can construct explanations with relevant cueing or support. They can draw on elements of procedural or epistemic knowledge to carry out a simple experiment in a constrained context. Level 3 students are able to distinguish between scientific and non-scientific issues and identify the evidence supporting a scientific claim.
Level 2 410	At Level 2, students are able to draw on everyday content knowledge and basic procedural knowledge to identify an appropriate scientific explanation, interpret data, and identify the question being addressed in a simple experimental design. They can use basic or everyday scientific knowledge to identify a valid conclusion from a simple data set. Level 2 students demonstrate basic epistemic knowledge by being able to identify questions that could be investigated scientifically.
Level 1a 335	At Level 1a, students are able to use basic or everyday content and procedural knowledge to recognize or identify explanations of simple scientific phenomenon. With support, they can undertake structured scientific enquiries with no more than two variables. They are able to identify simple causal or correlational relationships and interpret graphical and visual data that require a low level of cognitive demand. Level 1a students can select the best scientific explanation for given data in familiar personal, local and global contexts.
Level 1b 261	At Level 1b, students can use basic or everyday scientific knowledge to recognize aspects of familiar or simple phenomenon. They are able to identify simple patterns in data, recognize basic scientific terms and follow explicit instructions to carry out a scientific procedure.

Source: Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2015 https://nces.ed.gov/surveys/pisa/pisa2015/pisa2015highlights_2a.asp

Appendix A2 Matching participating countries across ILSAs

Table A2.1 OECD countries participating in different ILSAs

OECD countries that took part in PISA 2015	PIRLS 2016 OECD matching countries	TIMSS 2015 OECD matching countries
Australia	X	X
Austria	X	
Belgium	X	X
Canada	X	X
Chile	X	X
Czech Republic	X	X
Denmark	X	X
Estonia		
Finland	X	X
France	X	X
Germany	X	X
Greece		
Hungary	X	X
Iceland		
Ireland	X	X
Israel	X	
Italy	X	X
Japan		X
Korea		X
Latvia	X	
Luxembourg		
Mexico		
Netherlands	X	X
New Zealand	X	X
Norway	X	X
Poland	X	X
Portugal	X	X
Slovak Republic	X	X
Slovenia	X	X

OECD countries that took part in PISA 2015	PIRLS 2016 OECD matching countries	TIMSS 2015 OECD matching countries
Spain	X	X
Sweden	X	X
Switzerland		
Turkey		X
United Kingdom	X	X
United States	X	X

Table A2.2 Summary of OECD participating countries by income classification

PIRLS	2001	2006	2011	2016		
Total OECD countries	35	39	48	48		
Low-income	3%	0%	0%	0%		
Lower-middle-income	26%	15%	8%	4%		
Upper-middle-income	17%	21%	17%	15%		
High-income	54%	64%	75%	81%		
TIMSS	**2003**	**2007**	**2011**	**2015**		
Total OECD countries[64]	28	31	40	40		
Low-income	8%	3%	0%	0%		
Lower-middle-income	23%	25%	8%	4%		
Upper-middle-income	12%	11%	22%	18%		
High-income	58%	61%	70%	78%		
PISA	**2000**	**2003**	**2006**	**2009**	**2012**	**2015**
Total OECD countries	30	32	37	37	37	37
Low-income	0%	0%	0%	0%	0%	0
Lower-middle-income	3%	6%	0%	0%	0%	0
Upper-middle-income	20%	19%	24%	14%	11%	8%
High-income	77%	75%	76%	86%	89%	92%

Source: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

[64] Only participating countries for TIMSS Grade 4

Appendix A3 Pupil achievement by background

Table A3.1 Primary: Reading achievement by pupil background characteristics PIRLS 2016 Northern Ireland

Characteristic	n	% of pupils	Avg. Reading achievement	Standard error	Gap in achievement
Gender*					
Girl	1837	50%	574	2.8	18
Boy	1856	50%	556	2.8	
Number of books at home*					
26 or more books	2503	68%	586	2.1	65
0 to 25 books	1147	32%	521	3.0	
Highest parental education*[a]					
Completed university or higher	741	50%	611	4.1	45
Completed less than university	694	50%	566	4.1	
Pupil country of origin[a]					
Native born	1354	93%	588	3.2	3
Foreign born	105	7%	585	9.3	
Language spoken at home*					
English Always/ Almost always	3407	94%	567	2.1	22
English Sometimes/ never	257	6%	545	6.9	
Number of digital devices at home*[a]					
High access (7+)	630	42%	597	4.1	17
Low/Medium access (0-6)	823	58%	581	3.9	

*Difference in means is statistically significant at the 5% level

[a]Response rate less than 50% of the sample

Table A3.2 Primary: Reading achievement by School Census pupil characteristics PIRLS 2016 Northern Ireland

Characteristic	n	% of pupils	Avg. Reading achievement	Standard error	Gap in achievement
Socioeconomic status*					
FSM Non-eligible	2556	69%	580	3.6	48
FSM Eligible	1054	31%	532	2.1	
SEN Stage*					
Pupils with no SEN stage	2787	77%	583	2.1	80
Pupils with SEN stage 1 to 5	823	23%	503	4.6	
SEN Statement*					
Pupils with no statement of SEN	85	98%	567	2.1	99
Pupils with SEN Statement	3525	2%	468	13.7	
Ethnicity					
White	3485	97%	565	2.2	1
Black and minority ethnic	125	3%	564	10.0	
Newcomer status*					
Not a newcomer	3517	98%	566	2.2	47
Newcomer	93	2%	519	10.5	
Pupil type of residence*					
Rural	1154	41%	572	3.5	11
Urban	2447	59%	560	2.8	
Income Deprivation Affecting Children (IDAC)*					
Pupil doesn't reside in the 30% most deprived SOA	2657	71%	569	2.3	15
Pupil resides in the 30% most deprived SOA	944	29%	554	4.3	
Education deprivation*					
Pupil doesn't reside in the 30% most deprived SOA	2603	73%	575	2.4	34
Pupil resides in the 30% most deprived SOA	998	27%	541	3.9	

*Difference in means is statistically significant at the 5% level

Table A3.3 Primary Maths achievement by pupil characteristics TIMSS 2015 Northern Ireland

Characteristic	n	% of pupils	Avg. maths achievement	Standard error	Gap in achievement
Gender					
Girl	1514	50%	569	3.9	-2
Boy	1601	50%	571	3.1	
Number of books at home*					
26 or more books	2091	68%	592	2.9	65
0 to 25 books	1006	32%	527	3.8	
Highest parental education*					
Completed university or higher	785	42%	623	4.0	63
Completed less than university	1008	58%	560	4.0	
Pupil country of origin					
Native born	1663	90%	586	3.5	10
Foreign born	168	10%	576	9.7	
Language spoken at home*					
English Always/ Almost always	2855	92%	573	3.1	29
English Sometimes/ never	248	8%	544	5.5	
Number of digital devices at home*					
High access (7+)	797	43%	596	4.0	19
Low/Medium access (0-6)	1036	57%	577	4.1	

*Difference in means is statistically significant at the 5% level

Table A3.4 Primary Science achievement by pupil characteristics TIMSS 2015 Northern Ireland

Characteristic	n	% of pupils	Avg. science achievement	Standard error	Gap in achievement
Gender					
Girl	1514	50%	520	3.0	0
Boy	1601	50%	520	2.8	
Number of books at home*					
26 or more books	2091	68%	537	2.1	53
0 to 25 books	1006	32%	484	2.8	
Highest parental education*					
Completed university or higher	785	42%	559	3.0	48
Completed less than university	1008	58%	511	3.1	
Pupil country of origin					
Native born	1663	90%	531	2.7	11
Foreign born	168	10%	520	8.8	
Language spoken at home*					
English Always/ Almost always	2855	92%	522	2.3	26
English Sometimes/ never	248	8%	496	6.2	
Number of digital devices at home*					
High access (7+)	797	43%	540	3.1	18
Low/Medium access (0-6)	1036	57%	522	3.1	

*Difference in means is statistically significant at the 5% level

Table A3.5 Post-primary: Reading achievement by pupil characteristics PISA 2015 Northern Ireland

Characteristic	n	% of pupils	Avg. Reading achievement	Standard error	Gap in achievement
Gender*					
Girl	1216	50%	504	5.2	14
Boy	1185	50%	490	5.1	
Number of books at home*					
26 or more books	1511	65%	522	5.0	67
0 to 25 books	800	35%	455	5.4	
Highest parental education*					
Completed university or higher	923	41%	519	5.7	31
Completed less than university	1311	59%	488	5.0	
Pupil country of origin*					
Native born	1840	82%	507	5.0	47
Foreign born	439	18%	460	7.0	
Language spoken at home*					
English most of the time	2221	95%	500	4.8	27
Other language most of the time	118	5%	472	7.9	
Number of digital devices at home*					
High access (7+)	1544	70%	506	4.61	19
Low/Medium access (0-6)	674	30%	487	5.75	

*Difference in means is statistically significant at the 5% level

Table A3.6 Post-primary: Maths achievement by pupil characteristics PISA 2015 Northern Ireland

Characteristic	n	% of pupils	Avg. maths achievement	Standard error	Gap in achievement
Gender					
Girl	1216	50%	489	5.0	-7
Boy	1185	50%	496	5.0	
Number of books at home*					
26 or more books	1511	65%	517	4.9	64
0 to 25 books	800	35%	453	5.3	
Highest parental education*					
Completed university or higher	923	41%	517	5.4	35
Completed less than university	1311	59%	482	5.0	
Pupil country of origin*					
Native born	1840	82%	500	4.7	34
Foreign born	439	18%	466	7.6	
Language spoken at home*					
English most of the time	2221	95%	495	4.6	19
Other language most of the time	118	5%	476	9.3	
Number of digital devices at home					
High access (7+)	1544	70%	501	4.7	20
Low/Medium access (0-6)	674	30%	482	5.5	

*Difference in means is statistically significant at the 5% level

Table A3.7 Post-primary: Science achievement by pupil characteristics PISA 2015 Northern Ireland

Characteristic	n	% of pupils	Avg. science achievement	Standard error	Gap in achievement
Gender					
Girl	1216	50%	499	3.2	-3
Boy	1185	50%	501	3.9	
Number of books at home*					
26 or more books	1511	65%	528	3.3	74.3
0 to 25 books	800	35%	453	4.0	
Highest parental education*					
Completed university or higher	923	41%	525	4.6	35
Completed less than university	1311	59%	490	3.3	
Pupil country of origin*					
Native born	1840	82%	510	3.0	46
Foreign born	439	18%	464	6.4	
Language spoken at home*					
English most of the time	2221	95%	502	2.9	24
Other language most of the time	118	5%	479	7.2	
Number of digital devices at home					
High access (7+)	1544	70%	509	2.8	19
Low/Medium access (0-6)	674	30%	490	4.4	

*Difference in means is statistically significant at the 5% level

Appendix A4 Pupils reaching International benchmarks/proficiency levels across subjects, ILSAs and countries

Summary:

At primary benchmarks across the three countries we see:

- In reading: broadly similar patterns across the three countries
- In maths: a much higher proportion of high achieving students in Northern Ireland than in England or Northern Ireland
- In science: fewer high achieving pupils (and more low achieving pupils) than England and, to a lesser extent, in the Republic of Ireland.

At post-primary proficiency levels across the three countries we see:

- In reading: Northern Ireland has fewer high achieving students than England and the Republic of Ireland,
- In maths: Northern Ireland has fewer high achieving students than England and the Republic of Ireland
- In science: Northern Ireland has fewer high achieving students than England. (Science in the Republic of Ireland is similar to Northern Ireland at post-primary.)

Table A4.1 Primary: proportion of pupils reaching international benchmarks in PIRLS 2016 and TIMSS 2015, by country

	Lower[65]	Low	Intermediate	High	Advanced
PIRLS 2016 Reading					
Northern Ireland	3%	10%	26%	38%	22%
England	3%	11%	28%	37%	20%
Republic of Ireland	2%	8%	28%	40%	21%
International Median	4%	14%	35%	37%	10%
TIMSS 2015 Maths					
Northern Ireland	3%	11%	25%	34%	27%
England	4%	16%	31%	32%	17%
Republic of Ireland	3%	13%	33%	37%	14%
International Median	7%	18%	39%	30%	6%
TIMSS 2015 Science					
Northern Ireland	5%	19%	41%	29%	5%
England	3%	16%	39%	33%	10%
Republic of Ireland	4%	16%	39%	33%	7%
International Median	5%	18%	38%	32%	7%

[65] Percentage of pupils not reaching the low benchmark

Table A4.2 Post primary: proportion of pupils reaching international proficiency levels in PISA 2015[66], by country

	<1	1	2	3	4	5	6
	Low performers					Top performers	
PISA 2015 Reading							
Northern Ireland	0%	15%	26%	32%	21%	6%	0%
England	1%	17%	24%	28%	21%	8%	2%
Republic of Ireland	0%	10%	21%	32%	26%	9%	1%
PISA 2015 Maths							
Northern Ireland	4%	15%	25%	30%	20%	6%	1%
England	8%	14%	22%	26%	19%	9%	3%
Republic of Ireland	4%	11%	24%	30%	21%	8%	2%
PISA 2015 Science							
Northern Ireland	0%	18%	25%	30%	21%	6%	1%
England	0%	17%	22%	27%	22%	10%	2%
Republic of Ireland	0%	15%	26%	31%	20%	6%	1%

[66] Proficiency scores Reading: 335, 407, 480, 553, 626, 698
Proficiency scores Science: 335, 410, 484, 559, 633, 708. Source: http://www.oecd.org/pisa/summary-description-seven-levels-of-proficiency-science-pisa-2015.htm
Proficiency scores Maths: 358 420 482 545 607 669. Source: http://www.erc.ie/wp-content/uploads/2017/05/PISA-NAERM-Proficiency-levels.pdf

Table A4.3 Primary: proportion of pupils reaching international benchmarks in PIRLS 2011 and TIMSS 2011, by country

	Lower[67]	Low	Intermediate	High	Advanced
PIRLS 2011 Reading					
Northern Ireland	3%	10%	29%	39%	19%
England	5%	12%	29%	36%	18%
Republic of Ireland	3%	12%	32%	37%	16%
International Median	5%	15%	36%	36%	8%
TIMSS 2011 Maths					
Northern Ireland	4%	11%	26%	35%	24%
England	7%	15%	29%	31%	18%
Republic of Ireland	6%	17%	36%	32%	9%
International Median	10%	21%	41%	24%	4%
TIMSS 2011 Science					
Northern Ireland	6%	20%	41%	28%	5%
England	7%	17%	34%	31%	11%
Republic of Ireland	8%	20%	37%	28%	7%
International Median	8%	20%	40%	27%	5%

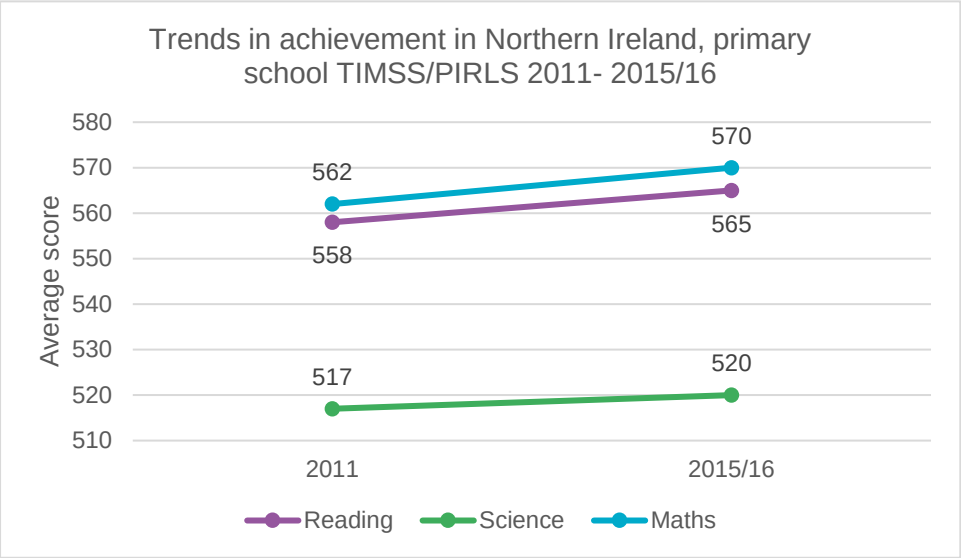
[67] Percentage of pupils not reaching the low benchmark

Table A4.4 Post primary: proportion of pupils reaching international proficiency levels in PISA 2012, by country

	<1	1	2	3	4	5	6
	Low performers					Top performers	
PISA 2012 Reading							
Northern Ireland	5%	12%	24%	30%	21%	7%	1%
England	6%	11%	23%	30%	22%	8%	1%
Republic of Ireland	2%	8%	20%	33%	26%	10%	1%
OECD Avg.	6%	12%	24%	29%	21%	7%	1%
PISA 2012 Maths							
Northern Ireland	9%	16%	24%	24%	18%	8%	2%
England	8%	14%	23%	25%	19%	9%	3%
Republic of Ireland	5%	12%	24%	28%	20%	9%	2%
OECD Avg.	8%	15%	23%	24%	18%	9%	3%
PISA 2012 Science							
Northern Ireland	5%	12%	24%	28%	21%	8%	2%
England	4%	11%	22%	28%	23%	10%	2%
Republic of Ireland	3%	9%	22%	31%	25%	9%	2%
OECD Avg.	5%	14%	27%	30%	18%	5%	1%

Appendix A5 Trends in achievement in Northern Ireland

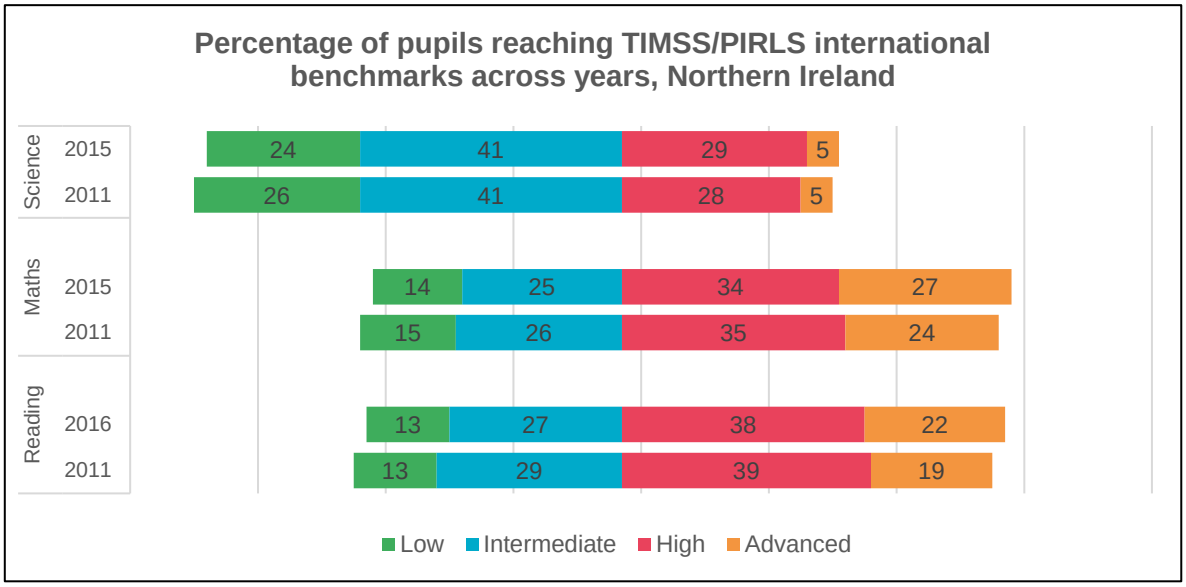
Figure A5.1 Primary: trends in achievement by subject in Northern Ireland



Primary: Although the average achievement scores in all three subjects increased slightly between 2011 and 2015/16, they were not significantly different.

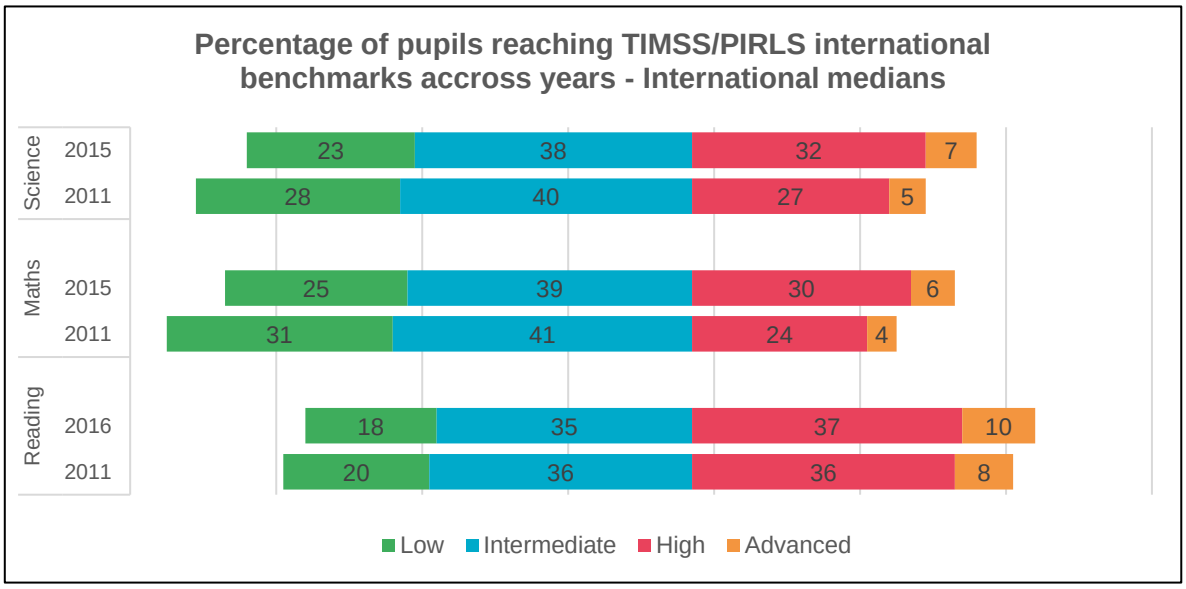
The benchmark data suggests that slightly more primary pupils reached the higher levels for reading and maths, and slightly fewer were seen at the lower levels in maths and science in 2015/16 compared with 2011.

A5.2 Primary: proportion of pupils reaching international benchmarks over time in Northern Ireland



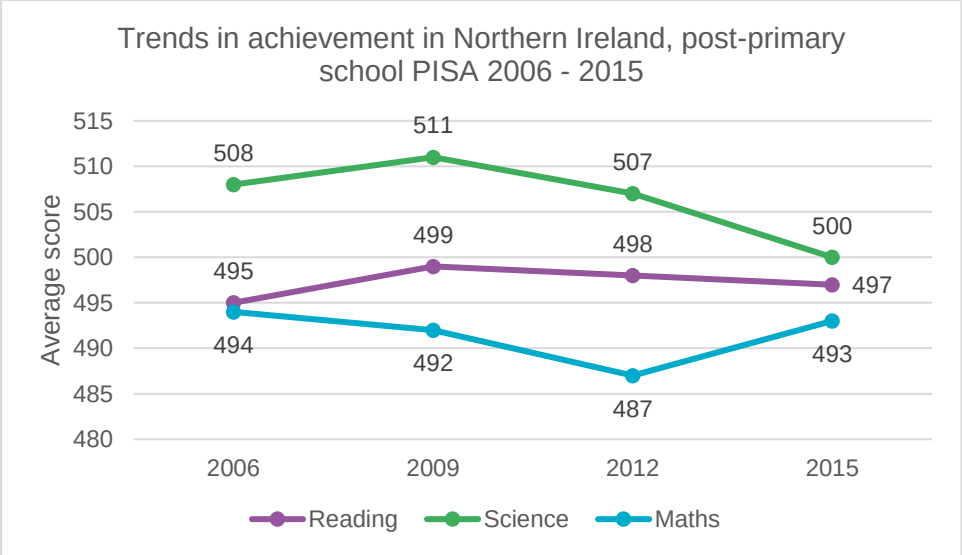
A similar slight shift was seen over time in all subjects internationally (Table 2.9), but Northern Ireland had a much higher proportion of pupils in the high and advanced categories for reading and maths, and a much lower proportion in the low and intermediate categories. For science, Northern Ireland's primary pupils do less well than pupils internationally.

Figure A5.3 Post-primary: proportion of pupils reaching international benchmarks over time (International median)



At post primary, as at primary, the differences in average achievement in Northern Ireland did not change significantly in any subject over time (Jerrim and Shure, 2016).

Figure A5.4 Post-primary: achievement over time by subject in Northern Ireland



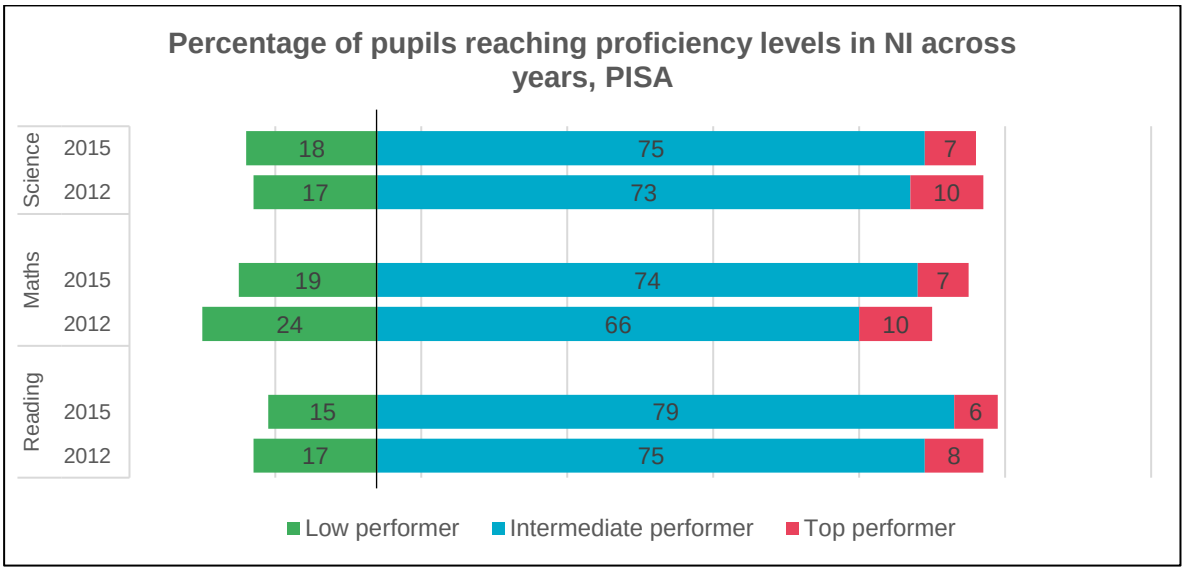
However, fewer post primary pupils reached the higher proficiency levels in 2015 in all three subject areas, but there were also fewer pupils working at the lower proficiency levels in maths and reading than in 2012.

This suggests that post-primary schools in Northern Ireland have had some success in improving the performance of their lower attaining pupils, perhaps at the expense of developing the higher attaining pupils for maths and reading. The pattern was different for science where there were fewer pupils at the highest proficiency levels in 2015 and slightly more at the lower levels than in 2012.

Compared with primary pupils, the proportion of Northern Ireland pupils achieving higher proficiency levels for reading and maths at post primary is much lower, i.e. they appear to have lost the advantage seen in primary school when compared with the international patterns.

Although we cannot make direct comparisons between the percentage points or point scales between the primary and post-primary studies. Comparing benchmark/proficiency level distributions confirms the conclusion that post-primary pupils in Northern Ireland do not excel in an international context in the way that primary pupils do for reading and maths.

Figure A5.5 Post-primary: proportions of pupils reaching proficiency levels over time in Northern Ireland



The proportion of pupils performing at the lower proficiency levels in maths decreased by 5 per cent between 2012 and 2015, and by two per cent in reading; in science the proportion of pupils in the lowest category increased by 1 per cent.

When we compare the performance of Northern Ireland's post-primary pupils in with the international population, the distributions were broadly quite similar for all three subjects. While there are, generally, fewer pupils categorised as 'low performers' in Northern Ireland, there were also fewer 'high performers' in 2015 than were seen internationally, particularly in maths.

Figure A5.6 Post primary: proportion of pupils reaching proficiency levels over time (OECD average)

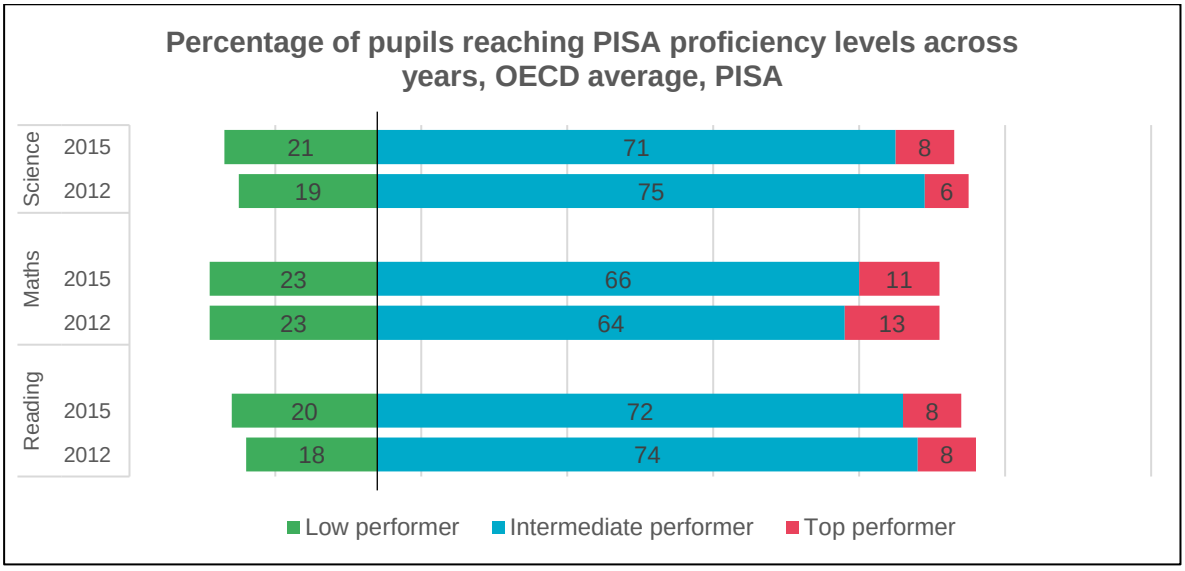
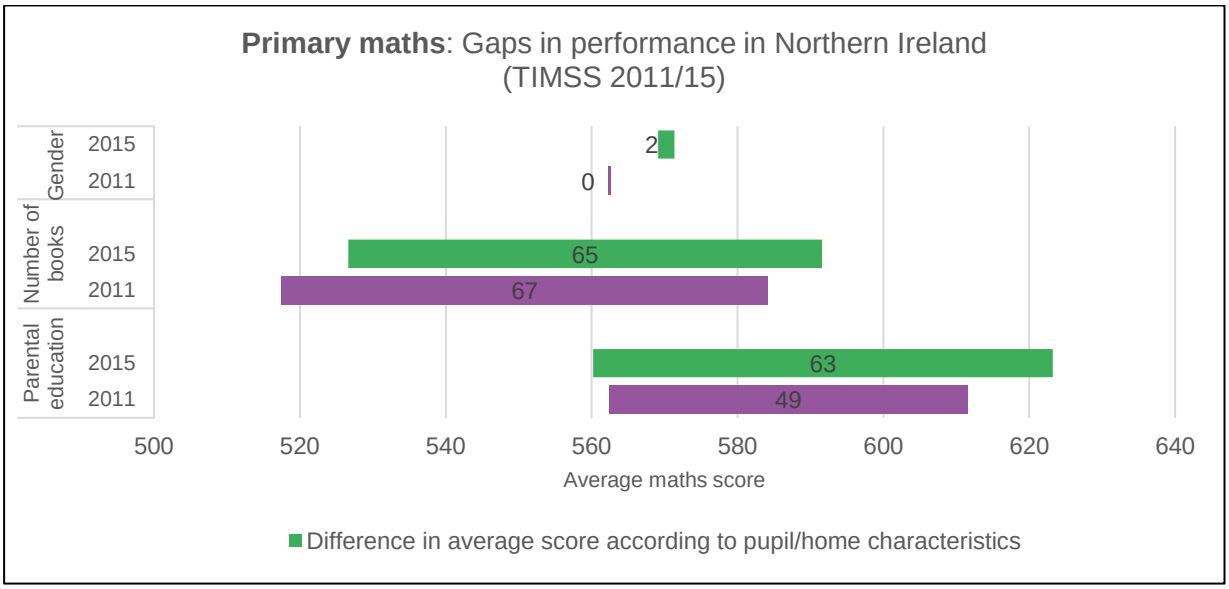
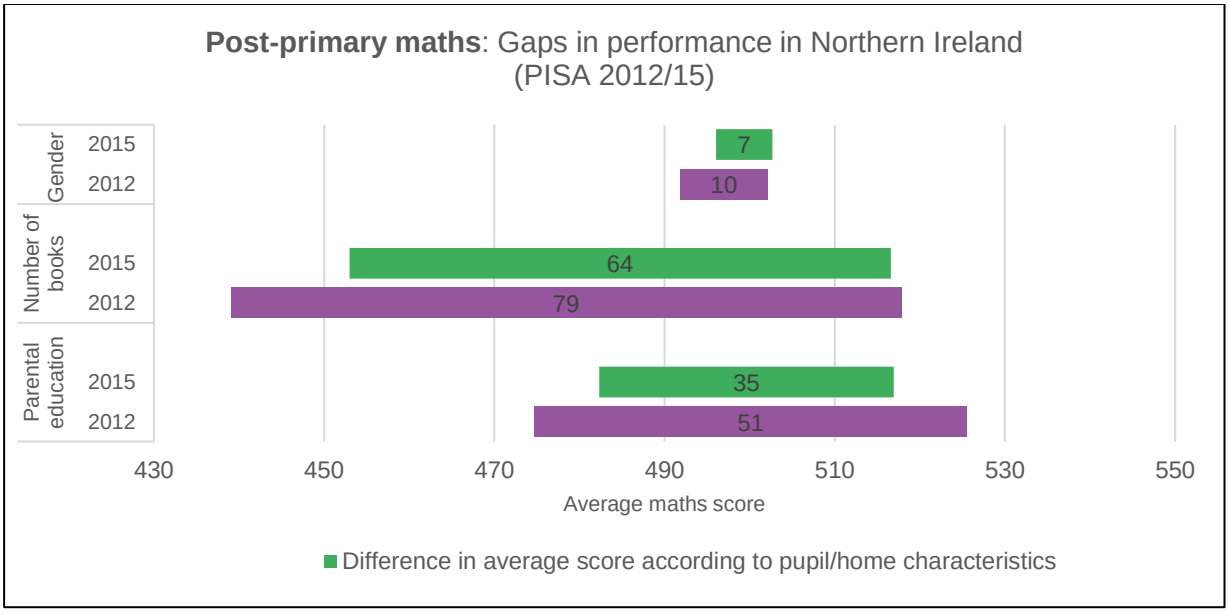


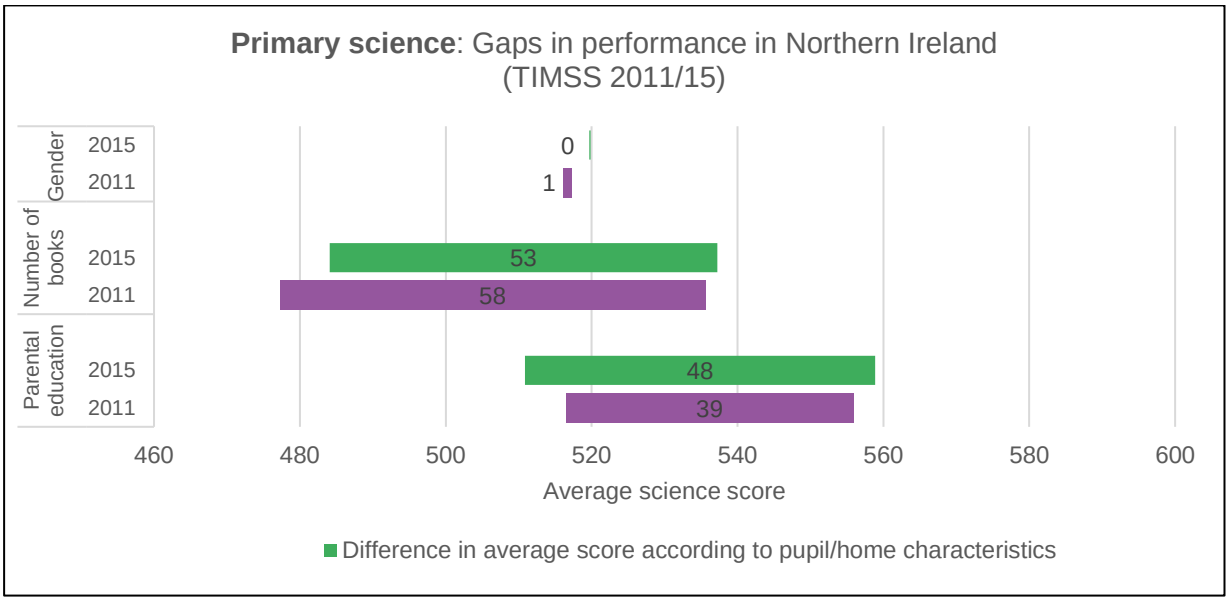
Figure A5.7 Gender and socioeconomic gaps in maths performance over time (primary and post-primary), Northern Ireland

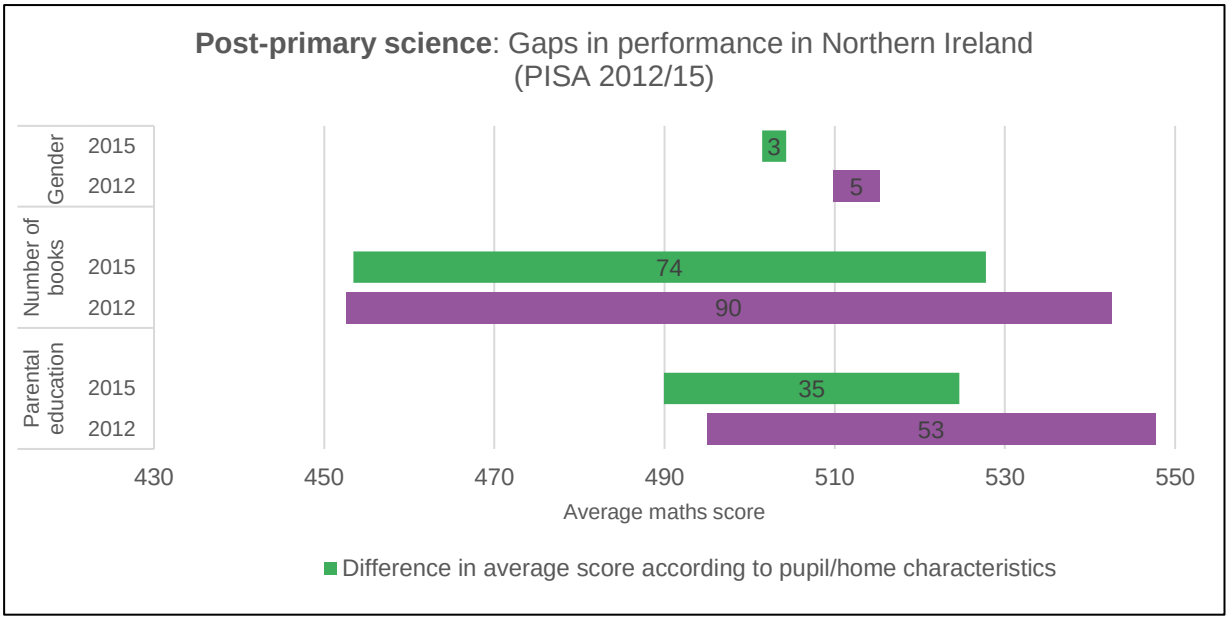




*Gender gaps are not significant, gaps measured by number of books and parental education are.

Figure A5.8 Gender and socioeconomic gaps in science performance over time (primary and post-primary), Northern Ireland





*Gender gaps are not significant, gaps measured by number of books and parental education are.

Appendix B: Pupil attitudes

Appendix B1 Pupil attitudes and achievement in primary school in Northern Ireland

Table B1.1 PIRLS 2016: attitudes towards reading and associated reading achievement in Northern Ireland

Characteristic	n	% of pupils	Avg. Reading achievement	Standard error
Engagement in reading lessons				
Very engaged	2,253	61%	567	2.60
Engaged	1,278	34%	566	3.15
Less than engaged	139	4%	539	10.41
Confidence in reading				
Very confident	1,864	50%	598	2.16
Confident	1,214	33%	553	2.97
Not confident	586	17%	493	4.10
Liking reading				
Very much like	1,414	39%	580	2.94
Like	1573	42%	567	2.67
Do not like	687	19%	531	3.76
Sense of belonging				
High sense of belonging	2,339	63%	575	2.40
Sense of belonging	1,099	30%	554	3.34
Little sense of belonging	231	7%	520	7.65

Table B1.2 TIMSS 2015: attitudes towards science and associated science achievement in Northern Ireland

Characteristic	n	% of pupils	Avg. Science achievement	Standard error
Engagement in science lessons				
Very engaged	2,199	72%	519	2.71
Engaged	715	23%	522	3.34
Less than engaged	170	6%	526	7.35
Confidence in science				
Very confident	1,076	36%	534	3.15
Confident	1,416	45%	521	2.66
Not confident	589	19%	492	4.47
Liking learning science				
Very much like	1,813	59%	526	2.52
Like	967	32%	515	3.60
Do not like	304	10%	500	6.55
Sense of belonging				
High sense of belonging	2,170	71%	523	2.47
Sense of belonging	817	25%	515	4.20
Little sense of belonging	112	3%	494	8.39

Table B1.3 TIMSS 2015: attitudes towards maths and associated maths achievement in Northern Ireland

Characteristic	n	% of pupils	Avg. Maths achievement	Standard error
Engagement in maths lessons				
Very engaged	2,268	74%	572	3.39
Engaged	719	22%	570	4.66
Less than engaged	113	4%	549	13.00
Confidence in maths				
Very confident	959	31%	614	3.76
Confident	1,435	46%	568	3.75
Not confident	697	23%	518	3.73
Liking learning maths				
Very much like	1,086	35%	585	4.01
Like	1,175	38%	573	3.79
Do not like	843	27%	547	4.41
Sense of belonging				
High sense of belonging	2,170	71%	576	3.30
Sense of belonging	817	25%	561	4.96
Little sense of belonging	112	3%	523	10.37

Table B1.4 PIRLS 2011: attitudes towards reading and associated reading achievement in Northern Ireland[68]

Characteristic	n	% of pupils	Avg. Reading achievement	Standard error
Engagement in reading lessons				
Engaged	1,312	37%	561	3.37
Somewhat engaged	1,942	55%	559	2.78
Not engaged	264	8%	551	5.39
Confidence in reading				
Confident	1,270	35%	591	3.13
Somewhat confident	1,913	55%	549	2.74
Not confident	330	10%	501	5.17
Liking reading				
Like learning	1,046	29%	590	3.49
Somewhat like	1793	51%	554	2.60
Do not like	692	20%	527	3.69
I feel like I belong to this school				
Agree a lot	2,277	64%	566	2.48
Agree a little	736	21%	554	3.76
Disagree a little	261	7%	546	5.88
Disagree a lot	221	7%	524	6.75

[68] The wording of the categories changed from 2011 to 2015/16, however the calculation method remained almost similar, expect for engagement. The sense of belonging scale was not created in 2011.

Table B1.5 TIMSS 2011: attitudes towards science and associated science achievement in Northern Ireland

Characteristic	n	% of pupils	Avg. Science achievement	Standard error
Engagement in science lessons				
Engaged	1,578	44%	531	3.35
Somewhat engaged	1,662	49%	509	3.39
Not engaged	260	8%	495	6.53
Confidence in science				
Confident	1,341	37%	537	3.12
Somewhat confident	1,399	40%	520	2.98
Not confident	755	23%	482	4.15
Liking learning science				
Like learning	1,827	51%	533	2.49
Somewhat like	1,234	36%	509	3.87
Do not like	442	13%	483	5.35
I feel like I belong to this school				
Agree a lot	2,269	64%	524	2.48
Agree a little	734	21%	516	3.39
Disagree a little	259	7%	509	5.71
Disagree a lot	227	7%	473	9.69

Table B1.6 TIMSS 2011: attitudes towards maths and associated maths achievement in Northern Ireland

Characteristic	n	% of pupils	Avg. Maths achievement	Standard error
Engagement in maths lessons				
Engaged	1,418	39%	574	3.92
Somewhat engaged	1,831	53%	558	3.35
Not engaged	260	8%	545	8.55
Confidence in maths				
Confident	1,233	35%	598	3.98
Somewhat confident	1,510	44%	557	2.82
Not confident	765	21%	519	4.82
Liking learning maths				
Like learning	1,273	36%	576	3.92
Somewhat like	1,312	38%	564	3.23
Do not like	927	26%	546	5.25
Sense of belonging				
Agree a lot	2,269	64%	569	2.87
Agree a little	734	21%	566	3.80
Disagree a little	259	7%	555	7.17
Disagree a lot	227	7%	512.7	12.0

Appendix B2 Attitudes of higher and lower attaining pupils across countries

Table B2.1 Northern Ireland Primary: attitudes of lower and higher achieving pupils in reading, PIRLS 2016[69]

	Lower achieving pupils (Q1)		Higher achieving pupils (Q4)	
	n	% of pupils	n	% of pupils
Engagement in reading lessons				
Very engaged	531	60%	587	63%
Engaged	301	33%	311	34%
Less than engaged	50	7%	30	3%
Confidence in reading				
Very confident	192	22%	718	77%
Confident	338	37%	185	21%
Not confident	350	41%	26	3%
Liking reading				
Very much like	78	33%	302	58%
Like	108	45%	160	31%
Do not like	520	22%	51	11%
Sense of belonging				
High sense of belonging	463	51%	661	71%
Sense of belonging	316	36%	244	26%
Little sense of belonging	104	13%	24	3%
Pupil feels tired				
Always/Almost always	427	49%	288	33%
Sometimes/never	437	51%	641	67%

[69] Lower achievers refers to the first quartile (bottom 25% in reading scores), Higher achievers refers to the fourth quartile (top 25% in reading scores).

Table B2.2 England Primary: attitudes of lower and higher achieving pupils in reading, PIRLS 2016

	Lower achieving pupils (Q1)		Higher achieving pupils (Q4)	
	n	% of pupils	n	% of pupils
Engagement in reading lessons				
Very engaged	703	55%	749	60%
Engaged	492	39%	463	37%
Less than engaged	79	7%	27	2%
Confidence in reading				
Very confident	300	23%	982	80%
Confident	487	39%	223	18%
Not confident	475	38%	29	2%
Sense of belonging				
High sense of belonging	602	47%	811	66%
Sense of belonging	492	39%	380	30%
Little sense of belonging	178	14%	49	4%
Pupil feels tired				
Always/Almost always	582	46%	364	29%
Sometimes/never	687	54%	875	71%

Table B2.3 Republic of Ireland Primary: attitudes of lower and higher achieving pupils in reading, PIRLS 2016

	Lower achieving pupils (Q1)		Higher achieving pupils (Q4)	
	n	% of pupils	n	% of pupils
Engagement in reading lessons				
Very engaged	649	59%	749	62%
Engaged	386	36%	396	34%
Less than engaged	54	5%	41	4%
Confidence in reading				
Very confident	307	30%	952	79%
Confident	420	38%	203	18%
Not confident	353	32%	26	3%
Sense of belonging				
High sense of belonging	546	49%	835	69%
Sense of belonging	402	38%	301	27%
Little sense of belonging	125	13%	48	5%
Pupil feels tired				
Always/Almost always	448	41%	294	26%
Sometimes/never	635	59%	889	74%

Appendix C: Regression tables

Table C1 Science: regression samples' means, TIMSS 2015

Pupil attitudes			Learning environment		
Variable	**Mean**	**Mean s.e.**	**Variable**	**Mean**	**Mean s.e.**
Science score	520.74	2.22	Science score	519.27	2.52
Age	10.42	0.01	Age	10.42	0.01
SES[70]	0.68	0.01	SES	0.67	0.02
Gender (girl)	0.50	0.01	Gender (girl)	0.49	0.01
Foreign born	0.11	0.01	Foreign born	0.10	0.01
Confidence in science - ASBGSCS	9.66	0.04	School emphasis on academic success - ACBGEAS	11.41	0.19
Engagement in science lessons - ASBGESL	9.99	0.06	Instruction affected by science resource shortage - ACBGSRS	10.25	0.14
Liking learning science - ASBGSLS	10.17	0.05	School discipline - ACBGDAS	10.83	0.13
Sense of belonging - ASBGSSB	10.19	0.06			

[70] Dichotomous variable where 0 is socioeconomic disadvantage (0 o 25 books at home) and 1 is socioeconomic advantage (26 and more books)

Table C2 Science: effect of pupil attitudes in science achievement in primary school in Northern Ireland, TIMSS 2015

Variable	Regression coefficient	Coefficient s.e.	t-value
Constant	329.42	53.35	6.17
Gender (girl)	-3.61	3.63	-0.99
Age	9.37	4.96	1.89
SES (books)	40.19	2.97	13.49
Foreign born	-11.18	5.84	-1.91
Confidence in science - ASBGSCS	7.31	1.47	4.96
Engagement in science lessons - ASBGESL	-6.07	1.06	-5.74
Liking learning science - ASBGSLS	3.02	1.08	2.78
Sense of belonging - ASBGSSB	2.55	1.21	2.11
Sample size (n)	3046		
Intra cluster correlation (ICC)	13.2%		

Table C3 Science: effect of learning environment in science achievement in primary school in Northern Ireland, TIMSS 2015

Variable	Regression coefficient	Coefficient s.e.	t-value
Constant	304.78	49.54	6.16
Gender (girl)	-3.26	4.33	-0.75
Age	13.21	4.46	2.96
SES (books)	43.74	3.64	11.99
Foreign born	-6.87	6.39	-1.07
School emphasis on academic success - ACBGEAS	-2.91	1.40	-2.07
Instruction (not) affected by science resource shortage - ACBGSRS	2.63	1.51	1.74
School discipline - ACBGDAS	4.96	1.35	3.67
Sample size (n)	2649		
Intra cluster correlation (ICC)	12.3%		

Table C4 Science: regression samples' means, PISA 2015

Pupil attitudes			Learning environment		
Variable	**Mean**	**Mean s.e.**	**Variable**	**Mean**	**Mean s.e.**
Science score	515.74	2.83	Science score	509.17	4.50
Age	15.74	0.01	Age	15.73	0.01
SES[71]	0.69	0.01	SES	0.67	0.02
Gender (girl)	0.51	0.01	Gender (girl)	0.50	0.02
Foreign born	0.16	0.01	Foreign born	0.17	0.02
Science Self-efficacy - SCIEEFF	0.15	0.03	Educational leadership - LEAD	0.37	0.11
Enjoyment of science - JOYSCIE	0.22	0.03	Staff shortage - STAFFSHORT	-0.53	0.12
Teacher support in science class - TEACHSUP	0.18	0.03	Education material shortage - EDUSHORT	0.07	0.16
Inquiry-based science teaching - IBTEACH	-0.12	0.02	Student behavior hindering learning - STUBEHA	-0.41	0.10
Sense of belonging - BELONG	-0.01	0.02			

[71] Dichotomous variable where 0 is socioeconomic disadvantage (0 o 25 books at home) and 1 is socioeconomic advantage (26 and more books)

Table C5 Science: effect of pupil attitudes in science achievement in post- primary school in Northern Ireland, PISA 2015

Variable	Regression coefficient	Coefficient s.e.	t-value
Constant	206.55	82.95	2.49
Gender (girl)	-6.91	4.501	-1.53
Age	17.801	5.24	3.39
SES (books)	25.13	4.63	5.42
Foreign born	-23.15	4.61	-5.02
Science Self-efficacy - SCIEEFF	8.08	1.83	4.41
Enjoyment of science - JOYSCIE	17.37	1.94	8.93
Teacher support in science class - TEACHSUP	-0.61	1.99	-0.31
Inquiry-based science teaching - IBTEACH	-9.65	2.75	-3.49
Sense of belonging - BELONG	-4.56	1.92	-2.37
Sample size (n)	1926		
Intra cluster correlation (ICC)	31.4%		

Table C6 Science: effect of learning environment in science achievement in post-primary school in Northern Ireland, PISA 2015[72]

Variable	Regression coefficient	Coefficient s.e.	t-value
Constant	134.99	90.29	1.49
Gender (girl)	-12.89	4.97	-2.59
Age	22.02	5.68	3.87
SES (books)	35.84	4.35	8.22
Foreign born	-20.56	4.93	-4.17
Educational leadership - LEAD	0.31	0.94	0.33
Staff shortage - STAFFSHORT	5.55	1.48	3.75
Education material shortage - EDUSHORT	2.76	1.02	2.71
Student behavior hindering learning - STUBEHA	-20.19	1.27	-15.78
Sample size (n)	1619		
Intra cluster correlation (ICC)	27.6%		

[72] The scales EDUSHORT, STAFFSHORT and STUBEHA has been reversed (changed sign) so that higher values of the scales reflect a more positive learning environment. The correlation coefficients have been reversed accordingly.

Table C7 Maths: regression samples' means, TIMSS 2015

Pupil attitudes			Learning environment		
Variable	**Mean**	**Mean s.e.**	**Variable**	**Mean**	**Mean s.e.**
Maths score	571.17	2.97	Maths score	570.05	3.27
Age	10.16	0.07	Age	10.83	0.13
SES[73]	0.68	0.01	SES	0.67	0.02
Gender (girl)	0.50	0.01	Gender (girl)	0.49	0.01
Foreign born	0.11	0.01	Foreign born	0.10	0.01
Confidence in maths	9.89	0.04	School emphasis on academic success	11.41	0.19
Engagement in maths lessons	10.16	0.07	Instruction affected by maths resource shortage	10.68	0.16
Liking learning maths	9.47	0.05	School discipline	10.83	0.13
Sense of belonging	10.19	0.06			

[73] Dichotomous variable where 0 is socioeconomic disadvantage (0 o 25 books at home) and 1 is socioeconomic advantage (26 and more books)

Table C8 Maths: effect of pupil attitudes in maths achievement in primary school in Northern Ireland, TIMSS 2015

Variable	Regression coefficient	Coefficient s.e.	t-value
Constant	273.71	61.68	4.43
Gender (girl)	1.76	3.39	0.52
Age	12.65	5.64	2.24
SES (books)	43.13	3.76	11.46
Foreign born	-7.98	6.36	-1.25
Confidence in maths	19.22	1.27	15.16
Engagement in maths lessons	-6.39	1.33	-4.82
Like learning maths	-4.26	1.49	-2.85
Sense of belonging	4.81	1.32	3.64
Sample size (n)	3058		
Intra cluster correlation (ICC)	13.7%		

Table C9 Maths: effect of learning environment in maths achievement in primary school in Northern Ireland, TIMSS 2015

Variable	Regression coefficient	Coefficient s.e.	t-value
Constant	303.72	48.12	6.31
Gender (girl)	-3.26	4.34	-0.74
Age	13.21	4.47	2.95
SES (books)	43.76	3.66	11.94
Foreign born	-6.82	6.37	-1.06
School emphasis on academic success	-2.68	1.37	-1.94
Instruction (not) affected by reading resource shortage	2.56	1.41	1.82
School discipline	4.80	1.44	3.31
Sample size (n)	2649		
Intra cluster correlation (ICC)	12.3%		

Table C10 Reading: regression sample means, PIRLS 2016

Pupil attitudes			Learning environment		
Variable	**Mean**	**Mean s.e.**	**Variable**	**Mean**	**Mean s.e.**
Reading score	588.63	3.28	Reading score	588.68	3.51
Age	10.39	0.01	Age	10.39	0.01
SES[74]	0.79	0.01	SES	0.78	0.01
Gender (girl)	0.52	0.02	Gender (girl)	0.52	0.02
Foreign born	0.07	0.01	Foreign born	0.07	0.01
Confidence in reading	10.49	0.07	School emphasis on academic success	11.99	0.20
Engagement in reading lessons	10.05	0.08	Instruction affected by reading resource shortage	10.67	0.20
Liking reading	9.92	0.05	School discipline	11.35	0.13
Sense of belonging	10.35	0.08			

[74] Dichotomous variable where 0 is socioeconomic disadvantage (0 o 25 books at home) and 1 is socioeconomic advantage (26 and more books)

Table C11 Reading: effect of pupil attitudes in reading achievement in primary school in Northern Ireland, PIRLS 2016

Variable	Regression coefficient	Coefficient s.e.	t-value
Constant	83.55	71.38	1.17
Gender (girl)	0.34	4.07	0.08
Age	29.50	6.53	4.51
SES (books)	33.79	4.80	7.03
Foreign born	6.75	6.08	1.11
Confidence in reading	14.97	1.23	13.28
Engagement in reading lessons	-6.16	1.73	-3.56
Like reading	2.76	1.46	1.88
Sense of belonging	4.62	1.58	2.92
Sample size (n)	1443		
Intra cluster correlation (ICC)	12.2%		

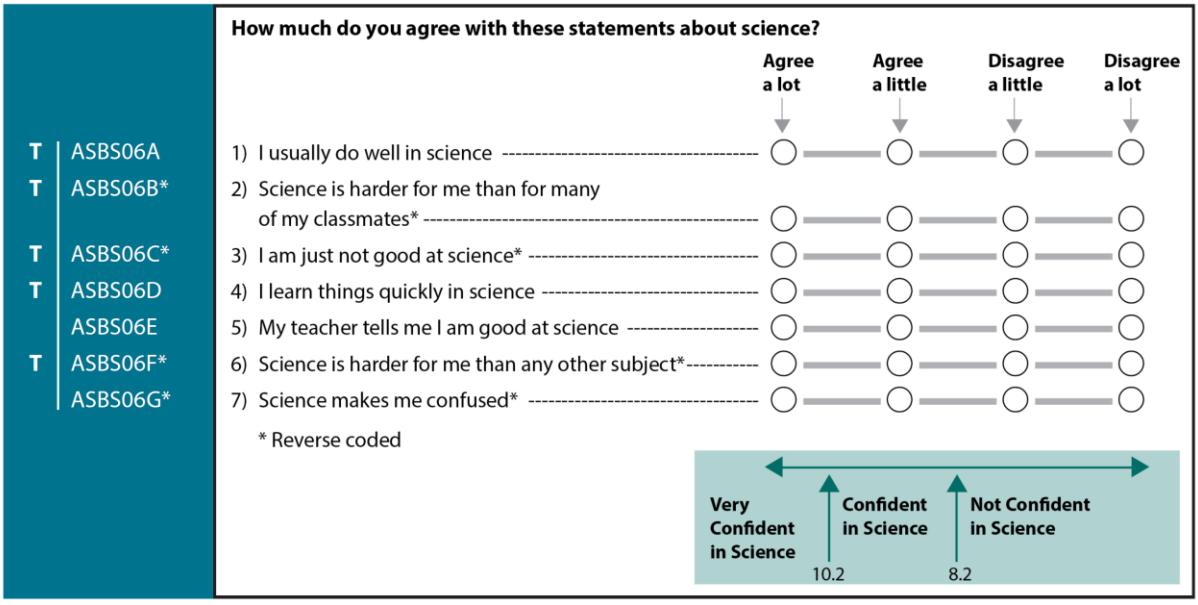
Table C12 Reading: effect of learning environment in reading achievement in primary school in Northern Ireland, PIRLS 2016

Variable	Regression coefficient	Coefficient s.e.	t-value
Constant	102.68	66.48	1.54
Gender (girl)	6.28	5.17	1.21
Age	36.62	7.58	7.58
SES (books)	55.03	5.98	9.19
Foreign born	-6.72	8.63	-0.78
School emphasis on academic success	1.65	1.88	0.87
Instruction (not) affected by reading resource shortage	-1.41	2.10	-0.67
School discipline	4.84	3.02	1.60
Sample size (n)	1131		
Intra cluster correlation (ICC)	11.2%		

Appendix D: Composite scales composition

D1 Scales composition in TIMSS 2015

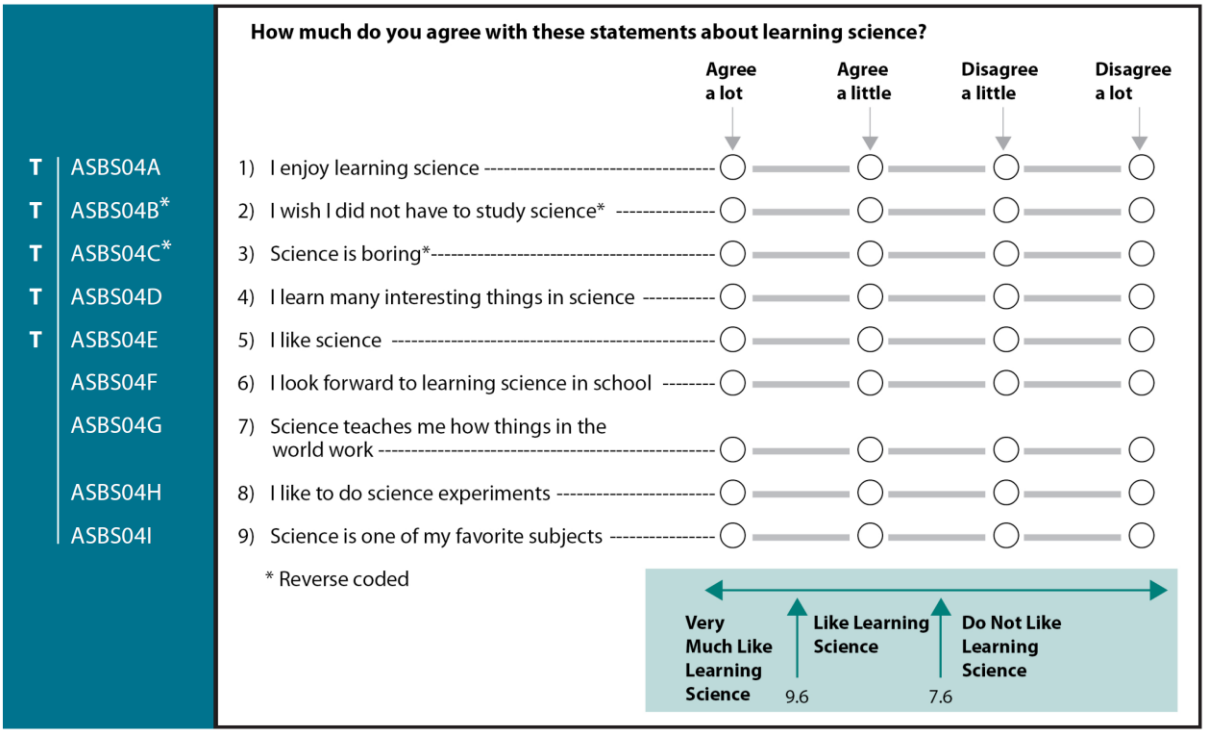
Items in the TIMSS 2015 Students Confident in Science Scale, Fourth Grade



How the TIMSS 2015 Students Confidence in Science Scale has changed since 2011.

- Item 7 “Science makes me confused” was included in 2015.
- 2011 Thresholds: Not confident (<8.3), Somewhat confident (>8.3 and <10.1), Confident (>10.1)

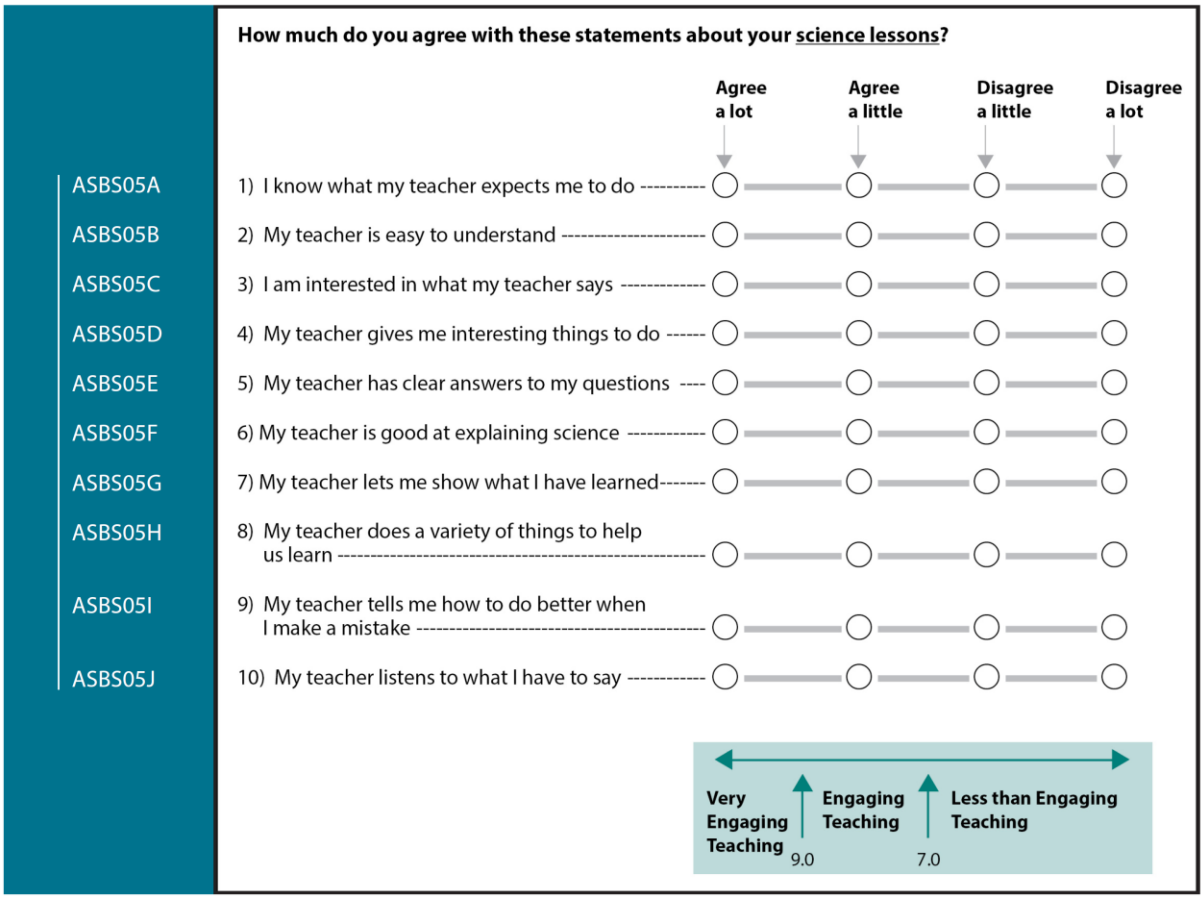
Items in the TIMSS 2015 Students Like Learning Science Scale, Fourth Grade



How the TIMSS 2015 Students Like Learning Science Scale has changed since 2011.

- Items 6, 7, 8 and 9 were included in 2015.
- 2011 Thresholds: Do not like learning science (<7.6), Somewhat like learning science (>7.6 and <9.7), Like learning science (>9.7)

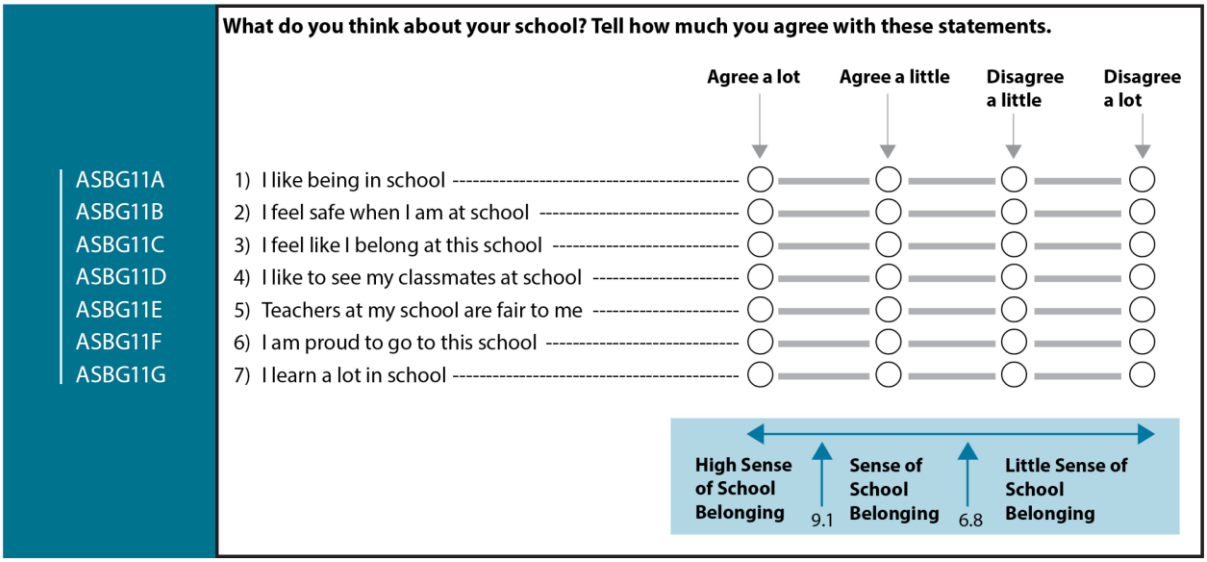
Items in the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Fourth Grade



How the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale has changed since 2011.

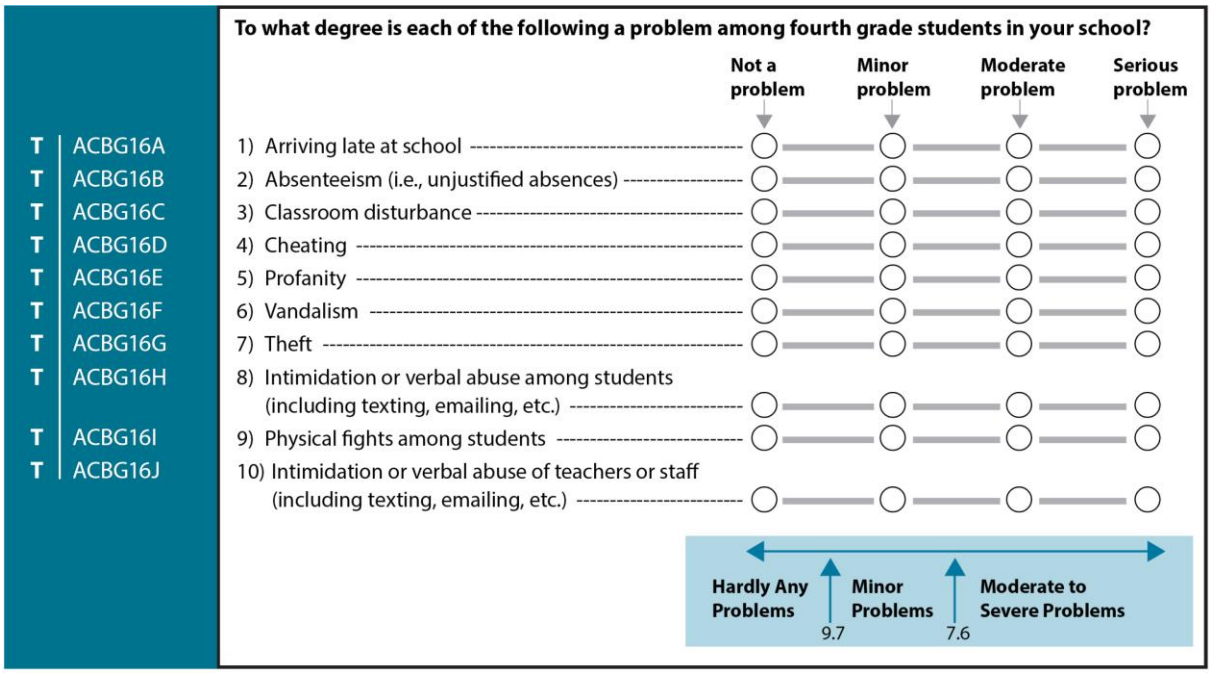
- Items 5, 6, 7, 8, 9 and 10 were included in 2015.
- Item "I think of things not related to the lesson" was removed in 2015.
- 2011 Thresholds: Not engaged (<7.4), Somewhat engaged (>7.4 and <10.1), Engaged (>10.1)

Items in the TIMSS 2015 Students' Sense of School Belonging Scale, Fourth Grade



How the TIMSS 2015 Students' Sense of School Belonging Scale has changed since 2011.
This scale was not created in TIMSS 2011

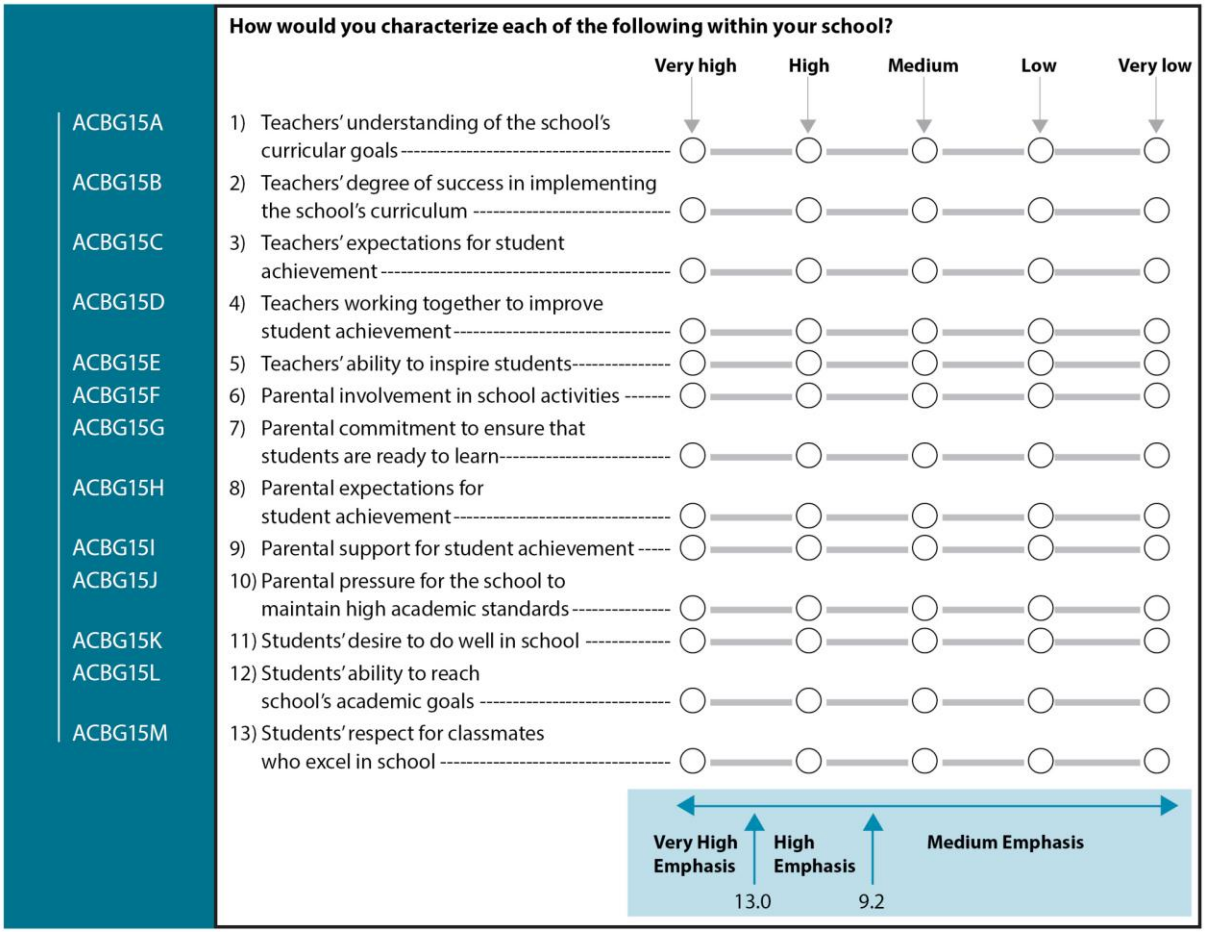
Items in the TIMSS 2015 School Discipline Problems – Principals' Reports Scale, Fourth Grade



How the TIMSS 2015 School Discipline Problems – Principals' Reports Scale has changed since 2011.

- 2011 Thresholds: Moderate problems (<7.6), Minor problems (>7.6 and <9.7), Hardly any problems (>9.7)

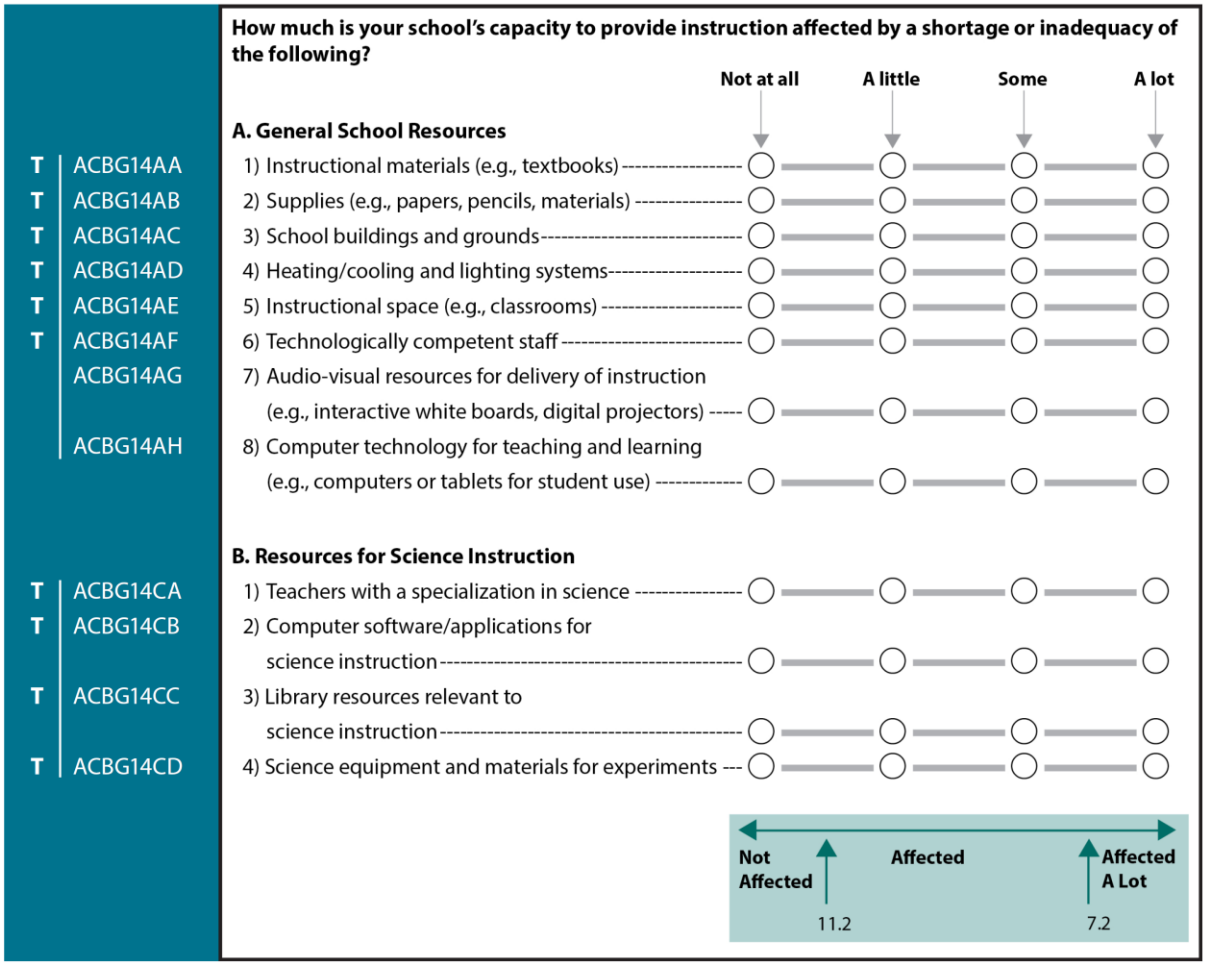
Items in the TIMSS 2015 School Emphasis on Academic Success – Principals' Reports Scale, Fourth Grade



How the TIMSS 2015 School Emphasis on Academic Success – Principals' Reports Scale has changed since 2011.

- Items 4, 5, 6, 7, 8, 10, 12 and 13 were included in 2015.
- 2011 Thresholds: Medium emphasis (<8.9), High emphasis (>8.9 and <13.1), Very high emphasis (>13.1)

Items in the TIMSS 2015 Instruction Affected by Science Resource Shortages – Principals' Reports Scale, Fourth Grade

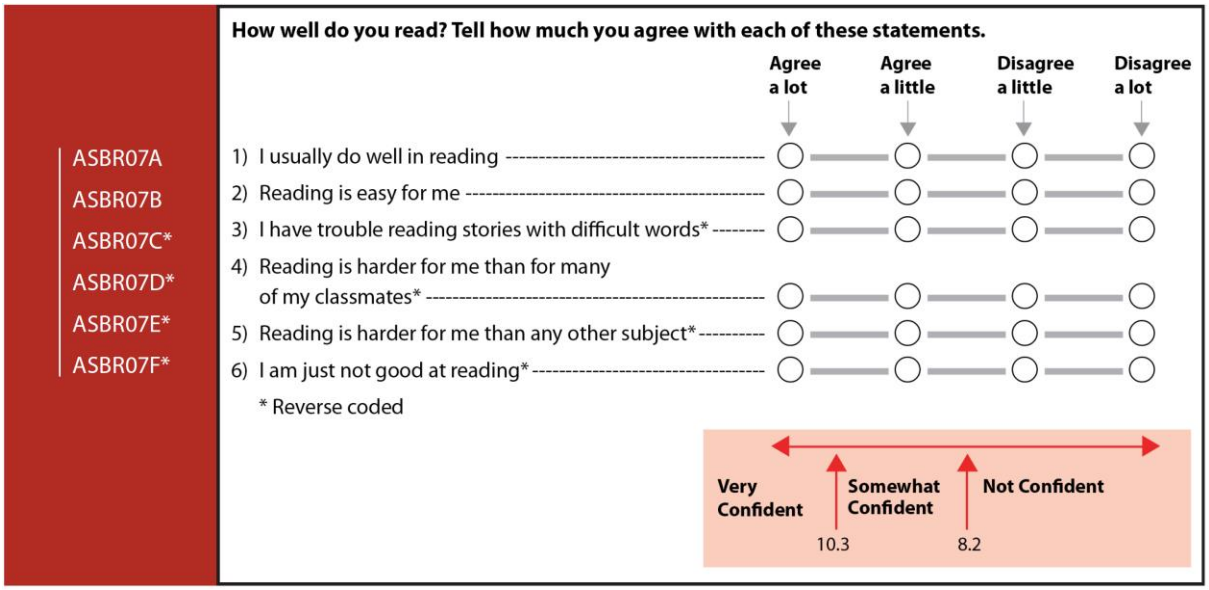


How the TIMSS 2015 Instruction Affected by Science Resource Shortages – Principals' Reports Scale has changed since 2011.

- Item 7 "Audio-visual resources" was moved from B. Resources for Science Instruction" to A. General School Resources
- 2011 Thresholds: Affected a lot (<7.1), Somewhat affected (>7.1 and <11.3), Not affected (>11.3)

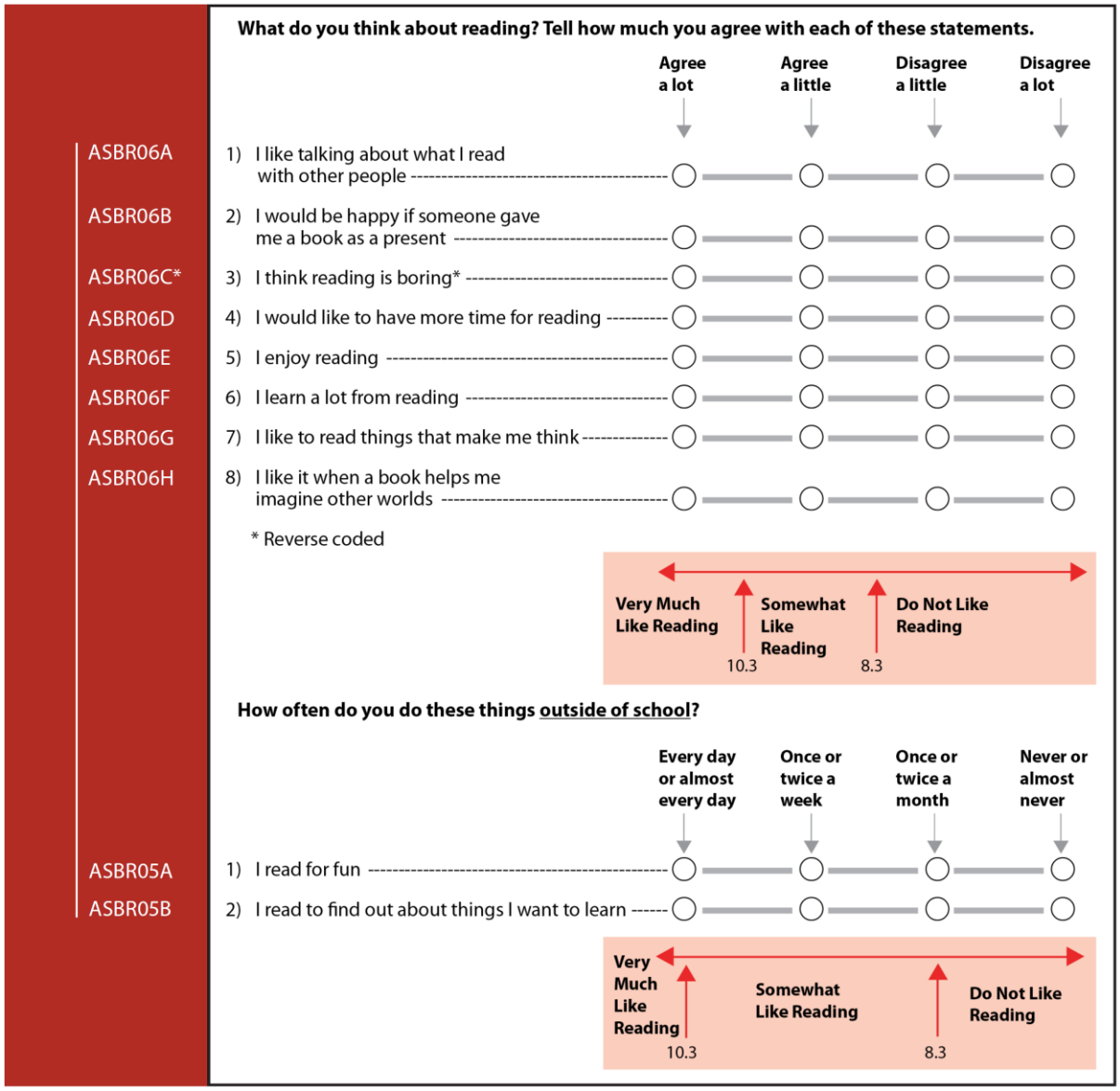
D.2 Scales composition in PIRLS 2016

Items in the PIRLS 2016 Students Confident in Reading Scale



How the PIRLS 2016 Students Confident in Reading Scale has changed since 2011.
• Item 6 “I am just not good at reading” was included in 2015 • Items “My teacher tells me I am a good reader” and “If a book is interesting, I don’t care how hard it is to read” were removed in 2015 • 2011 Thresholds: Not confident (<7.9), Somewhat confident (>7.9 and <10.6), Confident (>10.3)

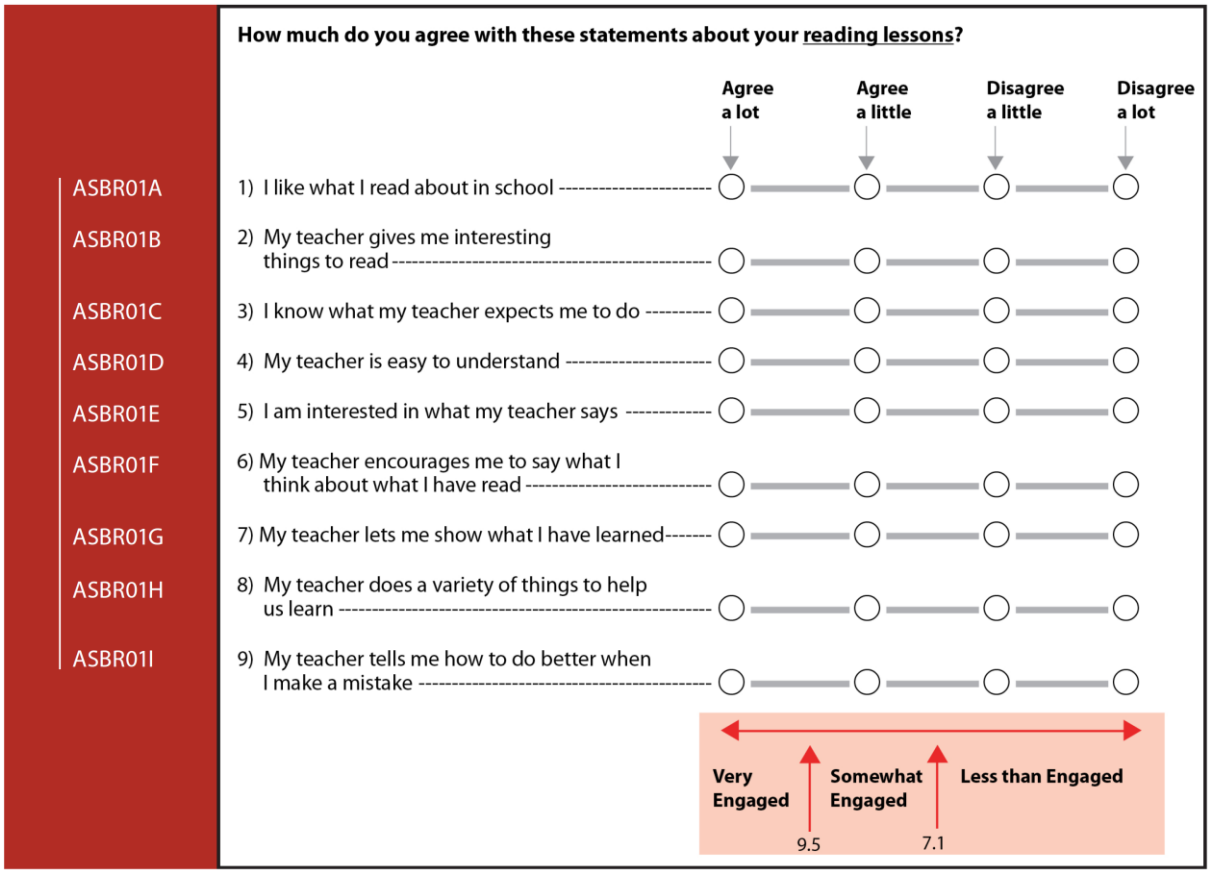
Items included in the PIRLS 2016 Students Like Reading Scale



How the PIRLS 2016 Students Like Reading Scale has changed since 2011.

- Items 6, 7 and 8 were included in 2015
- Item "I read only if I have to" was removed in 2015
- Second part: Item 2 changed from "I read things that I choose myself" in 2011
- 2011 Thresholds: Do not like reading (<8.2), Somewhat like reading (>8.2 and <11), Like reading (>11)

Items included in the PIRLS 2016 Students Engaged in Reading Lessons Scale

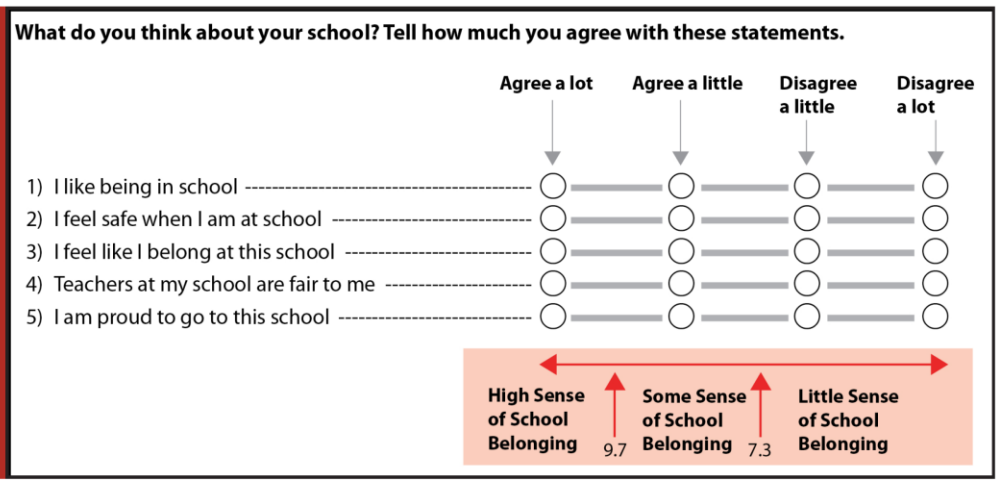


How the PIRLS 2016 Students Engaged in Reading Lessons Scale has changed since 2011.

- Items 6, 7, 8 and 9 were included in 2015
- Items “I think of things not related to the lesson” and “My teacher gives me interesting things to do” were removed in 2015
- 2011 Thresholds: Not engaged (<7.4), Somewhat engaged (>7.4 and <10.5), Engaged (>10.5)

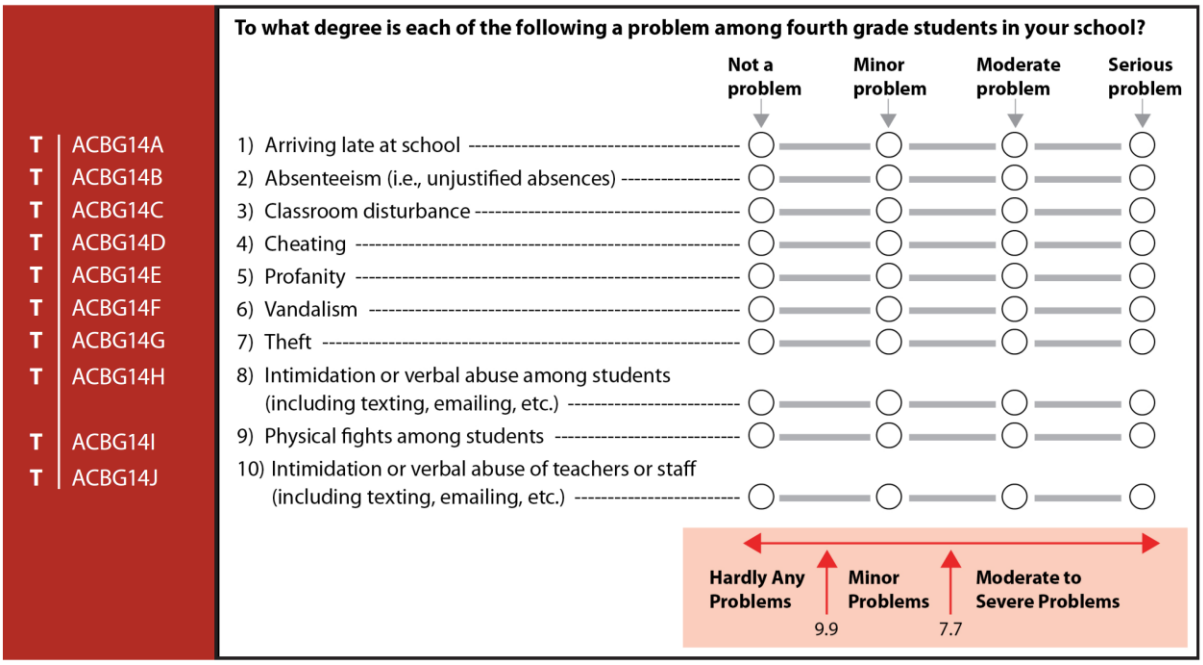
Items included in the PIRLS 2016 Students' Sense of Belonging Scale

ASBG12A
ASBG12B
ASBG12C
ASBG12D
ASBG12E



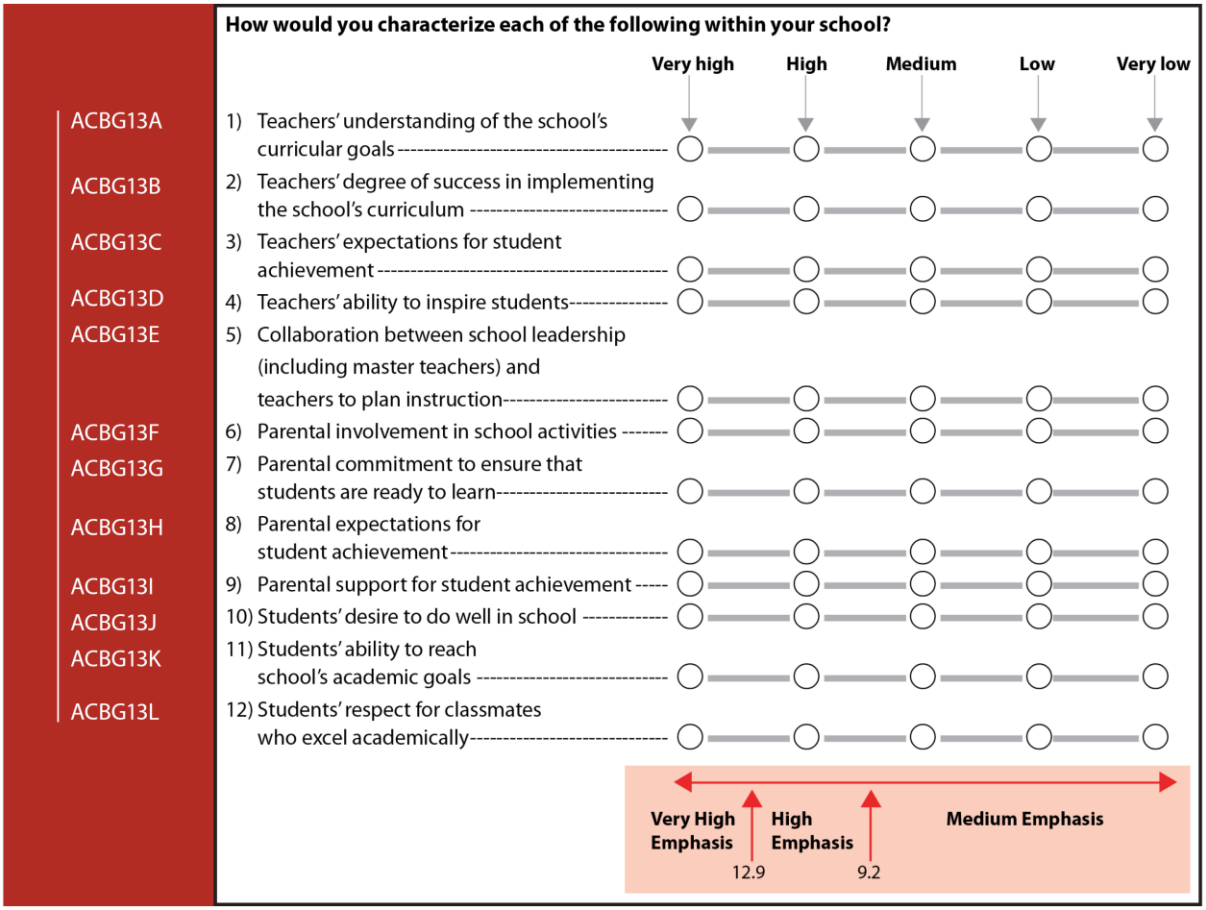
How the PIRLS 2016 Students' Sense of School Belonging Scale has changed since 2011.
This scale was not created in PIRLS 2011

Items included in the PIRLS 2016 School Discipline Scale



How the PIRLS 2016 School Discipline Scale has changed since 2011.
• 2011 Thresholds: Moderate problems (<7.7), Minor problems (>7.7 and <9.9), Hardly any problems (>9.9)

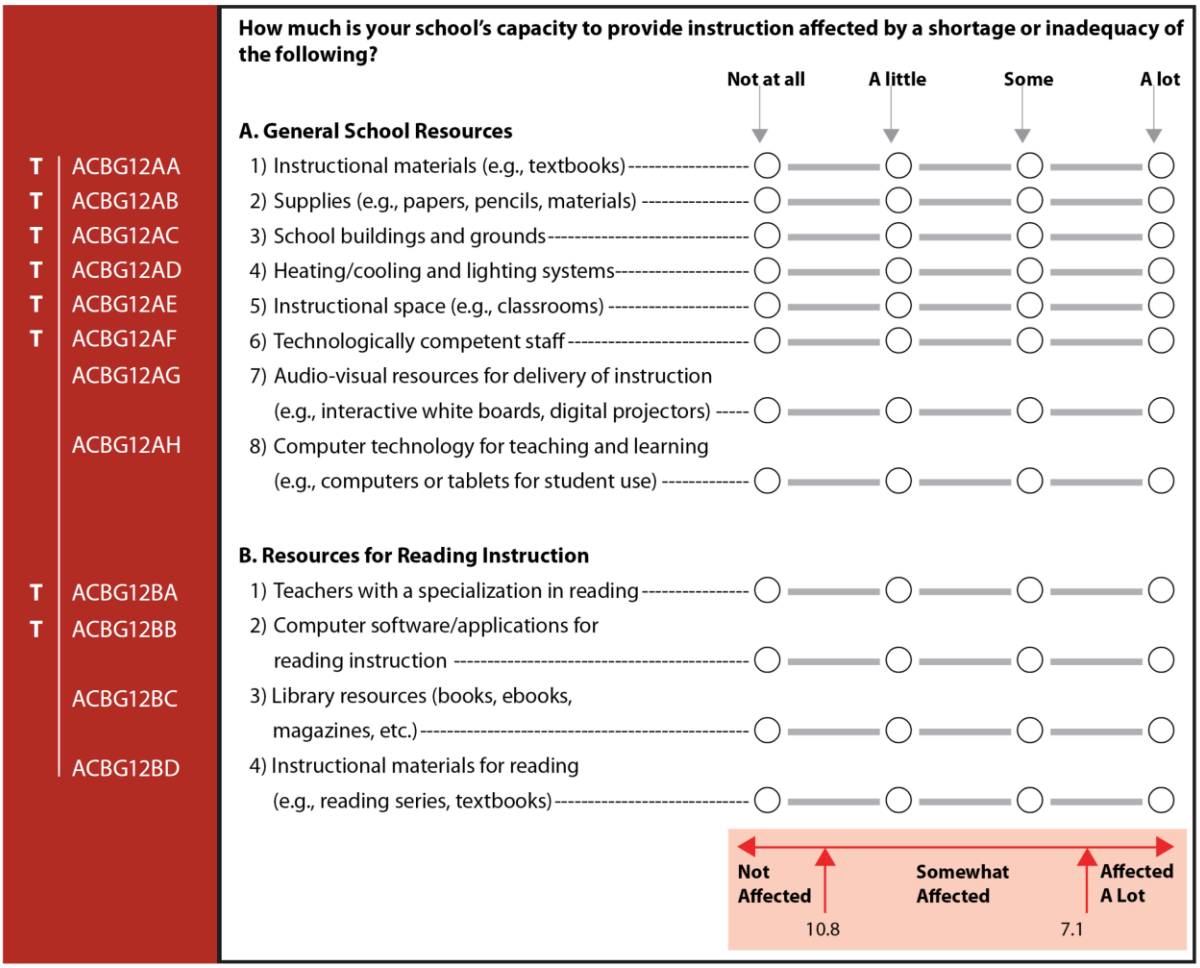
Items included in the PIRLS 2016 School Emphasis on Academic Success Scale



How the PIRLS 2016 School Emphasis on Academic Success Scale since 2011.

- Items 4, 5, 6, 7, 8, 11 and 12 were included in 2015
- 2011 Thresholds: Medium emphasis (<8.8), High emphasis (>8.8 and <13), Very high emphasis (>13)

Items included in the PIRLS 2016 Instruction Affected by Reading Resource Shortages Scale



		How much is your school's capacity to provide instruction affected by a shortage or inadequacy of the following?	Not at all	A little	Some	A lot
		A. General School Resources				
T	ACBG12AA	1) Instructional materials (e.g., textbooks)	○	○	○	○
T	ACBG12AB	2) Supplies (e.g., papers, pencils, materials)	○	○	○	○
T	ACBG12AC	3) School buildings and grounds	○	○	○	○
T	ACBG12AD	4) Heating/cooling and lighting systems	○	○	○	○
T	ACBG12AE	5) Instructional space (e.g., classrooms)	○	○	○	○
T	ACBG12AF	6) Technologically competent staff	○	○	○	○
	ACBG12AG	7) Audio-visual resources for delivery of instruction (e.g., interactive white boards, digital projectors)	○	○	○	○
	ACBG12AH	8) Computer technology for teaching and learning (e.g., computers or tablets for student use)	○	○	○	○
		B. Resources for Reading Instruction				
T	ACBG12BA	1) Teachers with a specialization in reading	○	○	○	○
T	ACBG12BB	2) Computer software/applications for reading instruction	○	○	○	○
	ACBG12BC	3) Library resources (books, ebooks, magazines, etc.)	○	○	○	○
	ACBG12BD	4) Instructional materials for reading (e.g., reading series, textbooks)	○	○	○	○

How the PIRLS 2016 Instruction Affected by Reading Resource Shortages Scale since 2011.

- Item 3 changed from "Library books" in 2011to "Library resources"
- Item 4 "Instructional materials for reading" was included in 2015
- Item 7 "Audio-visual resources" was moved from B. Resources for Reading Instruction to A. General School Resources
- 2011 Thresholds: Affected a lot (<6.7), Somewhat affected (>6.7 and <11.2), Not affected (>11.2)

D.3 Scales composition in PISA 2015

Item parameters in PISA 2015 for Sense of belonging to school (BELONG)

Item	Thinking about your school: to what extent do you agree with the following statements?	Parameter estimates				
		beta	d_1	d_2	d_3	alpha
ST034Q01TA	I feel like an outsider (or left out of things) at school.	-0.00458	0.56688	0.37422	-0.94110	1.21518
ST034Q02TA	I make friends easily at school.	0.00475	1.02240	0.57396	-1.59636	0.77746
ST034Q03TA	I feel like I belong at school.	0.15553	1.14692	0.59957	-1.74650	0.61414
ST034Q04TA	I feel awkward and out of place in my school.	-0.00104	0.74923	0.34099	-1.09022	1.12698
ST034Q05TA	Other students seem to like me.	0.04790	1.35674	0.85709	-2.21383	0.66787
ST034Q06TA	I feel lonely at school.	-0.07787	0.53076	0.30405	-0.83481	1.59837

Item parameters in PISA 2015 for Science self-efficacy (SCIEEFF)

Item	How easy do you think it would be for you to perform the following tasks on your own?	Parameter estimates				
		beta	d_1	d_2	d_3	alpha
ST129Q01TA	Recognise the science question that underlies a newspaper report on a health issue.	-0.16940	0.98685	0.30908	-1.29594	0.93845
ST129Q02TA	Explain why earthquakes occur more frequently in some areas than in others.	-0.27092	0.83348	0.16974	-1.00323	0.92431
ST129Q03TA	Describe the role of antibiotics in the treatment of disease.	0.06516	0.88992	0.10362	-0.99354	1.00384
ST129Q04TA	Identify the science question associated with the disposal of garbage.	0.00601	0.93480	0.13846	-1.07326	1.04883
ST129Q05TA	Predict how changes to an environment will affect the survival of certain species.	-0.03415	0.82526	0.13232	-0.95758	1.13443
ST129Q06TA	Interpret the scientific information provided on the labelling of food items.	-0.04337	0.91786	0.12501	-1.04287	0.98109
ST129Q07TA	Discuss how new evidence can lead you to change your understanding about the possibility of life on Mars.	0.28023	0.80702	0.13201	-0.93903	0.97553
ST129Q08TA	Identify the better of two explanations for the formation of acid rain.	0.14654	0.78166	0.13256	-0.91422	0.99352

Item parameters in PISA 2015 for Inquiry-based science teaching and learning practices (IBTEACH)

Item	When learning <school science> topics at school, how often do the following activities occur?	Parameter estimates				
		beta	d_1	d_2	d_3	alpha
ST098Q01TA	Students are given opportunities to explain their ideas.	-0.83337	0.97787	-0.23677	-0.74110	0.67430
ST098Q02TA	Students spend time in the laboratory doing practical experiments.	0.46050	1.06306	-0.49034	-0.57272	0.80028
ST098Q03NA	Students are required to argue about science questions.	0.08387	0.81230	-0.19579	-0.61652	1.17948
ST098Q05TA	Students are asked to draw conclusions from an experiment they have conducted.	-0.10179	0.89409	-0.17404	-0.72005	1.10195
ST098Q06TA	The teacher explains how a <school science> idea can be applied to a number of different phenomena (e.g. the movement of objects, substances with similar properties).	-0.50277	1.01857	-0.16747	-0.85110	0.86825
ST098Q07TA	Students are allowed to design their own experiments.	0.46842	0.46246	-0.15807	-0.30440	1.05809
ST098Q08NA	There is a class debate about investigations.	0.23539	0.67936	-0.16805	-0.51131	1.19736
ST098Q09TA	The teacher clearly explains the relevance of <broad science> concepts to our lives.	-0.36377	0.89348	-0.20540	-0.68808	0.87390

Item parameters in PISA 2015 for Teacher support in a science class (TEACHSUP)

Item	How often do these things happen in your <school science> lessons?	Parameter estimates				
		beta	d_1	d_2	d_3	alpha
ST100Q01TA	The teacher shows an interest in every student's learning.	-0.00750	1.26155	-0.08523	-1.17632	0.77330
ST100Q02TA	The teacher gives extra help when students need it.	-0.03532	1.25157	-0.04839	-1.20318	1.09980
ST100Q03TA	The teacher helps students with their learning.	-0.01039	1.10086	-0.02113	-1.07973	1.32146
ST100Q04TA	The teacher continues teaching until the students understand.	0.04437	1.13059	-0.07816	-1.05242	1.01506
ST100Q05TA	The teacher gives students an opportunity to express opinions.	0.01687	1.22992	-0.10423	-1.12570	0.79038

Item parameters in PISA 2015 for Enjoyment of science (JOYSCIE)

Item	How often do these things happen in your <school science> lessons?	Parameter estimates				
		beta	d_1	d_2	d_3	alpha
ST100Q01TA	The teacher shows an interest in every student's learning.	-0.00750	1.26155	-0.08523	-1.17632	0.77330
ST100Q02TA	The teacher gives extra help when students need it.	-0.03532	1.25157	-0.04839	-1.20318	1.09980
ST100Q03TA	The teacher helps students with their learning.	-0.01039	1.10086	-0.02113	-1.07973	1.32146
ST100Q04TA	The teacher continues teaching until the students understand.	0.04437	1.13059	-0.07816	-1.05242	1.01506
ST100Q05TA	The teacher gives students an opportunity to express opinions.	0.01687	1.22992	-0.10423	-1.12570	0.79038

Item parameters in PISA 2015 for Student-related factors affecting school climate (STUBEHA)

Item	In your school, to what extent is the learning of students hindered by the following phenomena?	Parameter estimates				
		beta	d_1	d_2	d_3	alpha
SC061Q01TA	Student truancy	-0.46872	1.48863	-0.12469	-1.36395	1.25759
SC061Q02TA	Students skipping classes	-0.28674	1.50293	-0.09281	-1.41012	1.46127
SC061Q03TA	Students lacking respect for teachers	0.08023	1.88225	-0.35878	-1.52347	0.81146
SC061Q04TA	Student use of alcohol or illegal drugs	0.73855	1.14267	-0.51484	-0.62783	0.78086
SC061Q05TA	Students intimidating or bullying other students	0.53229	2.05337	-0.64487	-1.40851	0.68882

Item parameters in PISA 2015 for Educational leadership (LEAD)

Item	Below are statements about your management of this school. Please indicate the frequency of the following activities and behaviours in your school during <the last academic year>.	Parameter estimates						
		beta	d_1	d_2	d_3	d_4	d_5	alpha
SC009Q01TA	I use student performance results to develop the school's educational goals.	0.46464	2.35073	0.32178	-0.69840	-1.35309	-0.62102	0.75818
SC009Q02TA	I make sure that the professional development activities of teachers are in accordance with the teaching goals of the school.	0.29463	2.09230	0.18305	-0.38615	-1.08206	-0.80714	0.83482
SC009Q03TA	I ensure that teachers work according to the school's educational goals.	-0.11346	1.86425	0.25513	-0.34342	-0.95865	-0.81732	1.00750
SC009Q04TA	I promote teaching practices based on recent educational research.	0.32348	1.44205	0.16228	-0.19596	-0.93725	-0.47112	0.87299
SC009Q05TA	I praise teachers whose students are actively participating in learning.	-0.01904	1.38715	0.29741	-0.14263	-0.85219	-0.68974	0.98060
SC009Q06TA	When a teacher has problems in his/her classroom, I take the initiative to discuss matters.	-0.13401	1.13879	0.37206	-0.07387	-0.67910	-0.75787	1.00091
SC009Q07TA	I draw teachers' attention to the importance of pupils' development of critical and social capacities.	0.05311	1.17565	0.36168	-0.10448	-0.67021	-0.76264	1.47738
SC009Q08TA	I pay attention to disruptive behaviour in classrooms.	-0.38714	0.76147	0.40453	-0.06023	-0.48927	-0.61649	0.92058
SC009Q09TA	I provide staff with opportunities to participate in school decision-making.	-0.18983	1.44581	0.53346	-0.12085	-0.93344	-0.92498	0.91883
SC009Q10TA	I engage teachers to help build a school culture of continuous improvement.	-0.17508	1.24219	0.43019	-0.12964	-0.73994	-0.80281	1.37113
SC009Q11TA	I ask teachers to participate in reviewing management practices.	0.39472	1.47123	0.09030	-0.04154	-0.84679	-0.67320	0.79238
SC009Q12TA	When a teacher brings up a classroom problem, we solve the problem together.	-0.32621	1.18322	0.38598	-0.11159	-0.66445	-0.79317	1.07053
SC009Q13TA	I discuss the school's academic goals with teachers at faculty meetings.	0.11599	1.75821	0.62338	-0.11506	-1.15915	-1.10738	0.99417

Item parameters in PISA 2015 for Shortage (STAFFSHORT)

Item	Is your school's capacity to provide instruction hindered by any of the following issues?	Parameter estimates				
		beta	d_1	d_2	d_3	alpha
SC017Q01NA	A lack of teaching staff.	0.06314	0.75909	0.34257	-1.10165	0.73336
SC017Q02NA	Inadequate or poorly qualified teaching staff.	0.13603	1.05954	0.03870	-1.09824	0.92824
SC017Q03NA	A lack of assisting staff.	-0.26505	0.60896	0.21200	-0.82096	0.95589
SC017Q04NA	Inadequate or poorly qualified assisting staff.	0.05843	0.72331	0.05539	-0.77870	1.38251

Item parameters in PISA 2015 for Shortage (EDUSHORT)

Item	Is your school's capacity to provide instruction hindered by any of the following issues?	Parameter estimates				
		beta	d_1	d_2	d_3	alpha
SC017Q05NA	A lack of educational material (e.g. textbooks, IT equipment, library or laboratory material).	0.21882	1.59613	0.43175	-2.02788	0.39524
SC017Q06NA	Inadequate or poor quality educational material (e.g. textbooks, IT equipment, library or laboratory material).	0.43446	1.84628	0.30677	-2.15305	0.40730
SC017Q07NA	A lack of physical infrastructure (e.g. building, grounds, heating/cooling, lighting and acoustic systems).	-0.11732	1.23750	0.14076	-1.37826	1.53249
SC017Q08NA	Inadequate or poor quality physical infrastructure (e.g. building, grounds, heating/cooling, lighting and acoustic systems).	-0.05024	1.32658	0.10092	-1.42751	1.66497

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