Students' perspectives on learning mathematics and science: Results from TIMSS 2015 in Ireland

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Educational Research Centre
2020

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Foras Taighde ar Oideachas
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The membership of the Committee advising on the implementation of TIMSS at primary level as of June 2020 is as follows (in alphabetical order):

- Aedín Ní Thuathail (Irish Primary Principals' Network).
- Aidan Clerkin (Educational Research Centre).
- Áine Lynch (National Parents Council – Primary).
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Chapter 1: Overview of TIMSS 2015

TIMSS (**T**rends in **I**nternational **M**athematics and **S**cience **S**tudy) is among the largest and most in-depth studies of educational achievement in the world. Fifty-six countries, including Ireland, took part in TIMSS in 2015. This chapter provides a brief introduction to the study and its implementation in Ireland.

What is TIMSS?

TIMSS is designed to assess the mathematics and science skills of students in Fourth grade (equivalent to Fourth Class in Ireland) and Eighth grade (Second Year) in participating countries, thereby providing national and cross-national comparative information for policy-makers and educators. The study is organised under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), a non-profit consortium of research institutes. The Educational Research Centre (ERC) managed Ireland's participation in TIMSS 2015 on behalf of the Department of Education and Skills (DES). TIMSS takes place every four years. The first implementation of TIMSS was in 1995. Ireland has participated on four occasions – in 2011 (at primary level only) and in 1995, 2015, and 2019 (at both primary and post-primary levels). This report presents findings from the 2015 cycle of TIMSS. The findings of the 2019 study will be available from December 2020.

An initial report for TIMSS 2015 in Ireland was published in November 2016 (Clerkin, Perkins & Cunningham, 2016), timed to coincide with the international launch of the results (Martin, Mullis, Foy, & Hooper, 2016; Mullis, Martin, Foy, & Hooper, 2016). The initial report focused on describing the achievement of Irish students in Fourth Class and Second Year on the TIMSS mathematics and science assessments and also included a comparison of the Irish curriculum, together with teachers' coverage of various topics in class, relative to the TIMSS assessment frameworks.

Which countries participated in TIMSS 2015?

As noted above, 56 countries participated in the study in at least one grade level (47[1] at Fourth grade and 39 at Eighth grade).[2] However, in order to facilitate a clear presentation of findings, international comparisons that are presented in tables or graphics in this report will be limited to a small group of countries that are of particular interest as comparators, rather than the full set of countries that took part in the study. This set of countries was selected as a result of high average performance on TIMSS 2015 (and, usually, other recent international assessments) or due to their cultural and/or linguistic similarities to Ireland. The selected countries are given in Table 1.1, in alphabetical order.[3]

These countries provide the main focus for comparison alongside Ireland and the TIMSS (international) average. Maintaining a consistent group of comparison countries in this manner

1 In addition to the 47 countries that participated in TIMSS 2015 at Fourth grade, two countries, Jordan and South Africa participated in a new, less difficult mathematics assessment called TIMSS Numeracy.
2 Seven benchmarking participants also took part. Benchmarking participants must follow the same procedures and meet the same data quality standards as countries, and can use the resulting (equivalent) data to benchmark their performance against national and international comparators.
3 Note that Finland and Northern Ireland participated at Fourth grade only. As a result, they are omitted from any tables that present Eighth grade data throughout this report.

provides a coherent and stable basis for comparison across differing national and thematic contexts. Other countries may also be referred to in text where especially noteworthy findings are observed.

Table 1.1: Selected comparison countries

	Grade levels	Primary reason for inclusion
Australia	4 and 8	Cultural/linguistic similarity
England	4 and 8	Cultural/linguistic similarity
Finland	4	High performance (science)
Hong Kong SAR	4 and 8	High performance
New Zealand	4 and 8	Cultural/linguistic similarity
Northern Ireland	4	Cultural/linguistic similarity
Rep. of Korea	4 and 8	High performance
Russian Fed.	4 and 8	High performance
Singapore	4 and 8	High performance
Slovenia	4 and 8	High performance (science)
United States	4 and 8	Cultural/linguistic similarity

Readers should note that, when making reference to other countries, the internationally-comparable terms 'Fourth grade' and 'Eighth grade' are used. 'Fourth Class' and 'Second Year' are only ever used to refer specifically to students in Ireland.

TIMSS average

Reference is made to the *TIMSS average* or *international average* throughout this report. This refers to the average of all 49 countries at Fourth grade (including Jordan and South Africa which participated in the TIMSS Numeracy assessment) or all 39 countries at Eighth grade for which data were available.

How did Irish students perform?

Prior to considering students' perspectives on learning mathematics and science, it is helpful to consider Irish students' overall performance on TIMSS 2015 (and whether performance has changed over time).

Students' performance on each domain is reported on a scale that is set to an international 'centrepoint' of 500. This centrepoint has been maintained since the first TIMSS, in 1995, and is the average of all countries that participated in TIMSS in 1995. It is a constant point of reference against which countries can monitor changes in their students' performance over time. It does not change with each cycle, unlike an international average, which would be expected to vary between cycles due to changes in performance within countries and different sets of countries taking part in each assessment year.

In general, Irish students achieved at a reasonably high level in TIMSS 2015, relative to other countries. At both grade levels, Irish students achieved mean mathematics and science scores that were significantly above both the centrepoint and the international average. Fourth Class students achieved a mathematics score that was significantly lower than that of students in seven countries, similar to that of students in four countries, and significantly higher than that of students in 37 countries. Performance in science was more moderate, with Fourth Class students achieving a score that was

significantly lower than that of students in 15 countries, similar to that of students in nine countries, and significantly higher than that of students in 22 countries. Second Year students achieved a mean mathematics score that was significantly lower than that of students in six countries, similar to that of students in five countries, and significantly higher than that of students in 27 countries. Their science score was significantly lower than for seven countries, similar to that of six countries, and significantly higher than for 25 countries.

Table 1.2 presents a summary of the differences in performance between students in Ireland and those in our selected comparison countries, along with the TIMSS average, for both domains at both grade levels. Statistically significant differences in scores are noted, where present, along with the difference from the mean score in Ireland for each country.

Students in four countries – Hong Kong, the Republic of Korea, the Russian Federation and Singapore – achieved significantly higher mean scores than Irish students on both domains and at both grade levels. In some other countries, students achieved a significantly higher score than Irish students in one domain but a lower score in the other domain, either at Fourth grade (Finland, Northern Ireland, the United States) or at both grade levels (Slovenia).

Table 1.2: Differences in performance between Ireland and comparison countries

	Fourth grade				Eighth grade			
	Maths		Science		Maths		Science	
	Sig?	Difference from IRL	Sig.?	Difference from IRL	Sig.?	Difference from IRL	Sig.?	Difference from IRL
Australia	↓	-30	↔	-5	↓	-19	↓	-18
England	↔	-1	↑	7	↔	-5	↔	7
Finland	↓	-12	↑	25	n/a	n/a	n/a	n/a
Hong Kong	↑	67	↑	28	↑	71	↑	16
Ireland		**547**		**529**		**523**		**530**
New Zealand	↓	-57	↓	-23	↓	-31	↓	-17
Northern Ireland	↑	23	↓	-9	n/a	n/a	n/a	n/a
Rep. of Korea	↑	61	↑	60	↑	82	↑	25
Russian Fed.	↑	17	↑	38	↑	15	↑	14
Singapore	↑	70	↑	62	↑	97	↑	67
Slovenia	↓	-27	↑	14	↓	-7	↑	21
United States	↓	-8	↑	17	↔	-5	↔	0
TIMSS average	↓	-38	↓	-23	↓	-42	↓	-44

Countries are ordered alphabetically.
↑ indicates a significantly higher mean score than Ireland.
↓ indicates a significantly lower mean score than Ireland.
↔ indicates that the score is not significantly different from Ireland's.

The strong focus on trend data in TIMSS also allows us to look beyond within-cycle comparisons. Significant improvements in both mathematics and science were found among Fourth Class students between 1995 and 2015, with most of this improvement occurring since 2011. At Second Year, significant improvements since 1995 were found for science performance, but not for mathematics. It was particularly notable that, at both grade levels, performance in both domains has increased since 1995 (and since 2011 for Fourth Class students) among lower- and medium-performing students, but not among the highest-achieving students. For a more detailed discussion of mathematics and science achievement, and for details on the administration of the survey, readers are referred to the initial report (Clerkin et al., 2016).

Contextual information for Ireland: Research series

This report is one of several TIMSS thematic reports that are being released as part of our ERC Research Report Series. TIMSS 2015 provides detailed information on students' personal experiences and attitudes; their home environment; their classroom environment and the teaching practices they experience; the school-level policies and practice that influence their daily lives; as well as national-level policies and the curricula for both grade levels. The study is designed to allow us to generalise these data to the national populations of Fourth Class and Second Year students, delivering robust information on their educational experiences.

In order to present this wealth of contextual data in the clearest fashion, each thematic report focuses on a particular topic in detail. Several short reports have been published to date, describing some of the structural characteristics of the Irish education system (Eivers & Chubb, 2017), the teaching of mathematics and science in Fourth Class (Clerkin, Perkins & Chubb, 2017), the teaching of mathematics and science in Second Year (Clerkin, Perkins & Chubb, 2018) and the home environment of primary and post-primary students in Ireland (Clerkin, Perkins & Chubb, 2020). All reports are made available for download from www.erc.ie/timss as they are published.[4] The international reports for TIMSS 2015 are available at https://timssandpirls.bc.edu.

A note on statistical significance

In the current report, tests of *statistical significance* are conducted to establish if differences between mean scale scores for achievement are large enough and reliable enough that we can be confident that the difference reported here is unlikely to have occurred by chance. For each comparison, a reference category is selected for each variable and comparisons are made between the mean score for this group and each remaining group. Statistical significance tests are reported at the 95% confidence level and measurement and sampling error are accounted for in the statistical comparisons. Where reference is made to a significant difference (i.e., significantly lower or higher) in this report, a test of statistical significance has been conducted.

Readers should note that statistical significance refers to the probability of an observed difference occurring by chance if no true difference exists. It does not necessarily imply that a difference is substantive or meaningful in terms of its implications for policy or practice: statistically significant differences can sometimes be very small in practical terms. Informed judgement should therefore be used in interpreting the results of the statistical tests presented here.

4 An e-appendix accompanying each report will also be available from www.erc.ie/timss, where relevant, to provide additional statistical information (e.g., standard errors) that may be omitted from the main reports in order to facilitate a concise presentation of findings.

Chapter 2: Introduction

One of the aims of TIMSS is to examine how different student characteristics can help explain patterns of achievement in mathematics and science. In particular, students' attitudes towards and beliefs about school and the subjects they learn are considered important contributors to students' achievement. For example, in TIMSS 2011, mean achievement was significantly higher among Irish primary school students who reported liking mathematics and science, and these significant effects remained when other factors, such as mother's education level, were accounted for (Cosgrove & Creaven, 2013). Indeed, positive attitudes towards Science, Technology, Engineering and Mathematics (STEM) have been emphasised by the STEM Education Review Group in their review of STEM education in the Irish school system by noting "our vision is to provide students in Ireland with a STEM education experience of the highest international quality; this provision should underpin high levels of student engagement, enjoyment, and excellent performance in STEM disciplines" (the STEM Education Review Group, 2016, p. 6).

At primary level, students in Ireland have reported comparatively more positive attitudes towards science than mathematics (Clerkin & Creaven, 2013), with almost 60% indicating that they like learning science compared to just over 40% for mathematics in TIMSS 2011. The proportion of students who like science in Ireland was higher than the TIMSS average, while the corresponding proportion for mathematics was lower than the average across TIMSS countries. A similar pattern was observed for students' engagement in their mathematics and science lessons, with reported levels of engagement higher for science (51%) than for mathematics (45%), although engagement in both science and mathematics was higher in Ireland than the corresponding TIMSS averages. Some gender differences were also evident among students in Ireland. Boys were more likely than girls to report liking science, while girls were only slightly more likely than boys to indicate they like mathematics. High levels of interest in primary school science have also been noted in other Irish studies (Murphy, Varley, & Veale, 2012) while attitudes towards mathematics appeared to be somewhat more positive among primary students that took part in the 2014 National Assessments[5] than in TIMSS 2011 (Kavanagh, Shiel, Gilleece, & Kiniry, 2015). In the National Assessments, it was found that over half of Sixth Class students considered mathematics as one of their best subjects, and that those who did so tended to outperform those who were unsure or disagreed with this statement.

Students' attitudes towards mathematics and science have also shown significant associations with students' achievement at post-primary level. In PISA[6] 2012, students in Ireland reported significantly higher levels of enjoyment of mathematics and were significantly more likely to view mathematics as useful for their future career; they also indicated significantly higher levels of anxiety about mathematics and were significantly more likely to report that their views about mathematics, and the mathematical ability of their parents and friends, influenced how they thought about mathematics (subjective norms), when compared to the averages across OECD countries (Perkins, Shiel, Merriman, Cosgrove & Moran, 2013). On the other hand, Irish students' confidence in completing different

5 National assessments of English reading and mathematics have been conducted in Ireland by the ERC since 1972. From 2009, the national assessments have been implemented at Second and Sixth Class.

6 PISA (the Programme for International Student Assessment) is a study of the OECD (Organisation for Economic Cooperation and Development) that examines the achievements of 15-year-old students in reading literacy, mathematics and science. The study is conducted every three years, with the first cycle in 2000. In each cycle, one subject area becomes the main focus of the study. In 2000, 2009 and 2018, reading was the main focus; in 2003 and 2012 it was mathematics; and in 2006 and 2015 the main focus was science.

types of mathematics tasks (self-efficacy) and their mathematics self-concept were similar to the OECD averages. With the exception of students' subjective norms, each of these variables was also significantly associated with mathematics achievement. Higher enjoyment of mathematics and viewing mathematics as 'more useful' were positively associated with achievement, and there was a negative association between students' performance in mathematics and their level of mathematics anxiety. Levels of instrumental motivation, self-efficacy, and self-concept related to mathematics were significantly higher among 15-year-old boys than girls in Ireland. Conversely, girls in Ireland reported significantly higher levels of mathematics anxiety than boys.

PISA 2012 in Ireland also included all of the 23 initial or pilot Project Maths[7] schools in the sample of selected schools. The performance and attitudes of students in these schools were compared to those attending non-pilot schools. Students in initial schools had significantly higher levels of anxiety about mathematics than students in the non-pilot schools, which may, in part, be related to the fact that they were the first to experience changes to the Junior Certificate examination arising from the transition under Project Maths (Merriman, Shiel, Cosgrove, & Perkins, 2014). On the other hand, Jeffes et al. (2013), in their evaluation of the implementation of Project Maths, noted that post-primary students in Ireland were generally positive and confident about their experience of learning mathematics.

In PISA 2015, 15-year-old students in Ireland reported significantly greater levels of enjoyment of science and interest in science topics than the average across OECD countries, and were also significantly more likely to perceive science as useful for their future careers (Shiel, Kelleher, McKeown, & Denner, 2016). Each of these measures of science attitudes was also significantly associated with science achievement. In Ireland, students' belief in their ability to use scientific knowledge to complete real world tasks (science self-efficacy) and the extent to which they value scientific approaches to enquiry (epistemic beliefs) were also significantly associated with performance in PISA science. While students' reported self-efficacy in Ireland was similar to the average reported across OECD countries, students in Ireland had one of the highest scores on epistemic beliefs, significantly above the OECD average. Boys in Ireland also reported significantly greater enjoyment of science, interest in science and science self-efficacy than did girls.

A consistent finding in large-scale international studies of achievement is that countries with the highest average achievement scores often score amongst the lowest on measures of academic self-concept and enjoyment. A number of different explanations for this phenomenon, known as the 'attitude-achievement paradox', have been hypothesised in the literature, including modesty bias (i.e., students in some countries may downplay their abilities because of cultural norms which discourage people drawing attention to personal strengths); differences in translations which may result in slightly stronger or weaker response categories across languages; and differences across education systems which may contribute towards greater pressure to achieve academically (Min, Cortina, & Miller, 2016).

Much research has been conducted to further understand the differences in boys' and girls' self-beliefs, engagement in, and attitudes towards school and learning. An OECD report on gender equality in education argues that "gender disparities in drive, motivation and self-beliefs are more pervasive and more firmly entrenched than gender differences in mathematics performance" (OECD, 2015, p. 68). In particular, it is noted that girls have lower levels of self-efficacy and self-concept than

7 Project Maths was an initiative to introduce a new approach to the teaching and learning of mathematics in post-primary schools in Ireland. It was implemented initially in 24 schools in 2008 and extended to all schools in 2010. One of the initial 24 schools amalgamated with another school and the remaining 23 schools were selected to participate in PISA 2012 in Ireland (Merriman et al., 2014).

boys even when their performance in mathematics and science is similar to that of boys, and that girls' lower performance in PISA mathematics and science amongst the highest-achieving students may in part be related to lower levels of confidence and greater levels of anxiety. It should be noted that measures of enjoyment and self-efficacy may have a reciprocal relationship with achievement, i.e., that behaviour, cognition and environment influence and are influenced by each other. Indeed, Williams and Williams (2010) noted that there was evidence of the reciprocal determinism of mathematics self-efficacy and achievement in many countries that participated in PISA in 2003. The authors also noted a consistent negative effect of gender on mathematics self-efficacy and suggest that gender differences in PISA mathematics performance, although generally small, may be influenced by lower levels of self-efficacy among girls.

Subject-specific attitudes can also be related to other aspects of students' schooling beyond achievement. Smyth and Hannan (2006) reported that students who find science interesting and useful are more likely to take science subjects at upper secondary level, while those who find science difficult are less likely to take any of the science subjects at upper secondary level. In particular, Third Year students who found science interesting were significantly more likely to take physics or chemistry at upper secondary, while those who found science useful were significantly more likely to take biology, even when Junior Certificate science grade was accounted for. The authors also noted that students who found mathematics useful and interesting were significantly more likely to take physics than not while boys who found mathematics difficult were significantly more likely to take biology than not.

Students' attitudes towards and engagement in school more broadly have also been associated with student outcomes. Byrne and Smyth (2010) noted in their interviews with young people that those who had left school early had more negative perceptions of their relationships with teachers and peers. The 2014 National Assessment found that 58% of Second Class students liked school, and that these students had significantly higher scores in reading and mathematics achievement compared to those who did not like school (Kavanagh et al., 2015). However, primary students' attitudes towards school have been shown to be somewhat less positive in Ireland compared to those in other countries. Findings from TIMSS 2011 suggest that students in Ireland are twice as likely to disagree a lot that they like being in school compared to international averages (Clerkin & Creaven, 2013). In addition, students in Ireland were less likely to report a strong sense of school belonging, although the difference here was less pronounced. More negative attitudes towards school were more likely to be found among boys, and in DEIS[8] Urban Band 2 schools.

Data from Growing Up in Ireland[9] (GUI) indicate high levels of affective engagement among primary school students (McCoy, Smyth, & Banks, 2012). Almost all students in this study indicated that they liked school, looked forward to school, and that they liked their teacher. However, as with the 2014 National Assessments, engagement was shown to vary by gender. Nine-year-old boys were about three times more likely to never like school, never look forward to school and never like their teacher than were girls, all else being equal. Children with a special educational need were also found to be significantly more likely to be disengaged from school, and children from lone parent families were significantly more likely to never look forward to going to school. On the other hand,

8 DEIS (Delivering Equality of opportunity In Schools) is a national programme aimed at addressing the educational needs of children and young people from disadvantaged communities. DEIS schools in urban areas are categorised into two bands with those in Band 1 experiencing greater levels of educational disadvantage than those in Band 2.

9 Growing Up in Ireland is a national longitudinal study of children in Ireland which studies factors associated with the wellbeing of children in Ireland. Two cohorts of children are studied, a child cohort (with data first collected when children were nine years old) and an infant cohort (with data first collected when children were nine months old).

children whose mothers have a degree-level qualification or higher were significantly less likely to have negative views about school, and children from an immigrant family were significantly more likely to look forward to school.

There is also evidence from GUI that children's views about school become less positive as they become older (Growing Up in Ireland Study Team, 2016). While 67% of young people consistently liked school from nine to 17/18 years, the proportion that disliked school increased from 6% at age nine to 11% at age 13 and 24% at age 17/18. However, those who have positive attitudes towards school when they are younger are more likely to also have positive views towards the end of schooling. Of those who always liked school when they were nine, 38% also liked it very much when they were 13, compared with 16% of those who never liked school at the age of nine. It has also been suggested that children may become less positive in their attitudes towards science between primary and post-primary school (Varley, Murphy, & Veale, 2013).

Rate of attendance at primary school, a basic measure of engagement, has been found to be positively and significantly associated with achievement, although this relationship was found to be weak (Eivers et al., 2010). One in ten 9-year-olds in the GUI study were found to have missed no days at school in the school year preceding the survey, one-third missed one to three days, just over one-quarter missed four to six days, and about 12% missed more than 11 days (Growing Up in Ireland Study Team, 2009). In PISA, about 75% of 15-year-olds in Ireland had not skipped any days of school in the two weeks preceding the survey, somewhat lower than the corresponding OECD average of 80% (Shiel et al., 2016).

The development of positive attitudes is outlined as a primary aim in the current primary and junior cycle mathematics and science curricula. Fourth Class children who took part in TIMSS 2015 were taught the mathematics and science curricula that were introduced as part of the Primary School Curriculum in 1999 (DES/NCCA 1999a; 1999b), while Second Year students were taught the mathematics curriculum that was introduced as part of Project Maths in 2012 (DES/NCCA, 2017). The current junior cycle science curriculum (DES/NCCA, 2015) was introduced after the implementation of TIMSS 2015, meaning that Second Year students who participated in the study were taught under the previous curriculum which was introduced in 2003 (DES/NCCA, 2003).

TIMSS 2015 offers an opportunity to explore how the attitudes of students in Ireland compare to those in other countries, but also, how attitudes may change between primary and post-primary school. The remainder of this research brief describes the attitudes and behaviours of Fourth Class and Second Year students who took part in TIMSS in 2015, and how these factors relate to student performance in mathematics and science. Chapter 3 outlines the rate of school absence among students in both grade levels and the extent to which they reported feeling that they belong in their school. Chapter 4 presents students' attitudes towards mathematics and their mathematics lessons, including the extent to which students like learning mathematics, their level of confidence in the subject, their views on engaging teaching in their mathematics lessons and the value they ascribed to mathematics. Chapter 5 examines these same variables in relation to students' attitudes towards science and science lessons. Finally, Chapter 6 discusses the main findings and presents some conclusions.

The aims of this report are to describe patterns of interest, beliefs and engagement among TIMSS participants in Ireland in a comparative context, providing, where relevant, information on how variations in these measures are related to achievement outcomes. Relationships between these measures and achievement are examined one at a time and the joint (multivariate) relationships between them and achievement are not considered.

Chapter 3: Absence from school, and school belonging

This chapter describes the frequency of school absence among students in the countries that participated in TIMSS 2015 and the extent to which students reported feeling that they belong in their school. The relationships between these variables and mathematics and science performance are also explored. Occasionally, for ease of interpretation, response categories are collapsed when reporting data. In such cases, there may be slight differences between data that is presented in the text and that which is presented in tables due to rounding. Findings are presented separately for each grade level.

Absence from school

Students in Fourth and Eighth grades were asked about how often they are absent from school. The percentages of students who reported being absent about *once every two weeks or more*, *once a month* or *never or almost never*[10] are considered separately for each grade level in the sections that follow. Students in Ireland are compared to students in a selection of other TIMSS countries and the associations between absence from school and average mathematics and science performance are also considered. The reasons for school absences were not asked for in TIMSS.

Fourth Class

In Ireland, 10% of Fourth Class students reported that they were absent *once every two weeks or more,* while this was the case for 15% of students on average across all TIMSS countries (Table 3.1). Twenty percent of students in Ireland reported that they were absent from school *once a month*, while 70% reported that they were absent *never or almost never*. Both of these percentages are slightly above the corresponding TIMSS averages (18% and 67%, respectively).

Compared to Ireland, England, Northern Ireland and Singapore had similar percentages of students who were absent *once every two weeks or more* (9%, 11% and 10%, respectively). However, all three countries had slightly larger percentages of students who were absent *never or almost never* (75%, 73% and 76%, respectively). Among our other comparison countries, Slovenia (14%) and Australia (13%) had the highest percentages of students who were absent at least once every two weeks. Students in the Republic of Korea were the least likely to report absence from school, with 93% indicating that they were *never or almost never* absent and only 2% reporting that they are absent *once every two weeks or more*.

10 Students were presented with four response categories: 'once a week or more', 'once every two weeks', 'once a month' and 'never or almost never'. In the current report the 'once a week or more' and 'once every two weeks' categories were collapsed to create one category, 'once every two weeks or more', due to the relatively low numbers of students selecting these response categories in Ireland.

Table 3.1: Percentage of Fourth grade students reporting absence from school, and mean achievement for mathematics and science – Ireland and comparison countries

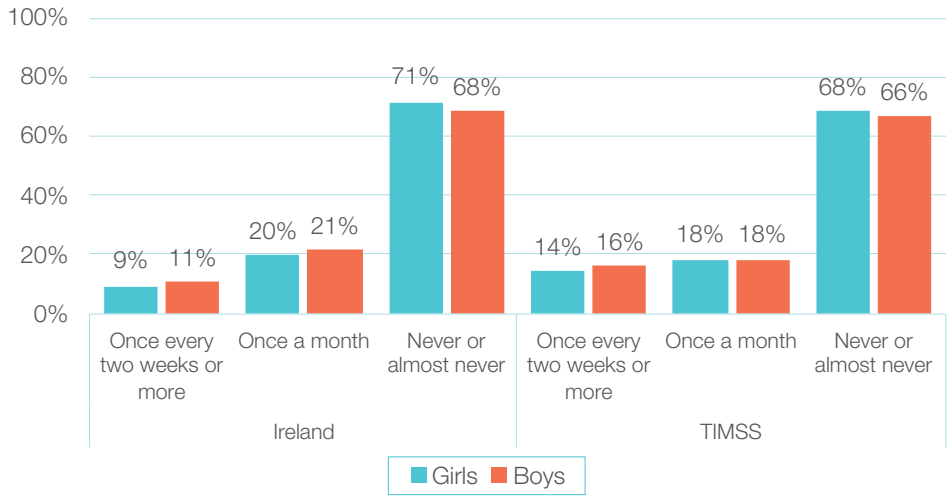
	Once every two weeks or more *(reference)*			Once a month			Never or almost never		
	%	Maths	Science	%	Maths	Science	%	Maths	Science
Australia	13	459	473	23	**523**	**531**	63	**528**	**533**
England	9	494	487	16	**541**	**534**	75	**555**	**543**
Finland	8	504	525	37	**534**	**552**	55	**541**	**560**
Hong Kong SAR	6	563	508	14	**599**	**543**	81	**621**	**562**
Ireland	10	488	477	20	**541**	**527**	70	**558**	**537**
New Zealand	--	--	--	--	**--**	**--**	--	**--**	**--**
Northern Ireland	11	499	470	16	**560**	**517**	73	**583**	**528**
Rep. of Korea	2	533	530	5	**574**	**558**	93	**612**	**592**
Russian Fed.	8	530	533	12	**558**	**560**	81	**568**	**572**
Singapore	10	524	495	14	**598**	**571**	76	**634**	**607**
Slovenia	14	488	510	18	**517**	**540**	68	**528**	**551**
United States	12	492	499	18	**539**	**545**	70	**549**	**556**
TIMSS	15	468	465	18	**506**	**503**	67	**521**	**517**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.
The TIMSS average mathematics scores do not include South Africa and Jordan both of which participated in the TIMSS Numeracy study.
Data are not available for New Zealand.

In Ireland and across our comparison countries, students' absence from school was negatively, and significantly, associated with student achievement in both mathematics and science. Students in Ireland who reported being absent *once every two weeks or more* scored an average of 488 in mathematics, which is significantly lower than the mean score of those who were absent just *once a month* (541), and those who were *never or almost never* absent (558). This pattern was also evident when looking at science achievement. Students who reported being absent *once every two weeks or more*, on average, achieved a signficantly lower science score (477) than those who were absent *once a month* (527), or *never or almost never* (537).

Further, both in Ireland and internationally, there was very little variation in the rate of student absenteeism by gender (Figure 3.1). For example, 9% of Fourth Class girls in Ireland reported being absent from school *once every two weeks or more*, while this was the case for 11% of boys. Likewise, 20% of girls and 21% of boys in Ireland were absent from school *once a month*. Additionally, 71% of girls indicated that they are absent *never or almost never,* while 68% of boys reported the same. A similar pattern was observed internationally.

Figure 3.1: Percentage of Fourth grade students by frequency of school absence and student gender – Ireland and TIMSS average



Second Year

One in ten (10%) Second Year students in Ireland reported being absent from school *once every two weeks or more*, compared to a TIMSS average of 16% (Table 3.2). Just over a quarter of students (27%) in Ireland reported that they were absent from school *once a month*, while 63% were absent *never or almost never*. Looking at the comparison countries, students in England (69%) were slightly more likely to report being absent *never or almost never* compared to those in Ireland. The Russian Federation (18%) had the highest percentage of students who were absent *once every two weeks or more.* Elsewhere, students in the Republic of Korea were the least likely to report frequent absenteeism with 96% indicating that they are absent from school *never or almost never*.

Table 3.2: Percentage of Eighth grade students reporting absence from school, and mean achievement for mathematics and science – Ireland and comparison countries

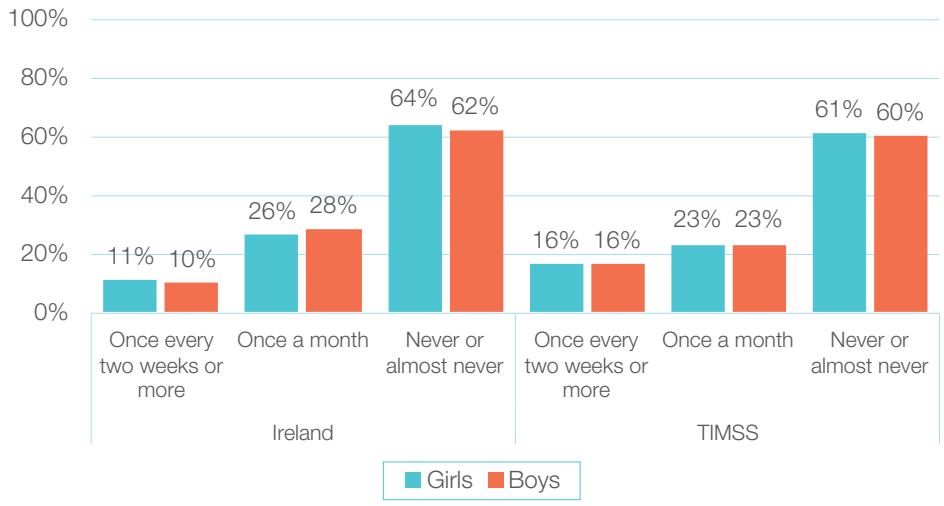
	Once every two weeks or more *(reference)*			Once a month			Never or almost never		
	%	Maths	Science	%	Maths	Science	%	Maths	Science
Australia	13	466	474	28	**501**	**510**	59	**519**	**525**
England	8	472	484	24	**505**	**525**	69	**531**	**549**
Hong Kong SAR	4	528	487	9	**576**	**538**	87	**600**	**550**
Ireland	10	480	482	27	**516**	**520**	63	**535**	**543**
New Zealand	--	--	--	--	--	--	--	--	--
Rep. of Korea	1	518	480	3	520	486	96	**609**	**558**
Russian Fed.	18	522	527	23	**539**	**543**	58	**542**	**550**
Singapore	6	527	493	12	**587**	**568**	82	**633**	**609**
Slovenia	12	495	523	32	**517**	**552**	57	**521**	**558**
United States	12	478	489	26	**516**	**530**	62	**528**	**539**
TIMSS	16	435	437	23	**471**	**477**	61	**496**	**502**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.
Data are not available for New Zealand.

There is also a negative association between students' absence from school and student achievement in both mathematics and science at Eighth grade. For example, in Ireland, students who reported being absent *once every two weeks or more* achieved an average mathematics score of 480, which is significantly lower than the mean score of those who were absent *once a month* (516) and those who were absent *never or almost never* (535). For science, students who were absent *once every two weeks or more* achieved a mean science score of 482; significantly lower than the mean score of those who were absent *once a month* (520) and those who were absent *never or almost never* (543). Similar patterns were observed across the majority of our comparison countries for both mathematics and science. In the Republic of Korea, students who reported being absent *once every two weeks or more* achieved significantly lower mean mathematics and science scores than those who were absent *never or almost never*, but did not differ significantly from those who were absent *once a month* in terms of their mean mathematics or science performance.

There was very little variation in absenteeism by student gender, either in Ireland or internationally (Figure 3.2). In Ireland, similar proportions of girls and boys reported that they were absent *once every two weeks or more* (11% and 10%, respectively). This was also the case for those who were absent *once a month* (26% of girls and 28% of boys), and for those who were absent *never or almost never* (64% of girls and 62% of boys). A similar pattern can be seen internationally, with near identical proportions of Eighth grade girls and boys reporting varying levels of absenteeism.

Figure 3.2: Percentage of Eighth grade students by frequency of school absence and student gender – Ireland and TIMSS average



Sense of school belonging

Students at both grade levels were presented with seven statements that enquired about their attitudes towards their school and their sense of school belonging. Students' responses to these statements are presented separately for Fourth and Eighth grade in the following sections.

Fourth Class

Nearly all Fourth grade students in Ireland and on average across TIMSS countries agreed *a lot* or *a little* that they liked seeing their classmates and that they learned a lot in school (Table 3.3). Similarly, over 90% of students in Ireland and across other TIMSS countries agreed *a lot* or *a little* that their

teachers were fair to them and that they were proud to go to their school. However, students in Ireland were more likely to agree strongly with these statements than their international peers.

Findings related to students' sense of safety and belonging were also very positive with 94% of those in Ireland indicating that they felt safe when at school (TIMSS: 90%) and 88% agreeing *a lot* or *a little* that they feel they belong (TIMSS: 88%). From this it is clear that students in Ireland feel particularly safe at school in an internationally comparative context. In addition, over three-quarters (79%) of students in Ireland said that they liked being in school compared to 86% of students internationally. However, 10% of students in Ireland disgreed *a lot* with this statement, while just 6% of students did so internationally.

Table 3.3: Percentage of Fourth grade students endorsing various statements about their attitudes to school – Ireland and TIMSS average

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
I like being in school	IRL	37	42	11	10
	TIMSS	53	33	8	6
I feel safe when I am at school	IRL	73	20	4	2
	TIMSS	63	27	7	4
I feel like I belong at this school	IRL	68	20	7	5
	TIMSS	64	24	7	5
I like to see my classmates at school	IRL	92	6	1	1
	TIMSS	84	13	2	1
Teachers at my school are fair to me	IRL	76	18	4	2
	TIMSS	68	23	5	4
I am proud to go to this school	IRL	79	15	3	2
	TIMSS	68	23	5	4
I learn a lot in school	IRL	87	11	2	1
	TIMSS	79	17	2	1

Note: Figures may not add exactly to 100% due to rounding.

The responses to this set of statements were combined to form an overall measure of students' sense of school belonging (Table 3.4). Overall, nearly three-quarters (73%) of Fourth Class students in Ireland had a *high sense of school belonging* compared to two-thirds (66%) of students internationally. Among our comparison countries, only England (71%) and Northern Ireland (71%) had similar proportions of students reporting *a high sense of school belonging*. Very few students in Ireland reported having *little sense of school belonging* but this was also the case on average across all other TIMSS countries (4% vs. 4%). In contrast, fewer than half of Fourth grade students in Hong Kong (46%) reported a *high sense of belonging*, while about one in ten students felt *little sense of belonging.*

In Ireland there is a positive relationship between students' sense of belonging and mathematics and science achievement. Students in Ireland who reported a *high sense of school belonging* had significantly higher average mathematics (553) and science (533) scores, compared to those who reported *some sense of school belonging* (537 for mathematics and 521 for science) and those who reported *little sense of school belonging* for mathematics (519) but not for science (513). Statistically significant relationships between sense of school belonging and mathematics and science achievement were found in Australia, England, Hong Kong and the United States. In Slovenia, no statistically significant relationship was found between sense of school belonging and mathematics or science achievement, while in the Republic of Korea a clear positive relationship was observed

between sense of school belonging and mathematics achievement but not for science achievement.

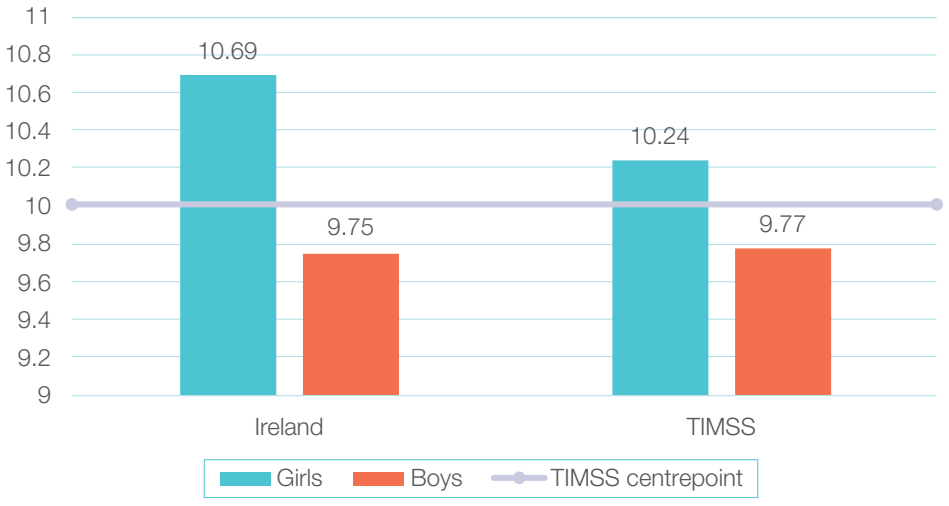
Table 3.4: Percentage of Fourth grade students by the exent to which they feel they belong in their school and mean achievement for mathematics and science – Ireland and comparison countries

	High sense of school belonging *(reference)*			Some sense of school belonging			Little sense of school belonging		
	%	Maths	Science	%	Maths	Science	%	Maths	Science
Australia	62	524	529	33	**511**	**520**	5	**483**	**493**
England	71	551	540	25	**538**	**530**	4	**505**	**503**
Finland	68	539	556	28	**531**	552	3	**509**	**527**
Hong Kong SAR	46	624	565	43	**611**	**552**	11	**593**	**540**
Ireland	73	553	533	23	**537**	**521**	4	**519**	513
New Zealand	67	493	508	29	492	507	4	**459**	**481**
Northern Ireland	71	576	523	25	**561**	515	3	**523**	**494**
Rep. of Korea	52	614	591	45	**603**	588	3	**587**	578
Russian Fed.	68	568	568	29	**558**	566	3	548	566
Singapore	56	622	593	39	**615**	590	6	**596**	**573**
Slovenia	55	519	542	39	523	545	6	518	541
United States	64	548	554	29	**532**	**539**	7	**506**	**518**
TIMSS	66	510	511	30	**499**	501	4	**482**	487

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

In addition to the composite measure, the combined responses to the statements presented in Table 3.3 were also used to construct a scale score. The sense of school belonging scale has a mean of ten and a standard deviation of two on average across all TIMSS 2015 countries. Students in Ireland achieved an average score of 10.19. On average, girls in Ireland reported a significantly higher sense of school belonging than boys (10.69 compared to 9.75), a pattern which was also observed on average across TIMSS countries (Figure 3.3).

Figure 3.3: Fourth grade students' sense of school belonging scale scores by student gender – Ireland and TIMSS average



Second Year

Almost three-quarters (73%) of Second Year students in Ireland agreed *a lot* or *a little* that they like being in school. This was notably lower than the corresponding international average (82%). Additionally, one in ten students in Ireland (10%) *disagreed a lot* that they like being in school, compared to 6% on average across TIMSS countries (Table 3.5). Overall, however, students in Ireland had positive attitudes towards specific aspects of school. In particular, students in Ireland were more likely to feel safe at school than the average student across all TIMSS countries (90% agreed *a lot* or *a little* compared to 85% of students internationally). In addition, a large majority of students in Ireland indicated that they had positive relationships with their teachers and peers, with 96% agreeing (*a lot* or *a little*) that they liked seeing their classmates at school, and 82% agreeing that their teachers were fair to them. Both these percentages are very similar to the corresponding international averages. Further, the majority of students both in Ireland and across TIMSS countries as a whole agreed *a lot or a little* that they learned a lot in school (90% and 91%, respectively), and that they were proud of the school they attended (87% and 82%, respectively).

Table 3.5: Percentage of Eighth grade students endorsing various statements about their attitudes to school – Ireland and TIMSS average

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
I like being in school	IRL	24	49	17	10
	TIMSS	38	43	12	6
I feel safe when I am at school	IRL	52	38	8	3
	TIMSS	47	38	10	5
I feel like I belong at this school	IRL	45	37	12	6
	TIMSS	46	36	11	6
I like to see my classmates at school	IRL	75	20	3	1
	TIMSS	71	23	5	2
Teachers at my school are fair to me	IRL	39	43	14	4
	TIMSS	44	39	12	5
I am proud to go to this school	IRL	51	35	9	4
	TIMSS	47	35	12	7
I learn a lot in school	IRL	53	37	8	2
	TIMSS	56	34	7	3

Note: Figures may not add exactly to 100% due to rounding.

Responses to the seven statements above were combined in order to construct an overall measure of students' sense of school belonging (Table 3.6). In Ireland, 42% of students had a *high sense of school belonging*, slightly below the international TIMSS average (44%). Almost half of students in Ireland (48%) reported *some sense of school belonging*, while one in ten (10%) had *little sense of school belonging*. Among the comparison countries, Ireland, along with New Zealand and Australia, had greater proportions of students who reported a *high sense of school belonging*. Sense of school belonging was lower in Slovenia, with only 12% of students reporting a *high sense of school belonging* and over one in five (22%) reporting *little sense of school belonging.*

Both at the international level and in Ireland, there was a positive and statistically significant relationship between students' sense of school belonging and achievement in mathematics and science. The differences in achievement between students reporting a *high sense* and *little sense of school belonging* are larger at Eighth grade than at Fourth grade, in Ireland and internationally.

In Ireland, students who reported having a *high sense of school belonging* scored an average mathematics score of 537, which is significantly higher than those who reported *some sense of school belonging* (519) and those with *little sense of school belonging* (491). This pattern also emerged in relation to science achievement. Students who had a *high sense of school belonging* (545) significantly outperformed those with *some sense of school belonging* (525), and those with *little sense of school belonging* (492). In the Russian Federation and Slovenia, those who reported a *high sense of school belonging* did not differ significantly from those with *some sense of school belonging* in terms of their mean mathematics or science achievement, but had significantly higher mean mathematics and (Slovenia only) science performance compared to those who reported *little sense of school belonging*.

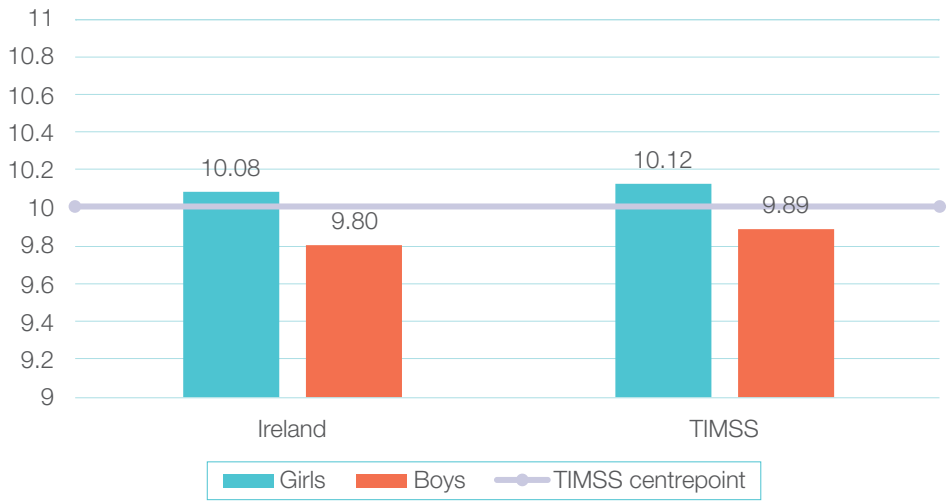
Table 3.6: Percentage of Eighth grade students by the extent towhich they feel like they belong in their school and mean achievement for mathematics and science – Ireland and comparison countries

	High sense of school belonging *(reference)*			Some sense of school belonging			Little sense of school belonging		
	%	Maths	Science	%	Maths	Science	%	Maths	Science
Australia	41	528	535	48	**499**	**506**	11	**460**	**465**
England	35	542	560	54	**513**	**532**	11	**478**	**497**
Hong Kong SAR	31	616	562	55	**591**	**542**	14	**560**	**525**
Ireland	42	537	545	48	**519**	**525**	10	**491**	**492**
New Zealand	43	509	528	49	**488**	**509**	8	**449**	**474**
Rep. of Korea	24	621	565	69	**605**	**555**	7	**568**	**526**
Russian Fed.	36	544	547	55	536	544	9	**526**	536
Singapore	37	638	614	55	**615**	**591**	9	**589**	**564**
Slovenia	12	527	564	66	519	555	22	**502**	**533**
United States	37	538	548	49	**514**	**526**	14	**485**	**501**
TIMSS	44	492	498	47	**479**	**483**	9	**458**	**459**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

As at Fourth grade, the statements measuring sense of school belonging were also combined to construct a scale score at Eighth grade. The sense of school belonging scale has a mean of ten across all TIMSS 2015 countries and a standard deviation of two. In Ireland, students scored an average of 9.94 on this scale. There was some variation in this score when looking at girls and boys separately. Girls (10.08) in Ireland scored significantly higher than boys (9.80), indicating than on average, girls in Ireland have a higher sense of school belonging. A similar pattern was observed on average across TIMSS countries (Figure 3.4).

Figure 3.4: Eighth grade students' sense of school belonging scale scores by student gender – Ireland and TIMSS average



Chapter summary

In Ireland, the rate of regular absence (i.e., *once every two weeks or more*) was very similar for students in Fourth Class and Second Year (both 10%), and was lower than the corresponding averages across TIMSS countries. On the other hand, the percentage of students in Ireland who reported that they were absent from school *once a month* was greater at Second Year than at Fourth Class and, at both grade levels, these percentages were slightly greater than the corresponding TIMSS averages. Students in England (at Fourth and Eighth grade) and Northern Ireland (at Fourth grade only) reported similar rates of regular absence to Ireland, while students in the Republic of Korea were the least likely, among our comparison countries, to report frequent absenteeism at both grade levels. Both in Ireland and internationally, there was little variation in the rate of student absenteeism by gender at both grade levels.

School absence was negatively, and significantly, associated with mathematics and science performance in Ireland and on average across TIMSS countries. Students who reported being absent *once every two weeks or more* had significantly lower mathematics and science scores than those who reported being absent from school *once a month*, and those who reported *never or almost never* being absent.

Students at both grade levels were also asked to indicate the extent to which they felt they belonged at school. Fourth Class students in Ireland were more likely to report a *high sense of school belonging* than the corresponding TIMSS average, and also when compared to Second Year students in Ireland. In particular, Fourth Class students were much more likely than Second Year students to agree that teachers at their school are fair to them. On the other hand, over 90% of students at both grade levels in Ireland agreed to some extent that they feel safe at school; that they like to see their classmates at school; and that they learn a lot in school. At both Fourth Class and Second Year, there was a positive relationship between students' sense of school belonging and their mathematics and science achievement. Girls in Ireland reported having a significantly higher sense of school belonging than boys at both grade levels.

Chapter 4: Students' attitudes toward mathematics, and mathematics lessons

This chapter discusses students' attitudes towards mathematics and mathematics lessons. Students in Fourth Class and Second Year were asked about how much they like learning mathematics, their level of confidence in the subject and their views on engaging teaching in their mathematics lessons. Second Year students were also asked about the value they ascribed to mathematics. The associations between students' attitudes and achievement are considered, as is the variation in students' attitudes by student gender and their access to home learning resources. Findings are presented separately for each grade level.

The extent to which students like learning mathematics

Students at both Fourth and Eighth grades were presented with nine statements relating to how they feel about learning mathematics:

- I enjoy learning mathematics;
- I wish I did not have to study mathematics;
- Mathematics is boring;
- I learn many interesting things in mathematics;
- I like mathematics;
- I like any schoolwork that involves numbers;
- I like to solve mathematics problems;
- I look forward to mathematics lessons;
- Mathematics is one of my favourite subjects.[11]

The responses to these nine statements were combined in order to create overall measures for Fourth and Eighth grade students that reflected the extent to which they liked learning mathematics. The scales, which were established in the 2011 cycle of the study, were set to have a mean of ten and a standard deviation of two across all countries that participated in TIMSS in 2011[12] at each grade level. Students were also categorised into three groups according to their score on the composite measure: those who *very much like learning mathematics*, those who *like learning mathematics*, and those who *do not like learning mathematics*.

Fourth Class

Overall, more than three-quarters (77%) of Fourth Class students reported that they liked learning mathematics to some degree (either *very much like learning mathematics* or *like learning mathematics*; Table 4.1). However, the proportion of students who indicated that they *very much like learning mathematics* (38%) is lower than the corresponding international average (46%). Further, a

11 Responses to these statements at both Fourth and Eighth grade, in Ireland and internationally, are presented in tables A4.1 and A4.4 in the e-appendix.
12 Data from TIMSS 2015 were placed on the TIMSS 2011 scale.

substantial minority of students in Ireland reported that they *do not like learning mathematics* (23%), compared to about one-in-five (19%) internationally. Students in Ireland, and internationally, were particularly likely to agree (*a lot* or *a little*) that they learn many interesting things in mathematics (88% both in Ireland and internationally) and that they enjoy learning mathematics (83% in Ireland and 85% internationally).

Looking at our comparison countries, students in the Russian Federation (52%), followed by those in England (50%), were the most likely to indicate that they *very much like* learning mathematics. The Russian Federation also had relatively fewer students who *do not like learning* mathematics (11%). Conversely, in the Republic of Korea, only 19% of students indicated that they *very much like learning mathematics*, while 35% reportedly *do not like learning mathematics.*

In Ireland and at the international level, there was a positive relationship between students' attitudes to learning mathematics and average mathematics achievement. In Ireland, students who *very much like learning mathematics* achieved an average mathematics score of 561, which is significantly higher than the average for those who *like learning mathematics* (547), and for those who *do not like learning mathematics* (528). Internationally, the mean mathematics score of students who *very much like mathematics* (521) was also significantly higher than the mean score for those who *like learning mathematics* (495), and for those who *do not like learning mathematics* (483).

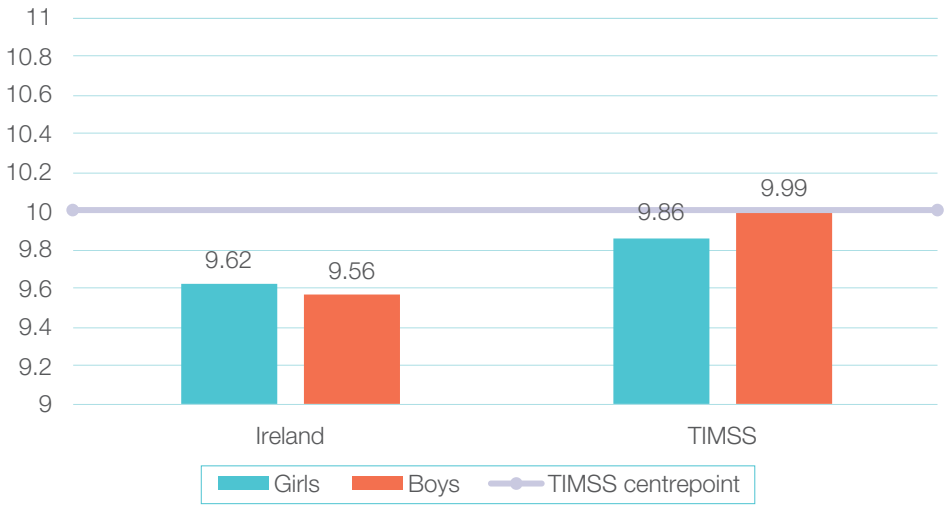
Table 4.1: Percentage of Fourth grade students by the extent to which they like learning mathematics and mean mathematics achievement – Ireland and comparison countries

	Very much like learning maths *(reference)*		Like learning maths		Do not like learning maths	
	%	Maths	%	Maths	%	Maths
Australia	37	535	36	**516**	27	**496**
England	50	555	32	**546**	17	**523**
Finland	28	550	41	**537**	31	**521**
Hong Kong SAR	35	631	38	**612**	27	**596**
Ireland	38	561	39	**547**	23	**528**
New Zealand	43	498	34	**488**	23	**485**
Northern Ireland	35	585	38	**573**	27	**547**
Rep. of Korea	19	645	46	**610**	35	**586**
Russian Fed.	52	577	37	**555**	11	**536**
Singapore	39	640	38	**611**	23	**591**
Slovenia	35	535	39	**518**	27	**505**
United States	42	555	35	**536**	23	**524**
TIMSS	46	521	35	**495**	19	**483**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

In Ireland, Fourth Class students had a mean score of 9.59 on the scale measuring the extent to which they like learning mathematics, which is somewhat lower than the average across all TIMSS 2015 countries (9.93). Figure 4.1 shows the variation in students' attitudes to learning mathematics by gender. Girls in Ireland (9.62) were slightly more likely to report positive attitudes towards learning mathematics than were boys (9.56). However, this difference was not statistically significant. Internationally, this pattern was reversed as boys (9.99), on average, reported significantly more positive attitudes than girls (9.86).

Figure 4.1: Fourth grade students' enjoyment of learning mathematics scale scores by student gender – Ireland and TIMSS average



Second Year

Eighth grade students were generally less positive in their responses about their attitudes towards mathematics than their Fourth grade counterparts. Eighth grade students were most likely to agree (*a lot* or *a little*) with statements suggesting that they learned many interesting things in mathematics (Ireland: 63%; TIMSS: 73%) and that it was a subject that they enjoyed learning (Ireland: 63%; TIMSS: 71%). Conversely, only 38% of students in Ireland agreed that they look forward to mathematics class or that mathematics is one of their favourite subjects, compared to international averages of 50% and 51%, respectively.

In Ireland, 14% of students reported that they *very much like learning mathematics,* while 35% *like learning mathematics* (Table 4.2). The proportion of students in Ireland who *very much like learning mathematics* is considerably lower than the international average (22%). Further, students in Ireland were more likely to express unfavourable views towards the subject than their international peers, with 52% indicating that they *do not like learning mathematics* compared to 38% across all TIMSS countries.

Among our comparison countries, Singapore (24%) had the highest proportion of students who reported that they *very much like learning mathematics* and, along with the Russian Federation, the lowest proportion of those who *do not like learning mathematics* (33% for both countries). In contrast, very small percentages of students in Slovenia (5%) and the Republic of Korea (8%) reported that they *very much like learning mathematics* and the proportions of students who *do not like learning mathematics* in both countries far exceeds the international average (67% and 58%, respectively). In general, students in our comparison countries were less likely to hold positive views about mathematics than on average across all TIMSS countries.

In Ireland, and at the international level, there was a significant positive association between the extent to which students like learning mathematics and average mathematics achievement. In Ireland, students who indicated that they *very much like learning mathematics* achieved an average score of 562, significantly above the mean score for those who *like learning mathematics* (537), and those who *do not like learning mathematics* (505). Similarly, at the international level, students who *very much like learning mathematics* achieved an average mathematics score of 518, which is

signficantly higher than the mean for those who *like learning mathematics* (485); and those who *do not like learning mathematics* (462).

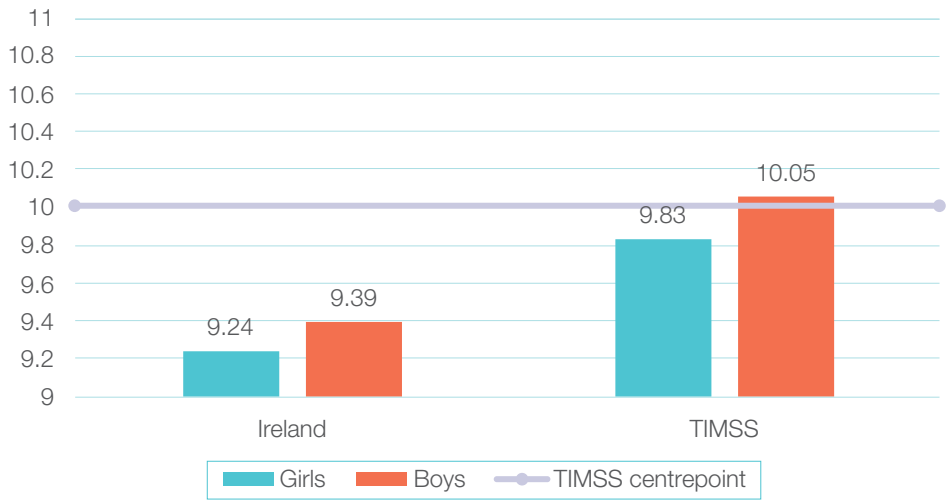
Table 4.2: Percentage of Eighth grade students by the extent to which they like learning mathematics and mean mathematics achievement – Ireland and comparison countries

	Very much like learning maths *(reference)*		Like learning maths		Do not like learning maths	
	%	Maths	%	Maths	%	Maths
Australia	13	551	36	**522**	50	**482**
England	14	559	39	**532**	48	**498**
Hong Kong SAR	15	638	39	**605**	46	**572**
Ireland	14	562	35	**537**	52	**505**
New Zealand	14	534	40	**501**	46	**476**
Rep. of Korea	8	668	34	**634**	58	**581**
Russian Fed.	19	566	48	**545**	33	**512**
Singapore	24	654	42	**625**	33	**592**
Slovenia	5	560	28	**541**	67	**503**
United States	17	554	36	**528**	47	**499**
TIMSS	22	518	39	**485**	38	**462**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

As at Fourth grade, scale scores were also constructed to reflect students' attitudes to learning mathematics. Second Year students in Ireland had a mean score of 9.31 on this scale, which is considerably lower than the TIMSS 2015 average of 9.94. Figure 4.2 shows the variation in students' attitudes to learning mathematics by student gender. In Ireland, boys (9.39) were significantly more likely to hold a positive attitude towards learning mathematics than girls (9.24). This was also the case across all TIMSS countries, with boys (10.05) scoring higher than girls (9.83) on this scale.

Figure 4.2: Eighth grade students' enjoyment of learning mathematics scale scores by student gender – Ireland and TIMSS average



The extent to which students feel confident in learning mathematics

Students were presented with nine statements which sought to assess to what extent they are confident in mathematics:

- I usually do well in mathematics;
- Mathematics is harder for me than many of my classmates;
- I am just not good at mathematics;[13]
- I learn things quickly in mathematics;
- Mathematics makes me nervous;
- I am good at working out difficult mathematics problems;
- My teacher tells me I am good at mathematics;
- Mathematics is harder for me than any other subject;
- Mathematics makes me confused.[14]

An overall measure of how confident students feel in learning mathematics, based on students' degree of agreement with each of these statements, was constructed at both Fourth and Eighth grade. These scales were both set to have a mean of ten and a standard deviation of two across all countries that participated in TIMSS in 2011.[15] The extent to which students felt confident in mathematics was described at three levels: those who are *very confident in mathematics*, those who are *confident in mathematics*, and those who are *not confident in mathematics*.

Fourth Class

In Ireland, 37% of Fourth Class students indicated that they were *very confident in mathematics*, compared to 32% internationally (Table 4.3). A further 45% were reportedly *confident in mathematics*, the same as the TIMSS average (45%), while almost one student in five (18%) was *not confident in mathematics*, compared to 23% internationally. The majority of Fourth grade students agreed (*a lot* or *a little*) that they usually do well in mathematics (Ireland: 91%; TIMSS: 87%), that they learn things quickly in mathematics (Ireland: 81%; TIMSS: 80%) or that their teachers tell them that they are good at the subject (Ireland: 82%; TIMSS: 76%). However, around one-quarter (26%) of students in Ireland, and one-third (33%) of students internationally, agreed (*a lot* or *a little*) that mathematics made them nervous.

Among our selected comparison countries, Ireland and England had the highest percentages of students who were *very confident in mathematics* (both 37%) followed closely by the United States (35%). By contrast, only 13% of students in the Republic of Korea felt *very confident* while the percentages of students who reported feeling *very confident in mathematics* in Hong Kong (19%) and Singapore (19%) were also notably smaller than the international average.

Student achievement in mathematics was positively associated with the extent to which they felt confident in the subject. In Ireland, students who reported feeling *very confident in mathematics* (583) scored significantly higher than those who were *confident* (539) and those who were *not confident* (498). This was also the case internationally. Across all TIMSS countries, students who were *very confident* (546) in mathematics significantly outperformed those who indicated they were *confident* (502) and those who were *not confident* (460).

13 At Eighth grade, this statement was phrased as 'Mathematics is not one of my strengths'.
14 Responses to these statements at both Fourth and Eighth grades, in Ireland and internationally, are presented in tables A4.7 and A4.10 in the e-appendix.
15 Data from TIMSS 2015 were placed on the TIMSS 2011 scale.

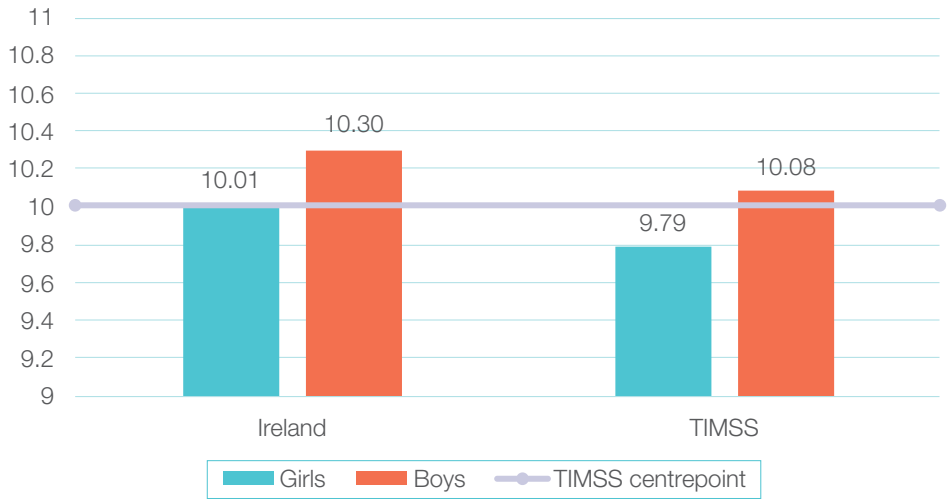
Table 4.3: Percentage of Fourth grade students by the extent to which they feel confident in learning mathematics and mean mathematics achievement – Ireland and comparison countries

	Very confident in maths *(reference)*		Confident in maths		Not confident in maths	
	%	Maths	%	Maths	%	Maths
Australia	27	569	46	**514**	27	**473**
England	37	578	43	**541**	20	**499**
Finland	28	572	51	**532**	20	**493**
Hong Kong SAR	19	660	45	**622**	36	**583**
Ireland	37	583	45	**539**	18	**498**
New Zealand	22	543	48	**492**	30	**452**
Northern Ireland	31	614	46	**568**	23	**518**
Rep. of Korea	13	668	51	**623**	36	**566**
Russian Fed.	28	599	45	**569**	28	**522**
Singapore	19	681	42	**633**	39	**572**
Slovenia	32	559	46	**517**	22	**471**
United States	35	583	41	**534**	24	**492**
TIMSS	32	546	45	**502**	23	**460**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

In Ireland, students scored an average of 10.17 on the scale measuring the extent to which students felt confident in mathematics, slightly above the TIMSS 2015 average of 9.94. The extent to which students felt confident in mathematics also varied by gender (Figure 4.3). Boys (10.30) had a significantly higher mean score than girls (10.01) on the scale measuring how confident they were in mathematics. Similarly, on average across all TIMSS countries, Fourth grade boys (10.08) scored higher on this scale than did girls (9.79).

Figure 4.3: Fourth grade students' scale scores on the measure of how confident they feel in learning mathematics by student gender – Ireland and TIMSS average



Second Year

Relatively few Eighth grade students reported that they felt *very confident* in mathematics, both in Ireland and internationally. For example, in Ireland, only 16% of students felt *very confident in mathematics*, while this was the case for just 14% of students internationally (Table 4.4). An additional 42% of students in Ireland felt *confident in mathematics* (TIMSS average: 43%) and the remaining 43% of students in Ireland reported that they were *not confident in mathematics*. However, this was largely in line with most of the comparison countries, as well as the corresponding international average (43%). Out of the comparison countries, the United States had the highest percentage of students who were reportedly *very confident in mathematics* (21%). By contrast, students in the Republic of Korea were the least likely to report being *very confident in mathematics* with only 8% doing so, and over half (55%) indicating that they were *not confident* in the subject.

Nearly three-quarters (74%) of Eighth grade students in Ireland agreed (*a lot* or *a little*) that they usually do well in mathematics. This was similar to the corresponding international average (72%). However, about half of students in Ireland and internationally agreed (*a lot* or *a little*) that mathematics is not one of their strengths (52% in Ireland and internationally) and that mathematics makes them confused (52% in Ireland and 48% internationally). On the other hand, fewer students in Ireland indicated that mathematics is harder for them than any other subject when compared to the average across TIMSS countries (39% and 47%, respectively).

There was a positive association between the extent to which students felt confident in learning mathematics and their average achievement in the subject. In Ireland, students who were *very confident in mathematics* scored an average of 583, significantly above those who were *confident in mathematics* (534) and those who were *not confident in mathematics* (492). A similar pattern was also observed among our comparison countries and on average across all TIMSS countries.

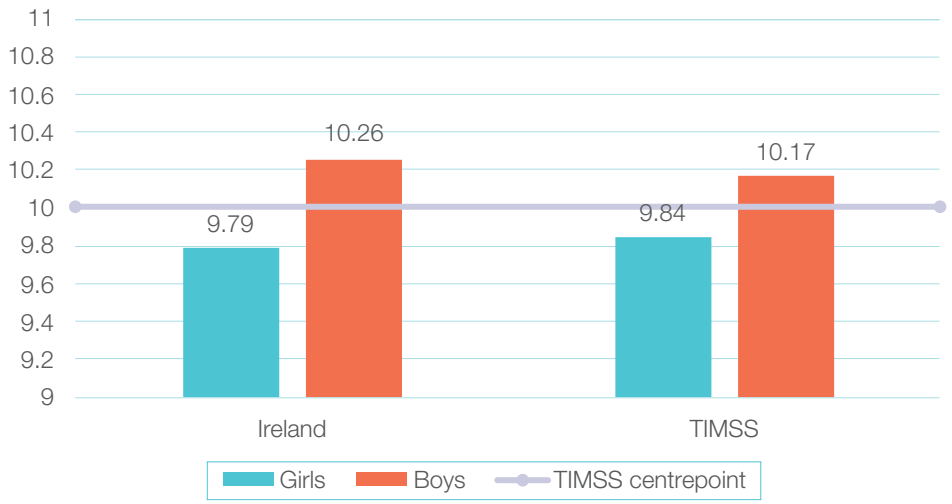
Table 4.4: Percentage of Eighth grade students by the extent to which they feel confident in learning mathematics and mean mathematics achievement – Ireland and comparison countries

	Very confident in maths *(reference)*		Confident in maths		Not confident in maths	
	%	Maths	%	Maths	%	Maths
Australia	15	580	42	**522**	43	**465**
England	15	578	50	**530**	35	**479**
Hong Kong SAR	10	660	36	**611**	54	**571**
Ireland	16	583	42	**534**	43	**492**
New Zealand	12	576	43	**509**	44	**456**
Rep. of Korea	8	687	38	**643**	55	**569**
Russian Fed.	12	602	42	**558**	46	**503**
Singapore	13	675	41	**642**	46	**588**
Slovenia	12	586	44	**535**	44	**479**
United States	21	573	40	**530**	39	**480**
TIMSS	14	554	43	**494**	43	**449**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

With regard to the extent to which students felt confident in learning mathematics, students in Ireland scored an average of 10.02 on this scale, very close to the TIMSS 2015 average of 10.00. Figure 4.4 shows that in Ireland, boys (10.26) had a significantly higher mean score than girls (9.79) had on the scale measuring how confident they felt in learning mathematics. This was also observed at the international level, with boys scoring an average of 10.17 compared to girls (9.84).

Figure 4.4: Eighth grade students' scale scores on the measure of how confident they feel in learning mathematics by student gender – Ireland and TIMSS average



Students' views on teaching in their mathematics lessons

TIMSS asked students to indicate their views on the lessons they received. Students were presented with ten statements:

- I know what my teacher expects me to do;
- My teacher is easy to understand;
- I am interested in what my teacher says;
- My teacher gives me interesting things to do;
- My teacher has clear answers to my questions;
- My teacher is good at explaining mathematics;
- My teacher lets me show what I have learned;
- My teacher does a variety of things to help us learn;
- My teacher tells me how to do better when I make a mistake;
- My teacher listens to what I have to say.[16]

An overall scale of students' views on engaging teaching in their mathematics lessons was constructed at both Fourth grade and Eighth grade based on students' responses to these ten statements. These scales were set to have a mean of ten and a standard deviation of two at each grade level across all countries that participated in TIMSS 2015. Students were categorised into three groups according to their score on these scales: those who indicated they experienced *very engaging teaching* in their mathematics lessons, those who experienced *engaging teaching*, and those who reported that they encountered *less than engaging teaching*.

16 Responses to these statements at both Fourth and Eighth grade, in Ireland and internationally, are presented in tables A4.13 and A4.16 in the e-appendix.

Fourth Class

Almost three-quarters (73%) of Fourth Class students experienced *very engaging teaching* in their mathematics lessons, slightly above the international average (68%). Almost a quarter (23%) experienced *engaging teaching* in mathematics classes, and the remaining 4% found their lessons *less than engaging* (Table 4.5). Several comparison countries had similar levels of students reporting *very engaging teaching* for mathematics; these included England (73%), Northern Ireland (74%), and the United States (73%). Fourth grade students in the Russian Federation reported the highest levels of engaging teaching among our comparison countries, with 77% indicating that mathematics teaching was *very engaging.* On the other hand, the Republic of Korea had the lowest percentage of students who found their mathematics classes *very engaging* (28%) and also the highest percentage of students who found mathematics teaching *less than engaging* (17%).

In general, the majority of Fourth Class students in Ireland gave very positive responses to the individual statements that make up the engaging teaching scale. In particular, over 95% of students agreed *a lot* or *a little* that their teacher was good at explaining mathematics, that their teacher did a variety of things to help them learn, and that their teacher tells them how to do better when they make a mistake.

Fourth grade students' reports of their classroom engagement in mathematics lessons were generally positively associated with average mathematics achievement (Table 4.5). In Ireland, students who found their mathematics lessons *very engaging* scored an average of 550 in mathematics, which is higher, although not significantly so, than those who experienced *engaging teaching* (545). Those who found their mathematics lessons *less than engaging* achieved a significantly lower score (525) than those who reported *very engaging teaching*. On average across all TIMSS countries, those who experienced *very engaging teaching* (510) significantly outperformed those who experienced *engaging teaching* (498) and *less than engaging teaching* in mathematics (481). Interestingly, in New Zealand, those who experienced *engaging teaching* in their mathematics lessons significantly outperformed those who found their mathematics teachers *very engaging* (498 and 489, respectively).

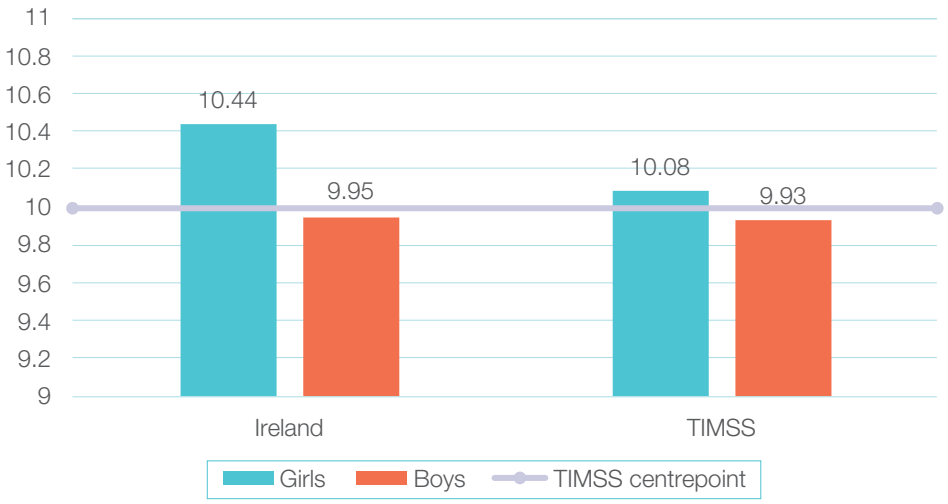
Table 4.5: Percentage of Fourth grade students by their views on engaging mathematics teaching and mean mathematics achievement – Ireland and comparison countries

	Very engaging teaching *(reference)*		Engaging teaching		Less than engaging teaching	
	%	Maths	%	Maths	%	Maths
Australia	63	519	31	520	6	**492**
England	73	548	24	545	4	**527**
Finland	58	540	37	**532**	5	**516**
Hong Kong SAR	50	621	38	**612**	11	**591**
Ireland	73	550	23	545	4	**525**
New Zealand	63	489	31	**498**	6	482
Northern Ireland	74	572	22	570	4	549
Rep. of Korea	28	620	55	**606**	17	**597**
Russian Fed.	77	566	21	560	2	--
Singapore	55	625	37	**613**	7	**592**
Slovenia	58	521	37	522	5	**503**
United States	73	545	22	**535**	5	**510**
TIMSS	68	510	26	**498**	5	**481**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

Overall, students in Ireland scored an average of 10.19 on this scale, slightly above the TIMSS average of 10.00. Girls in Ireland (10.44) scored significantly higher than boys (9.95), implying that, on average, girls found their mathematics lessons more engaging (Figure 4.5). This was also the case at the international level, with girls (10.08) scoring higher on this scale than boys (9.93).

Figure 4.5: Fourth grade students' views on engaging mathematics teaching scale scores by student gender – Ireland and TIMSS average



Second Year

In Ireland, 37% of students found the teaching in their mathematics lessons *very engaging* compared to 43% of their international peers (Table 4.6). An additional 41% of students in Ireland found their mathematics lessons *engaging,* which is the same as the TIMSS average. Further, students in Ireland were more likely to hold negative views about their mathematics lessons than the average student across all TIMSS countries, with 22% reporting that mathematics lessons were *less than engaging* compared to 17% internationally. Among the comparison countries, the Russian Federation and the United States had the highest percentages of students who found mathematics lessons *very engaging* (44% and 43%, respectively). This was the case for roughly a third of students in Singapore (33%), New Zealand (32%), and Australia (34%). Notably, less than one in ten (8%) students in the Republic of Korea found their mathematics lessons *very engaging*.

Most Second Year students in Ireland expressed positive views regarding engaging teaching in their mathematics lessons, though they were somewhat less likely to do so compared to students across all TIMSS countries. For example, around three-quarters of students in Ireland agreed (*a lot* or *a little*) that their teacher is good at explaining mathematics (77%) and provides clear answers to their questions (74%). In both cases, these percentages were somewhat lower than the international averages (84% and 81%, respectively). On the other hand, 89% of Second Year students agreed *a lot* or *a little* that they know what their teacher expects them to do, compared to 85% on average across TIMSS countries.

Students' views on engaging teaching in their mathematics lessons were generally positively associated with average achievement in mathematics. In Ireland, students who reported *very engaging teaching* scored an average of 528, and those who experienced *engaging teaching* achieved an average of 523. This difference was not statistically significant. However, those who found their mathematics lessons *less than engaging* achieved a significantly lower score (517) than

students in either of the other two groups. Internationally, students who reported *very engaging teaching* (494) in their mathematics lessons scored significantly higher than those who reported *engaging teaching* (478) or *less than engaging teaching* (464).

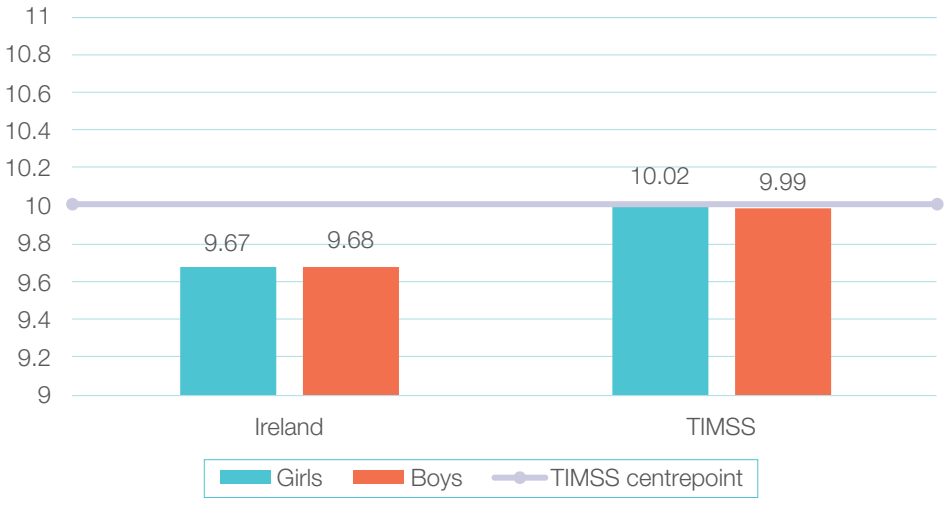
Table 4.6: Percentage of Eighth grade students by their views on engaging mathematics teaching and mean mathematics achievement – Ireland and comparison countries

	Very engaging teaching *(reference)*		Engaging teaching		Less than engaging teaching	
	%	Maths	%	Maths	%	Maths
Australia	34	521	42	**506**	24	**485**
England	38	532	42	**518**	20	**501**
Hong Kong SAR	26	606	49	**595**	24	**581**
Ireland	37	528	41	523	22	**517**
New Zealand	32	506	44	**495**	24	**475**
Rep. of Korea	8	642	52	**614**	40	**589**
Russian Fed.	44	548	46	**533**	11	**519**
Singapore	33	633	52	**620**	16	**596**
Slovenia	20	538	59	**515**	21	**500**
United States	43	530	36	**515**	21	**504**
TIMSS	43	494	41	**478**	17	**464**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

Figure 4.6 shows the scale scores for students' views on engaging teaching in their mathematics lessons. Overall, students in Ireland scored an average of 9.68, somewhat below the TIMSS average of 10.00. There was very little difference between girls and boys in Ireland in this respect, with girls scoring an average of 9.67 on this scale and boys scoring 9.68. Similarly, at the international level, girls (10.02) and boys (9.99) did not differ much in their views on engaging teaching in their mathematics lessons.

Figure 4.6: Eighth grade students' views on engaging mathematics teaching scale scores by student gender – Ireland and TIMSS average



The extent to which students value mathematics

Eighth grade students were asked to respond to nine statements which assessed the degree to which students value mathematics:

- I think learning mathematics will help me in my daily life;
- I need mathematics to learn other school subjects;
- I need to do well in mathematics to get to the university of my choice;
- I need to do well in mathematics to get the job I want;
- I would like a job that involves using mathematics;
- It is important to learn about mathematics to get ahead in the world;
- Learning mathematics will give me more job opportunities when I am an adult;
- My parents think that it is important that I do well in mathematics;
- It is important to do well in mathematics.[17]

Generally, students in both Ireland and across TIMSS countries provided positive responses to these statements. The large majority of students, in Ireland and internationally, agreed *a lot* or *a little* that it is important to do well in mathematics (Ireland: 93%; TIMSS: 90%), while most students in Ireland (95%) agreed that their parents think it is important to do well in mathematics, compared to a TIMSS average of 88%. Further, similarly high percentages of students agreed that learning mathematics will give them more job opportunities when they are an adult (Ireland: 91%; TIMSS: 86%). However, students were much less likely to agree *a lot* or *a little* that they would like a job involving mathematics, with 41% of students in Ireland agreeing that this was the case compared to 52% internationally.

Responses to these statements were used to create a composite measure to reflect the value students ascribe to mathematics. This scale was set to have a mean of ten and a standard deviation of two across all countries that participated in TIMSS 2011.[18] Students were categorised into three groups according to their score on this scale. These categories included those who *strongly value* mathematics, those who *value* mathematics, and those who indicated that they *do not value* mathematics.

Overall, the large majority of students in Ireland value mathematics as a subject (either *strongly value* or *value*), with only one in ten (11%) students reporting that they *do not value mathematics*. These figures are similar to the corresponding TIMSS averages (Table 4.7). In England, almost half of students (46%) indicated that they *strongly value mathematics*, the highest percentage among all the comparison countries. Similarly high percentages of students were found in the United States (44%), Australia (43%), New Zealand (42%) and Ireland (41%). Conversely, relatively few students in Hong Kong (19%), Slovenia (19%) and the Republic of Korea (13%) reported that they *strongly value mathematics*. Further, both Hong Kong and the Republic of Korea had the largest proportions of students who *do not value mathematics* (29% and 24%, respectively).

There is a positive association between the value students ascribed to mathematics and their average mathematics achievement, with students in Ireland who reported that they *strongly value mathematics* achieving a significantly higher average mathematics score (534) than those who *value mathematics* (520) and those who *do not value mathematics* (501). A similar pattern emerged across all comparison countries, with the exception of the Russian Federation where those who strongly

17 The responses to these statements at Eighth grade, in Ireland and internationally, are presented in Table A4.19 in the e-appendix.
18 Data from TIMSS 2015 were placed on the TIMSS 2011 scale.

value mathematics did not differ significantly from those who value mathematics in terms of their mathematics achievement.

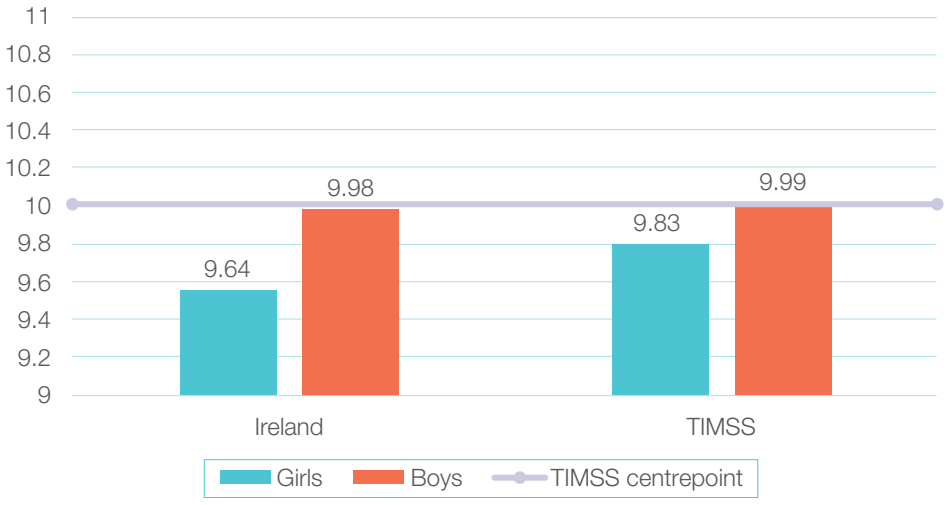
Table 4.7: Percentage of Eighth grade students by the value they ascribe to mathematics and mean mathematics scores – Ireland and comparison countries

	Strongly value maths *(reference)*		Value maths		Do not value maths	
	%	Maths	%	Maths	%	Maths
Australia	43	524	46	**501**	12	**464**
England	46	526	46	**518**	8	**490**
Hong Kong SAR	19	617	52	**602**	29	**567**
Ireland	41	534	48	**520**	11	**501**
New Zealand	42	505	48	**491**	10	**458**
Rep. of Korea	13	656	63	**614**	24	**557**
Russian Fed.	31	547	52	538	17	**522**
Singapore	34	629	58	**621**	8	**590**
Slovenia	19	532	64	**516**	17	**499**
United States	44	531	45	**516**	11	**488**
TIMSS	42	498	45	**477**	13	**449**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

Students in Ireland scored an average of 9.81 on the scale measuring the value they ascribe to mathematics, which is lower than the TIMSS 2015 average of 9.91. There was some variation in this when taking gender into account (Figure 4.7). For example, boys in Ireland scored an average of 9.98 on this scale, while girls scored an average of 9.64. This difference was statistically significant suggesting that, on average, boys ascribed more value to mathematics than did girls. A similar pattern was observed at the international level with boys scoring significantly higher than girls (9.99 and 9.83, respectively).

Figure 4.7: Value Eighth grade students ascribe to mathematics scale scores by student gender – Ireland and TIMSS average



The relationship between students' attitudes and their home educational environment

A scale measuring students' access to home resources for education and learning was established for students at each grade level across all countries. At Fourth grade, the *home learning resources* variable is based on student and parent responses to the following items: the number of books in the home (student report), the number of children's books in the home (parent report), the number of home study supports (student report), parental occupation (parent report), and parental education (parent report). At Eighth grade, the *home educational resources* variable is based only on students' responses to the following items: the number of books in the home, the number of home study supports, and parental education. [19]

Table 4.8 shows the correlations[20] among the scale scores measuring the extent to which Fourth Class students *like learning mathematics*, their views on *engaging teaching in their mathematics lessons*, the extent to which they feel *confident in mathematics* and their *home learning resources*. In general, there were moderate positive correlations among the attitudinal scales. For example, there was a moderate positive correlation (r = 0.43) between the extent to which students *like learning mathematics* and their views on *engaging teaching in their mathematics lessons*, suggesting that students who liked learning mathematics also tended to find their lessons engaging (and equally those who found their lessons engaging also liked learning mathematics). There was also a strong positive correlation (r = 0.60) between the extent to which students *like learning mathematics* and felt *confident in mathematics*. Finally, there was a moderate positive correlation (r = 0.30) between students' views on *engaging teaching in their mathematics lessons* and the extent to which they felt *confident in mathematics*.

Although there was a statistically significant correlation between the *home learning resources* variable and students' report of feeling *confident in mathematics*, this relationship was weak (r = 0.19). The correlations between *home learning resources* and the extent to which students' *like mathematics*, and between *home learning resources* and students' views of *engaging teaching*, were weak and not significant.

Table 4.8: Correlations among scale scores measuring the extent to which Fourth Class students like learning mathematics *(1)*, their views on engaging teaching in their mathematics lessons *(2)*, their confidence in learning mathematics *(3)* and their home learning resources *(4)*

	1.	2.	3.	4.
1. Students like learning mathematics	--	0.43	0.60	0.03
2. Students' views on engaging teaching in their mathematics lessons		--	0.30	-0.05
3. Students' confidence in learning mathematics			--	0.19
4. Home learning resources				--

Note: All correlations are statistically significant at .05 level except for those shaded in grey.

Table 4.9 below shows the correlations among the scale scores for Second Year students' attitudes to mathematics, and *home educational resources*. Overall, there were a number of

19 The descriptive statistics for these variables at Fourth and Eighth grade in Ireland and across TIMSS countries can be found in tables A4.22 to A4.29 in the e-appendix.

20 A correlation is a measure of the strength of a linear relationship between two variables. Correlation coefficients range on a scale from -1.0 to +1.0. A positive correlation indicates that an increase in one variable is associated with an increase in the value of the other variable. A negative correlation indicates that when the value of one variable increases, the value of the other decreases. A correlation of .10 can be considered a small or weak association, a correlation of .30 can be considered a moderate association and a correlation of .50 can be considered a strong or large association (Cohen, 1988).

moderate to strong positive correlations among the attitudinal variables. For example, there was a strong positive (r = 0.50) correlation between the extent to which students *like learning mathematics* and their views on *engaging teaching in their mathematics lessons*. This suggests that students who liked learning mathematics tended to find their lessons engaging and equally, those who found their lessons engaging also liked learning mathematics. There was also a strong positive correlation (r = 0.54) between the extent to which students *like learning mathematics* and the *value students ascribe to mathematics*, indicating that those who liked learning mathematics tended to value the subject too. There was a strong positive correlation (r = 0.68) between the extent to which students *like learning mathematics* and the extent to which students felt *confident in mathematics*. This was the strongest association between all scale scores and implies that students who liked learning mathematics tended to feel more confident in learning the subject (and those who felt more confident also liked mathematics).

Home educational resources were significantly and positively correlated with each of the attitudinal scales. However, each of these correlations was weak.

Table 4.9: Correlations among scale scores measuring the extent to which Second Year students like learning mathematics *(1)*, their views on their mathematics lessons *(2)*, their confidence in learning mathematics *(3)*, the value they ascribe to mathematics *(4)* and their home educational resources *(5)*

	1.	2.	3.	4.	5.
1. Students like learning mathematics	--	0.50	0.68	0.54	0.17
2. Students' views on engaging teaching in their mathematics lessons		--	0.35	0.38	0.06
3. Students' confidence in learning mathematics			--	0.39	0.16
4. Value students ascribe to mathematics				--	0.15
5. Home educational resources					--

Note: All correlations are statistically significant at the .05 level.

Chapter summary

In Ireland, around three-quarters (77%) of Fourth Class students reported that they liked learning mathematics to some extent while this was the case for around half (49%) of students in Second Year. While Fourth Class students expressed more positive views than their Second Year counterparts, both grade levels were generally less likely to indicate that they like learning mathematics than the corresponding averages across all TIMSS countries. In Ireland and at the international level, there was a significant positive association between the extent to which students like learning mathematics and average mathematics achievement at both Fourth and Eighth grade. On average, girls were slightly more likely than boys to report positive attitudes towards learning mathematics at Fourth Class in Ireland however, this difference was not statistically significant. On the other hand, at Second Year, boys were significantly more likely than girls to hold positive attitudes towards learning mathematics.

Thirty-seven percent of Fourth Class students in Ireland reported feeling very confident in learning mathematics, which is somewhat greater than the average across all TIMSS countries (32%). Second Year students were far less likely to indicate that this was the case, with only 16% doing so in Ireland and 14% internationally. Although the same as the TIMSS average, it is a concern that over two-fifths of Second Year students in Ireland reported that they did not feel confident in learning mathematics. At both grade levels in Ireland, there was a positive relationship between the extent to which students felt confident in learning mathematics and mathematics achievement. Similar patterns were observed on average across TIMSS countries. In Ireland and internationally, boys reported significantly higher levels of confidence in learning mathematics than did girls at both grade levels.

Students at both grade levels were asked about their views on the mathematics lessons they receive. In Ireland, Fourth Class students were generally positive about their mathematics lessons, and were more likely to find their lessons *very engaging* than their international peers (73% vs. 68%). A substantially lower percentage of Second Year students indicated that they found their mathematics lessons *very engaging* (37%). In addition, Second Year students in Ireland were less likely to report finding their lessons *very engaging* than on average across all TIMSS countries (37% vs. 43%), and more likely to indicate that their mathematics lessons were *less than engaging* (22% vs. 17%).

The relationship between students' views on their mathematics lessons and their mathematics acheivement is less clear than for other scales. While students in Ireland who reported that their mathematics lessons were *very engaging* scored on average higher than those who reported *engaging* teaching, this difference was not statistically significant at either Fourth Class or Second Year. On the other hand, students who reported that their mathematics lessons were *less than engaging* achieved a significantly lower average mathematics score than those who reported *very engaging* teaching, at both grade levels. On average, Fourth Class girls found their mathematics lessons more engaging than did Fourth Class boys. Conversely, there was very little difference in the extent to which boys and girls at Second Year found their mathematics lessons engaging. This was also the case internationally for Eighth grade students.

Students in Second Year were also asked about how much they value mathematics. Almost 90% of students in Ireland indicated that they value mathematics to some extent (either *strongly value* or *value*), which is similiar to the average across all TIMSS countries (87%). In Ireland and internationally, students who strongly value mathematics achieved the highest average mathematics scores, significantly outperforming those who *value* or *do not value* mathematics. On average, boys in Ireland ascribed a signficantly higher value to mathematics than did girls, a pattern which was also evident on average across TIMSS countries.

The relationships among each of the attitudinal variables were explored as well as the relationships between each of these variables and students' home resources for education and learning. A number of moderate to strong relationships were found. At both Fourth Class and Second Year, students who like learning mathematics also tended to find their lessons engaging and had greater confidence in learning the subject. Second Year students who liked mathematics were also more likely to value mathematics.

Fourth Class students who had access to more home learning resources were significantly more likely to feel confident in learning mathematics. However, this relationship was found to be weak. At Second Year, students who reported having access to more home educational resources were significantly more likely to like learning mathematics, find their mathematics lessons engaging, have greater confidence in learning mathematics, and ascribe greater value to mathematics, although these relationships were all found to be weak.

Chapter 5: Students' attitudes toward science, and science lessons

This chapter focuses on students' attitudes towards science and science lessons. Fourth Class and Second Year students were asked about their attitudes to learning science, their views on their science lessons, and how confident they felt in learning science. Students in Second Year were also asked about the value they ascribed to science. The relationships between students' attitudes and achievement are also considered, as well as the variation in students' attitudes by student gender. The findings for each grade level are considered separately.

It should be noted that science is not a compulsory subject at lower secondary level in Ireland, although over 90% of lower-secondary students take science as a subject. All Second Year students that participated in TIMSS were presented with science items as part of the cognitive test, regardless of whether they studied science or not. On the other hand, only students who studied science[21] were asked to answer questions relating to their attitudes to learning science, their views on their science lessons, how confident they felt in learning science and the extent to which they value science.

Further, while Second Year students in Ireland studied science as one single and integrated subject, in some countries Eighth grade students were taught subjects such as biology, chemistry, physics and Earth science as separate science subjects. This was the case for two of our comparison countries: Slovenia and the Russian Federation. As such, these two comparison countries are not included in the sections of this report which deal with Eighth grade students' attitudes towards science. It is also important to keep in mind that when referring to the TIMSS average for Eighth grade students, this only includes countries which taught science as an integrated subject.[22]

The extent to which students like learning science

Fourth and Eighth grade students were presented with nine statements regarding how they feel about learning science:

- I enjoy learning science;
- I wish I did not have to study science;
- Science is boring;
- I learn many interesting things in science;
- I like science;
- I look forward to learning science in school;
- Science teaches me how things in the world work;
- I like to do science experiments;
- Science is one of my favourite subjects.[23]

21 In TIMSS 2015, 4.7% of Second Year students that participated in TIMSS in Ireland did not study science.
22 The following countries taught Eighth grade science as separate subjects and therefore are not included in TIMSS averages for Eighth grade students: Georgia, Hungary, Kazakhstan, Lebanon, Lithuania, Malta, Morocco, the Russian Federation, Slovenia, and Sweden.
23 Responses to these statement at both Fourth and Eighth grades in Ireland and internationally are presented in tables A5.1 and A5.4 in the e-appendix.

The responses to these nine statements were combined in order to create overall measures for Fourth and Eighth grade students that reflected the extent to which they liked learning science. These scales, which were established in TIMSS 2011, were set to have a mean of ten and a standard deviation of two across all countries that participated in TIMSS in 2011 at each grade level.[24] Students were also categorised into three groups according to their score on the composite measure: those who *very much like learning science*, those who *like learning science*, and those who *do not like learning science*.

Fourth Class

Fourth Class students in Ireland expressed far more positive attitudes towards science than they did for mathematics, with 58% reporting that they *very much like learning science*, compared to 38% for mathematics (see Chapter 4). This was similar to the corresponding international average for science (56%) and to corresponding percentages in many of the comparison countries, including Hong Kong, New Zealand, the Russian Federation and Northern Ireland (Table 5.1). Further, 11% of Fourth Class students in Ireland, and on average across TIMSS countries, indicated that they *do not like learning science*. Finland (19%), England (17%) and Slovenia (17%) had notably higher percentages of students who *do not like learning science.*

Fourth grade students generally gave very positive responses to the statements about learning science. In particular, the vast majority of students in Ireland (95%) and internationally (92%) agreed (*a lot* or *a little*) that they like to do science experiments. Similarly, high percentages agreed that science teaches them how things in the world work (93% in Ireland; 93% internationally).

Table 5.1: Percentage of Fourth grade students by the extent to which they like learning science and mean science achievement – Ireland and comparison countries

	Very much like learning science *(reference)*		Like learning science		Do not like learning science	
	%	Science	%	Science	%	Science
Australia	54	531	34	**522**	12	**505**
England	49	542	34	**535**	17	**523**
Finland	38	558	44	555	19	**545**
Hong Kong SAR	57	569	32	**543**	11	**533**
Ireland	58	539	31	**519**	11	**506**
New Zealand	58	514	32	**501**	10	**480**
Northern Ireland	59	526	32	**515**	10	**500**
Rep. of Korea	42	605	44	**582**	14	**566**
Russian Fed.	58	570	34	564	8	566
Singapore	56	600	33	**582**	11	**567**
Slovenia	43	551	40	**540**	17	**531**
United States	61	555	28	**540**	11	**526**
TIMSS	56	518	33	**492**	11	**483**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

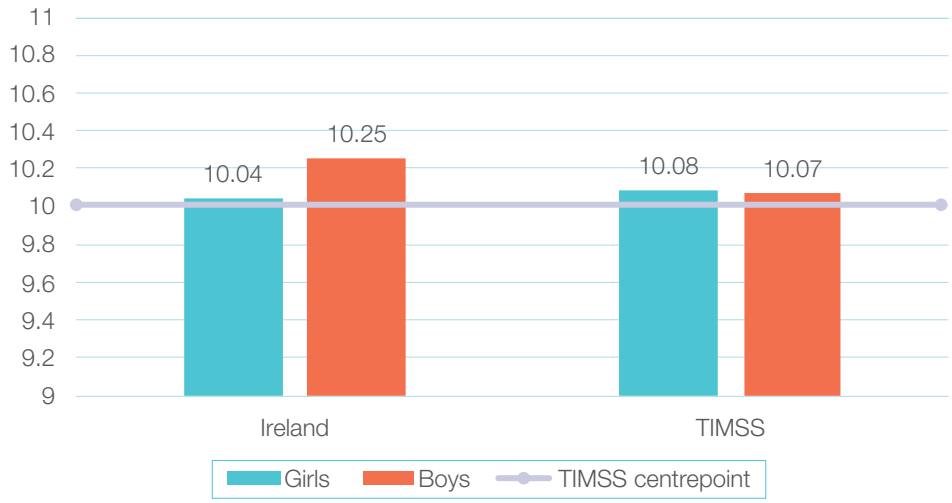
There was a positive association between students' enjoyment of learning science and average science achievement in Ireland and on average across TIMSS countries. Students in Ireland who

24 Data from TIMSS 2015 were placed on the TIMSS 2011 scale.

very much like learning science achieved an average science score of 539, which was significantly higher than those who *like learning science* (519) and those who *do not like learning science* (506). Of all the comparison countries in Table 5.1, only students in the Russian Federation and Finland did not have a significant association between liking learning science and science achievement.

Fourth Class students have a mean score of 10.16 on the scale measuring the extent to which they like learning science, which is slightly higher than the TIMSS 2015 average of 10.08. Unlike the small gender differences in liking mathematics (Chapter 4), there were significant differences in the extent to which Fourth Class boys and girls liked learning science (Figure 5.1). Boys in Ireland (10.25) reported significantly more positive attitudes to learning science than did girls (10.04). This contrasts with the TIMSS averages for boys and girls, where boys (10.07) and girls (10.08) reported similar levels of enjoyment of learning science.

Figure 5.1: Fourth grade students' enjoyment of learning science scale scores by student gender – Ireland and TIMSS average



Second Year

Second Year students in Ireland were much less likely to express positive views about learning science than Fourth Class students (33% reported that they *very much like learning science* compared to 58% at Fourth Class). In addition, a much greater proportion of Second Year students indicated that they *do not like learning science* (26%) than was the case at Fourth Class (11%).

Further, students in Ireland are somewhat less likely to express positive views towards science than their international peers (Table 5.2). For example, the percentage of Second Year students who agreed that they *very much like learning science* (33%) is lower than the corresponding international average across TIMSS countries (37%), while the percentage who *do not like learning science* is notably higher (26% in Ireland; 19% on average across TIMSS countries).

Students were most likely to agree (*a lot* or *a little*) with statements which suggested that science teaches them about how things in the world work (Ireland: 87%; TIMSS: 88%), and that they like to conduct science experiments (Ireland: 87%; TIMSS: 87%). Conversely, students in Ireland were less likely to indicate that science is one of their favourite subjects with about half (52%) of students reporting that this was the case, compared to an international average of 67%.

In England and New Zealand, the percentage of students who *very much like science* (31% in

both countries) was similar to that in Ireland. In Singapore, 38% of students indicated that they *very much like learning science*; the highest among the comparison countries. Conversely, students in the Republic of Korea were the least likely to express positive views towards science, with only one in ten (10%) reporting that they *very much like* the subject and almost half of students indicating that they *do not like learning science* (49%).

Both in Ireland and internationally, students' attitudes to learning science were positively and significantly associated with their average science achievement (Table 5.2). For example, students in Ireland who reported that they *very much like science* scored an average of 565, which is significantly higher than the score for those who *like learning science* (534) and for those who *did not like learning science* (493).

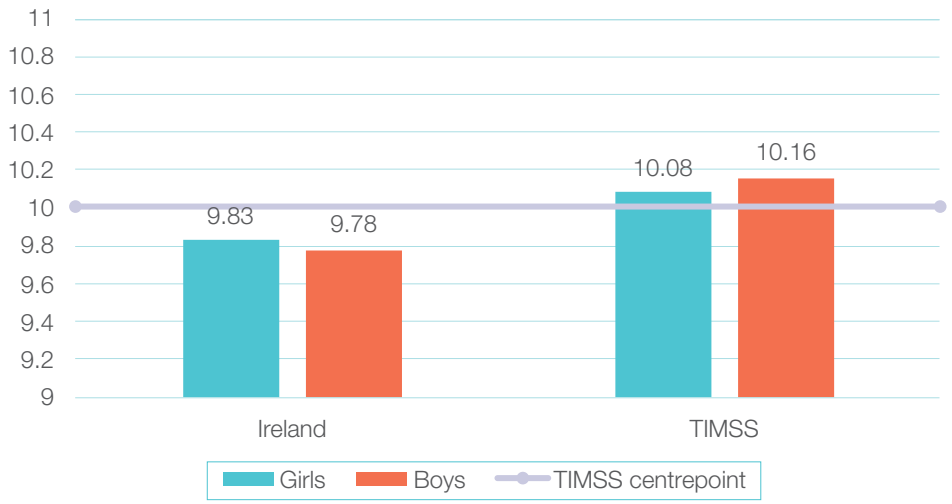
Table 5.2: Percentage of Eighth grade students by the extent to which they like learning science and mean science achievement – Ireland and comparison countries

	Very much like learning science *(reference)*		Like learning science		Do not like learning science	
	%	Science	%	Science	%	Science
Australia	28	550	43	**512**	29	**482**
England	31	569	44	**536**	25	**504**
Hong Kong SAR	30	574	51	**542**	19	**512**
Ireland	33	565	41	**534**	26	**493**
New Zealand	31	542	47	**509**	22	**484**
Rep. of Korea	10	622	41	**572**	49	**528**
Singapore	38	622	47	**588**	15	**558**
United States	36	556	42	**524**	21	**504**
TIMSS	37	516	44	**475**	19	**453**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

Students in Ireland scored an average of 9.82 on the scale reflecting the extent to which students like learning science, which is somewhat lower than the TIMSS average of 10.13. Figure 5.2 displays the average scores for boys and girls in Ireland and internationally on this scale. In Ireland, girls scored 9.83 on this measure, slightly but not significantly higher than boys who scored an average of 9.78. However, at the international level, this pattern is reversed. On average across all TIMSS countries, boys (10.16) scored significantly higher than girls (10.08) on this scale.

Figure 5.2: Eighth grade students' enjoyment of learning science scale scores by student gender – Ireland and TIMSS average



The extent to which students feel confident in learning science

Students in Fourth grade were presented with seven statements that aimed to measure the extent to which they felt confident in learning science:

- I usually do well in science;
- Science is harder for me than many of my classmates;[25]
- I am just not good at science;[26]
- I learn things quickly in science;
- My teacher tells me I am good at science;
- Science is harder for me than any other subject;
- Science makes me confused.

Eighth grade students were presented with an additional statement:

- I am good at working out difficult science problems.[27]

An overall scale measuring how confident students felt in learning science was created for each grade level based on the extent of students' agreement with these seven/eight statements. The scales were established in 2011 and were set to have a mean of ten and a standard deviation of two across all countries that participated in TIMSS 2011 at each grade level.[28] The extent to which students felt confident in learning science was also described at three levels according to their score on the overall scale: those who are *very confident in science*, those are *confident in science*, and those who are *not confident in science*.

25 At Eighth grade, this statement was phrased as 'science is more difficult for me than for many of my classmates.'
26 At Eighth grade, this statement was phrased as 'science is not one of my strengths.'
27 Responses to these statements at both Fourth and Eighth grades in Ireland and internationally are presented in tables A5.7 and A5.10 in the e-appendix.
28 Data from TIMSS 2015 were placed on the TIMSS 2011 scale.

Fourth Class

In Ireland, 38% of Fourth Class students indicated that they were *very confident in science* compared to 40% on average across TIMSS countries (Table 5.3). A further 45% indicated that they were *confident in science* (TIMSS: 42%), while the remaining 16% of Fourth Class students in Ireland were *not confident in science* (TIMSS: 18%). Looking at our comparison countries, students in the United States were the most likely to report being *very confident in science* (44%), followed by those in the Russian Federation (40%). On the other hand, almost a third of students in Singapore (31%) reported that they are *not confident in science*.

Most Fourth grade students agreed (*a lot* or *a little*) that they usually do well in science (Ireland: 87%; TIMSS: 87%) and that they learn things quickly (Ireland: 80%; TIMSS: 83%). However, 23% of students in Ireland agreed to some extent that science was harder for them than it was for their classmates. This was the case for 29% of students internationally. Further, around one in four students (25%) in Ireland agreed *a lot* or *a little* that science makes them confused, which is similar to the average across TIMSS countries (24%).

The extent to which Fourth grade students felt confident in learning science was positively associated with science achievement, both internationally and in Ireland. In Ireland, students who reported feeling *very confident in science* (546), on average, scored significantly higher than those who were *confident* (530), or *not confident in science* (492). Similarly, at an international level, Fourth grade students who were *very confident in science* (532) scored significantly higher in science than those who were *confident* or *not confident* in science (501 and 464, respectively).

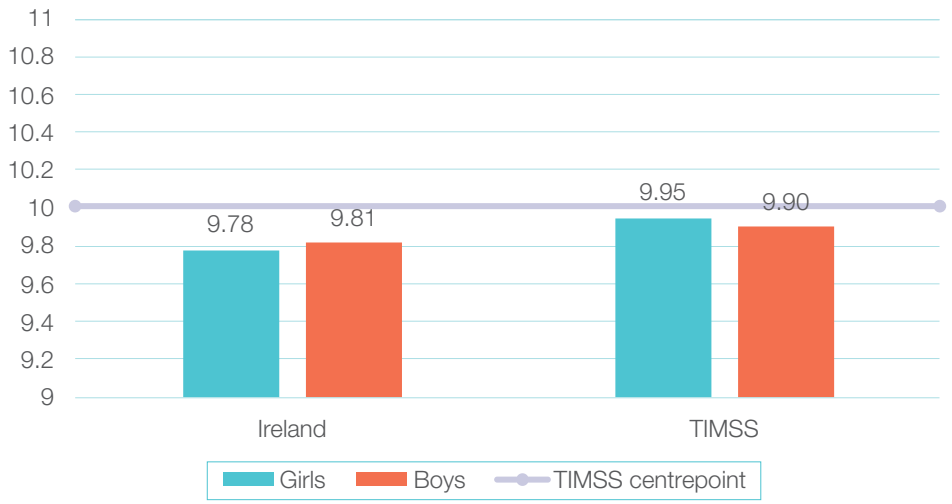
Table 5.3: Percentage of Fourth grade students by the extent to which they feel confident in learning science and mean science achievement – Ireland and comparison countries

	Very confident in science *(reference)*		Confident in science		Not confident in science	
	%	Science	%	Science	%	Science
Australia	35	542	45	**525**	20	**494**
England	33	556	42	**537**	25	**510**
Finland	34	573	52	**552**	14	**519**
Hong Kong SAR	25	588	48	**558**	27	**526**
Ireland	38	546	45	**530**	16	**492**
New Zealand	24	537	51	**510**	25	**470**
Northern Ireland	36	534	45	**521**	19	**492**
Rep. of Korea	20	622	57	**592**	24	**556**
Russian Fed.	40	582	41	**566**	19	**543**
Singapore	26	621	43	**596**	31	**559**
Slovenia	35	566	47	**543**	18	**497**
United States	44	569	38	**542**	17	**506**
TIMSS	40	532	42	**501**	18	**464**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

Students in Fourth Class in Ireland scored an average of 9.80 on the scale measuring the extent to which they felt confident in learning science. There was little variation in this measure when looking at gender, with boys scoring an average of 9.81 and girls scoring 9.78 (Figure 5.3). This difference was not statistically significant, suggesting that Fourth Class girls and boys are similarly confident in learning science. On average across TIMSS countries, girls (9.95) reported just slightly, although statistically significantly, higher scores than boys (9.90) on the scale measuring how confident they felt in learning science.

Figure 5.3: Fourth grade students' scale scores on the measure of how confident they feel in learning science by student gender – Ireland and TIMSS average



Second Year

In Ireland, about a quarter (26%) of Second Year students reported that they were *very confident in science* compared to 22% of students internationally. An additional 36% of students in Ireland reported that they felt *confident in science* (TIMSS average: 39%), while 38% of students in Ireland were *not confident in science* (TIMSS average: 40%). Of the comparison countries, students in the United States were the most likely to express high levels of confidence in science, with 30% reportedly *very confident* in the subject. In England, roughly one-fifth (21%) of students felt *very confident in science* while the Republic of Korea (7%) had the lowest percentage of students who were *very confident in science* relative to the comparison countries. Notably, a large majority (70%) of students in the Republic of Korea reported being *not confident in science*.

In Ireland, around three-quarters (74%) of students agreed (*a lot* or *a little*) that they usually did well in science. This was broadly similar to the equivalent across all TIMSS countries (76%). Further, 52% of students in Ireland agreed to some extent that they were good at working out difficult science problems (TIMSS: 58%). Conversely, 37% of students agreed that science makes them confused, just slightly below the corresponding international average (40%). While 29% of students in Ireland agreed (*a lot* or *a little*) that science is more difficult for them than for their classmates, this is markedly below the international average of 40%.

The extent to which students felt confident in learning science was positively associated with their average science achievement (Table 5.4). In Ireland, those who were *very confident in science* had an average science score of 585, which is significantly higher than the average score of those who were *confident in science* (543) and of those who were *not confident in science* (492). A similar pattern was observed at the international level.

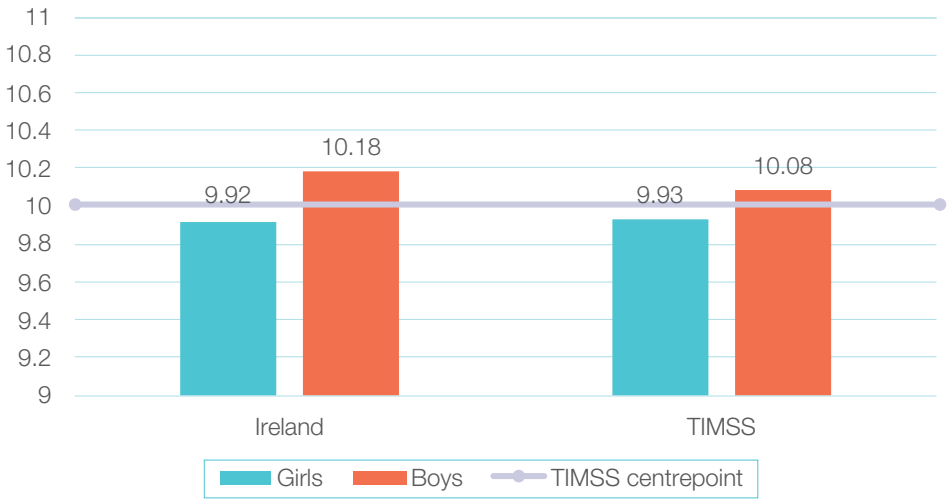
Table 5.4: Percentage of Eighth grade students by the extent to which they feel confident in learning science and mean science achievement – Ireland and comparison countries

	Very confident in science *(reference)*		Confident in science		Not confident in science	
	%	Science	%	Science	%	Science
Australia	17	571	37	**526**	45	**482**
England	21	585	41	**547**	38	**503**
Hong Kong SAR	13	592	38	**560**	49	**523**
Ireland	26	585	36	**543**	38	**492**
New Zealand	16	572	39	**528**	45	**482**
Rep. of Korea	7	642	23	**599**	70	**532**
Singapore	17	633	40	**608**	44	**572**
United States	30	568	39	**533**	30	**495**
TIMSS	22	538	39	**490**	40	**452**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

Figure 5.4 shows the average scores for boys and girls, in Ireland and internationally, on the scale measuring the extent to which students felt confident in learning science. Overall, students in Ireland had an average scale score of 10.05, which is about the same as the TIMSS 2015 average score (10.02). However, these scores varied somewhat by student gender. In Ireland, Second Year boys (10.18) reported a significantly higher mean score than did girls (9.92) on the scale measuring how confident they felt in learning science. This was also the case at the international level, where boys scored an average of 10.08 and girls scored an average of 9.93.

Figure 5.4: Eighth grade students' scale scores on the measure of how confident they feel in learning science by student gender – Ireland and TIMSS average



Students' views on teaching in their science lessons

Fourth and Eighth grade students were asked to indicate their agreement with the following ten statements about the extent to which they found science lessons engaging:

- I know what my teacher expects me to do;
- My teacher is easy to understand;
- I am interested in what my teacher says;
- My teacher gives me interesting things to do;
- My teacher has clear answers to my questions;
- My teacher is good at explaining science;
- My teacher lets me show what I have learned;
- My teacher does a variety of things to help us learn;
- My teacher tells me how to do better when I make a mistake;
- My teacher listens to what I have to say.[29]

Responses to these statements were used to construct an overall indicator of how engaging students found their science lessons at both Fourth and Eighth grade. These scales were set to have a mean of ten and a standard deviation of two at each grade level across all countries that participated at these grade levels in TIMSS 2015. Students were categorised into three groups according to their score on these scales: those who indicated they experienced *very engaging teaching* in their science lessons, those who experienced *engaging teaching*, and those who reported that they encountered *less than engaging teaching*.

Fourth Class

The statements measuring the extent to which students experienced engaging teaching in their science lessons elicited positive responses from most students, both in Ireland and internationally. For example, nearly all students agreed (*a lot* or *a little*) that their teacher did a variety of things to help them learn (Ireland: 94%; TIMSS: 94%), and that their teacher was good at explaining science (Ireland: 94%; TIMSS: 95%).

In Ireland, 71% of Fourth Class students reported that they experienced *very engaging teaching* in their science lessons, slightly above the international average of 69% (Table 5.5). A further one-quarter (24%) of students reported *engaging teaching* in their science lessons, while only 5% of students experienced *less than engaging teaching* in science lessons. Of the comparison countries presented in Table 5.5, only the Russian Federation (80%), the United States (75%) and Northern Ireland (72%) had greater proportions of students indicating that they experienced *very engaging teaching* in their science lessons. The Republic of Korea had the lowest proportion of students who indicated that the teaching they received in their science lessons was *very engaging* (33%) and the highest proportion who indicated that the teaching they received was *less than engaging* (17%).

However, in Ireland, there was not a straightforward association between students' classroom engagement and their science achievement. The scores of those who felt their science lessons were *very engaging* (529) did not differ significantly from the scores of those who reported that they received *engaging* (533) or *less than engaging teaching* (520) in terms of their science achievement. However, those who indicated they received *engaging teaching* in their science lessons had significantly higher mean science achievement than those who found science teaching *less than engaging.* There is a mixed pattern of results among our comparison countries in terms of the relationship between

29 Responses to these statements at both Fourth and Eighth grades in Ireland and internationally are presented in tables A5.13 and A5.16 in the e-appendix.

students' views on engaging teaching in science lessons and science achievement. For example, no significant relationship was observed between these variables in Australia or Northern Ireland. On the other hand, students who indicated they received *very engaging teaching* had significantly higher mean science achievement than those who reported *engaging* or *less than engaging teaching* in Hong Kong, the Republic of Korea, Singapore and the United States.

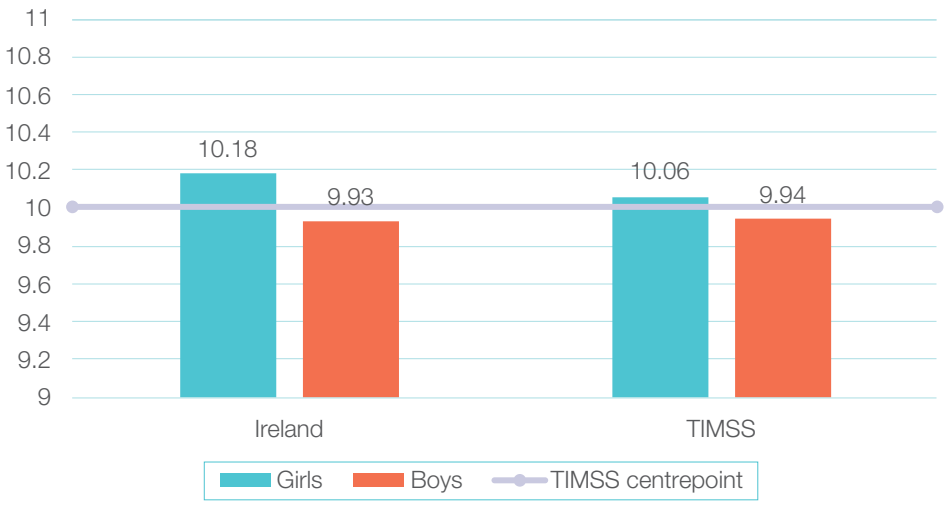
Table 5.5: Percentage of Fourth grade students by their views on engaging science teaching and mean science achievement – Ireland and comparison countries

	Very engaging teaching *(reference)*		Engaging teaching		Less than engaging teaching	
	%	Science	%	Science	%	Science
Australia	63	524	29	528	8	517
England	70	534	24	**544**	6	535
Finland	60	556	34	554	6	**532**
Hong Kong SAR	55	562	33	**553**	12	**544**
Ireland	71	529	24	533	5	520
New Zealand	61	504	31	**514**	8	499
Northern Ireland	72	519	23	522	6	526
Rep. of Korea	33	597	50	**587**	17	**583**
Russian Fed.	80	567	18	568	2	--
Singapore	56	595	35	**587**	9	**577**
Slovenia	62	545	33	544	5	**522**
United States	75	551	19	**543**	6	**526**
TIMSS	69	510	25	**500**	6	**489**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

Students in Ireland scored an average of 10.05 on a scale measuring their views on their science lessons, which is almost identical to the TIMSS average of 10.00. Some variation was apparent when looking at this measure and gender. In Ireland, girls (10.18) scored significantly higher than boys (9.93), showing that girls found their science lessons more engaging. A similar pattern was observed for the TIMSS average (Figure 5.5).

Figure 5.5: Fourth Class students' views on engaging science teaching scale scores by student gender – Ireland and TIMSS average



Second Year

Almost half of Second Year students in Ireland (45%) found the teaching they received in their science lessons was *very engaging*, which is similar to the TIMSS average of 47% (Table 5.6). On the other hand, about a fifth (21%) of students in Ireland reported that teaching in their science classes was *less than engaging*, slightly higher than the TIMSS average of 17%. Students in the Republic of Korea were the least likely among the comparison countries to indicate that they received *very engaging teaching* in their science lessons, with just one in ten (10%) reporting so. In contrast, just over half (51%) of students in the United States experienced *very engaging* teaching in their science lessons.

In general, Second Year students responded positively to the statements measuring engaging teaching. For example, the majority (85%) of students in Ireland agreed (*a lot* or *a little*) that they know what their teacher expects them to do (TIMSS: 83%). Similarly, high percentages of students, both in Ireland and across all TIMSS countries, agreed that their teacher listens to what they have to say (Ireland: 82%; TIMSS: 82%). In Ireland, students were least likely to endorse the statement that their science teacher lets them show what they have learned, with 68% agreeing (*a lot* or *a little*) that this was the case compared to 75% across TIMSS countries.

There was a positive association between students' views on their science lessons and their average achievement in science. In Ireland, students who reported that their science lessons were *very engaging* scored an average of 545, which is significantly higher than the mean science score for those who found science lessons *engaging* (535), and for those who reported their lessons were *less than engaging* (509). The same pattern emerged for all of our comparison countries, with the partial exception of England, as well as on average across all TIMSS countries.

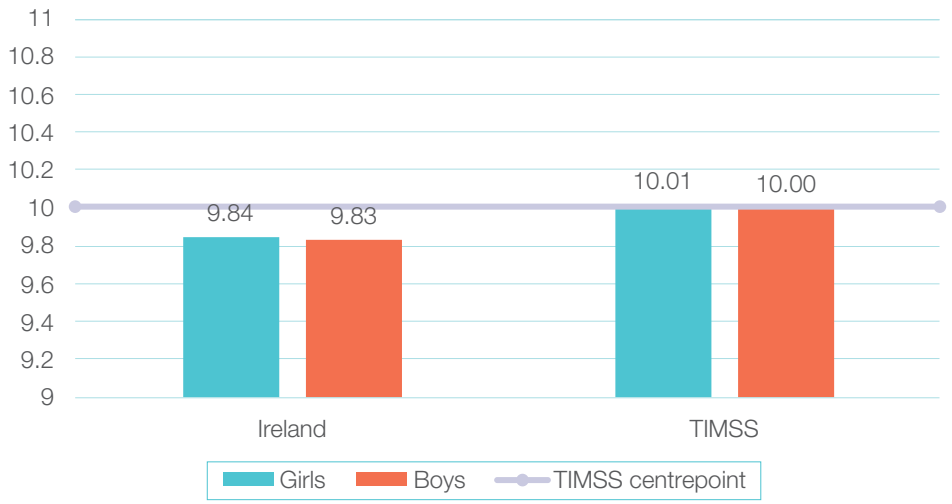
Table 5.6: Percentage of Eighth grade students by their views on engaging science teaching and mean science achievement – Ireland and comparison countries

	Very engaging teaching *(reference)*		Engaging teaching		Less than engaging teaching	
	%	Science	%	Science	%	Science
Australia	38	534	39	**507**	22	**490**
England	38	545	42	540	20	**522**
Hong Kong SAR	34	557	48	**545**	17	**526**
Ireland	45	545	34	**535**	21	**509**
New Zealand	42	527	40	**509**	18	**492**
Rep. of Korea	10	604	47	**567**	43	**533**
Singapore	35	606	52	**595**	13	**578**
United States	51	539	32	**529**	17	**515**
TIMSS	47	498	36	**480**	17	**464**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

In Ireland, Second Year students scored an average of 9.84 on the scale measuring experience of engaging teaching, somewhat lower than the TIMSS average of 10.01. Boys (9.83) and girls (9.84) expressed very similar attitudes towards the teaching in their science lessons (Figure 5.6). This was also the case on average across TIMSS countries.

Figure 5.6: Eighth grade students' views on engaging science teaching scale scores by student gender – Ireland and TIMSS average



The extent to which students value science

Eighth grade students were also asked to indicate their level of agreement with nine statements enquiring about the degree to which they value science:

- I think learning science will help me in my daily life;
- I need science to learn other school subjects;
- I need to do well in science to get into the university of my choice;
- I need to do well in science to get the job I want;
- I would like a job that involves using science;
- It is important to learn about science to get ahead in the world;
- Learning science will give me more job opportunities when I am an adult;
- My parents think that it is important that I do well in science;
- It is important to do well in science.[30]

Students generally gave positive responses to these statements. In Ireland, the statements most likely to be endorsed were those suggesting that it is important to do well in science (Ireland: 83%; TIMSS: 86%), or drawing attention to the value that parents place on the importance of doing well in science (Ireland: 80%; TIMSS: 80%). Compared to the average across TIMSS countries, students in Ireland were much less likely to agree (*a lot* or *a little*) that they wanted a job that involves science (Ireland: 49%; TIMSS: 59%), or that they need science to learn other school subjects (Ireland: 58%; TIMSS: 73%).

These responses were used to construct an overall measure of the extent to which Eighth grade students value science. The scale, which was established in 2011, was set to have an average of ten and a standard deviation of two across all countries that participated in TIMSS 2011.[31] In Ireland, students were less likely to place value on science than they were on mathematics. For example,

30 The responses to these statements at Eighth grade, in Ireland and internationally, are presented in Table A5.19 in the e-appendix.
31 Data from TIMSS 2015 were placed on the TIMSS 2011 scale.

close to a third (30%) of students reported that they *strongly value science*, compared to about 40% who felt the same about mathematics. In Ireland, the proportion of students who *strongly value science* was also considerably lower than the corresponding TIMSS average (40%); further, over one-quarter (27%) indicated that they *do not value science* (compared to a corresponding 19% on average across TIMSS countries).

Among our comparison countries, England had the largest percentage of students who *strongly value science*, with almost two-fifths (39%) indicating that this was the case (Table 5.7). Similar percentages of students in the United States (38%), the Russian Federation (38%), and Singapore (37%) also reported that they *strongly value science.* Students in the Republic of Korea were the least likely of all comparison countries to *strongly value science*, with just 13% reporting that this was the case.

There is a positive association between the value students ascribed to science and their science achievement. In Ireland, students who *strongly value science* achieved, an average science score of 557, which is significantly higher than the average score of those who reported that they *value science* (540) and of those who *do not value science* (501). Internationally, significant differences were also observed between these groups on average across TIMSS participants.

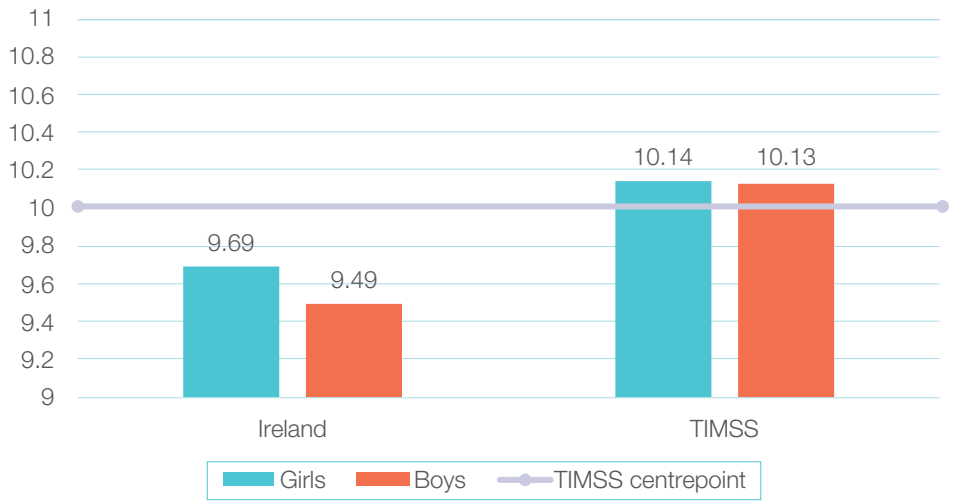
Table 5.7: Percentage of Eighth grade students by the value they ascribe to science and mean science scores – Ireland and comparison countries

	Strongly value science *(reference)*		Value science		Do not value science	
	%	Science	%	Science	%	Science
Australia	27	547	41	**517**	32	**482**
England	39	558	43	**536**	18	**502**
Hong Kong SAR	24	565	46	**549**	31	**528**
Ireland	30	557	43	**540**	27	**501**
New Zealand	30	537	46	**514**	24	**486**
Rep. of Korea	13	605	51	**566**	36	**522**
Russian Fed.	38	544	48	545	14	543
Singapore	37	621	53	**589**	10	**548**
Slovenia	20	577	52	**556**	28	**525**
United States	38	550	42	**529**	19	**501**
TIMSS	40	506	41	**482**	19	**460**

Note: Figures may not add exactly to 100% due to rounding.
Significant differences, in relation to the reference category, are highlighted in **bold**.

In Ireland, Second Year students scored an average of 9.59 on the scale measuring the value they ascribed to science, considerably below the TIMSS average of 10.16. Figure 5.7 shows how this score varied by gender. Girls in Ireland scored an average of 9.69, while boys scored an average of 9.49. This difference, although small, was statistically significant, suggesting that girls in Ireland ascribed more value to science than did boys. At the international level, the value students ascribed to science did not differ significantly by student gender.

Figure 5.7: Value Eighth grade students ascribe to science scale scores by student gender – Ireland and TIMSS average



The relationship between students' attitudes and their home educational environment

As noted in Chapter 4, students at Fourth and Eighth grade were asked to indicate the level of various home resources for education and learning that they had access to at home. At Fourth grade, an international measure of *home learning resources* was constructed based on responses to: the number of books in the home (student report), the number of children's books in the home (parent report), the number of home study supports (student report), parental occupation (parent report), and parental education (parent report). A similar measure, *home educational resources*, was constructed at Eighth grade based only on: the number of books in the home, the number of home study supports, and parental education (all student responses). [32]

Table 5.8 provides the correlations[33] among the scale scores measuring the extent to which Fourth Class students *like learning science*, their views on *engaging teaching in their science lessons*, the extent to which they felt *confident in science* and their *home learning resources*. Among the attitudinal variables, there tended to be moderate to strong positive correlations. Students who *like learning science* were more likely to view the teaching in their science lessons as *engaging* (r = 0.42), and were more likely to report feeling *confident in science* (r = 0.62). Further, students who reported *engaging teaching in their science lessons* were more likely to report feeling *confident in science* (r = 0.40). As was the case with mathematics, the correlations between the attitudinal scales for science and *home learning resources* were statistically significant but the magnitude of the relationships was weak to negligible (ranging from r = 0.05 to r = 0.14).

32 The descriptive statistics for these variables at Fourth and Eighth grade in Ireland and across TIMSS countries can be found in tables A4.22 to A4.29 in the e-appendix.

33 A correlation is a measure of the strength of a linear relationship between two variables. Correlation coefficients range on a scale from -1.0 to +1.0. A positive correlation indicates that an increase in one variable is associated with an increase in the value of the other variable. A negative correlation indicates that when the value of one variable increases, the value of the other decreases. A correlation of .10 can be considered a small or weak association, a correlation of .30 can be considered a moderate association and a correlation of .50 can be considered a strong or large association (Cohen, 1988).

Table 5.8: Correlations among scale scores measuring the extent to which Fourth Class students like learning science *(1)*, their views on engaging teaching in their science lessons *(2)*, their confidence in learning science *(3)* and their home learning resources *(4)*

	1.	2.	3.	4.
1. Students like learning science	--	0.42	0.62	0.05
2. Students' views on engaging teaching in their science lessons		--	0.40	-0.07
3. Students' confidence in learning science			--	0.14
4. Home learning resources				--

Note: All correlations are statistically significant at the .05 level.

Table 5.9 shows the correlations among the scale scores for Second Year students' attitudes to science, and *home educational resources*. Overall, there were moderate to strong correlations among the attitudinal measures. There was a strong relationship between the extent to which students *like learning science* and students' *views on engaging teaching in their science lessons* (r = 0.65), indicating that students who like science are more likely to report the teaching they receive in science as engaging (and equally those who report receiving engaging teaching are more likely to like learning science). Students who *like learning science* are also more likely to report feeling *confident in science* (r = 0.72) and to *value science* (r = 0.63). Strong correlations were observed between students' views on *engaging teaching in their science lessons* and the extent to which they felt *confident in science* as well as the extent to which students *value science*, and also between students' reports of feeling *confident in science* and the extent to which they *value science*.

The level of home educational resources available to a student was significantly correlated with each of the science attitudinal scales, suggesting that students who have access to more home educational resources hold more positive attitudes towards science. However, each of these relationships was found to be weak to moderate (ranging from r = 0.13 to r = 0.28).

Table 5.9: Correlations among scale scores measuring the extent to which Second Year students like learning science *(1)*, their views on their science lessons *(2)*, their confidence in learning science *(3)*, the value they ascribe to science *(4)* and their home educational resources *(5)*

	1.	2.	3.	4.	5.
1. Students like learning science	--	0.65	0.72	0.63	0.24
2. Students' views on engaging teaching in their science lessons		--	0.51	0.49	0.13
3. Students' confidence in learning science			--	0.50	0.28
4. Value students ascribe to science				--	0.24
5. Home educational resources					--

Note: All correlations are statistically significant at the .05 level.

Chapter summary

Fourth Class students in Ireland were more likely to report that they like learning science to some extent (89%) than Second Year students (74%). Also, while the percentage of students at Fourth Class who reported that they like learning science to some extent was the same as the corresponding TIMSS average (89%), the percentage at Second Year was somewhat below the average across TIMSS countries that participated at Eighth grade (81%). At both grade levels, in Ireland and internationally, the extent to which students like learning science was positively and significantly associated with science achievement. In Ireland, Fourth Class boys were significantly more likely than girls to indicate that they like learning science, while there was no significant difference in terms of liking science between boys and girls at Second Year.

The percentage of Fourth Class students who indicated that they were *very confident* in science (38%) is similar to the average across TIMSS countries (40%). On the other hand, although the percentage of Second Year students who report being *very confident* in science (26%) is considerably lower than at Fourth Class, it is somewhat higher than the corresponding TIMSS average of 22%. In Ireland and internationally, students' confidence in learning science was positively associated with science achievement at both Fourth and Eighth grade. Fourth Class girls and boys in Ireland have similar levels of confidence in science, while at Second Year boys reported significantly higher levels of confidence in science than did girls.

Fourth Class students generally held positive views about their science lessons, with 71% indicating that the teaching they received in these lessons was *very engaging*. This is also in line with the corresponding international average of 69%. At Second Year, the percentage was lower, with 45% of students in Ireland indicating that they received *very engaging* teaching in their science lessons. However, this was also similar to the corresponding international average at Eighth grade (47%).

The relationship between students' views on their science lessons and science achievement varied by grade level in Ireland. At Fourth Class, the relationship was not straightforward. Those who indicated that they received *very engaging teaching* did not differ significantly from those who received *engaging* or *less than engaging teaching* in terms of their average science achievement. However, the average achievement of Fourth Class students who rated the science teaching they received as *engaging* was significantly higher than that of those reporting they received *less than engaging teaching*. At Second Year, there was a positive and significant relationship between students' views on the science teaching they received and their science achievement.

The relationship between gender and students' views on engaging teaching in their science lessons also varied by grade level. In Ireland and internationally, Fourth grade girls had significantly higher average scores than boys on the scale measuring engaging teaching in science. On the other hand, at Eighth grade, boys and girls did not differ significantly in terms of their views on engaging science teaching, both in Ireland and internationally.

Second Year students were asked about how much they value science. The percentage of students in Ireland who indicated that they *strongly value science* (30%) was lower than the average across TIMSS countries (40%). Students in Ireland also placed lower value on science than mathematics, with 73% indicating they value science to some extent compared to 89% for mathematics. The extent to which students value science was significantly associated with science achievement in Ireland and internationally, with those students who value science more achieving higher science scores on average. While the value ascribed to science did not differ significantly by gender at the international level, in Ireland, girls were more likely than boys, on average, to value science.

The relationships among the variables measuring attitudes towards science were examined as well as the relationships between these variables and students' home resources for education and learning. A number of moderate to strong relationships were found between the attitudinal variables. At both grade levels, students who like learning science tended to report feeling more confident in learning the subject and viewed the teaching they received in science lessons as more engaging. Students at Fourth Class and Second Year who viewed their science teaching as engaging also tended to report feeling confident in learning science. At Second Year, students who ascribe greater value to science tend to like learning science more, feel more confident in learning the subject and rate the teaching they receive in their science lessons as more engaging. The relationships between students' home resources for education and learning and their attitudes towards science, although statistically significant, were weak to moderate at both grade levels.

Chapter 6: Summary and conclusions

This report presents the findings from TIMSS 2015 in relation to students' engagement and sense of belonging in school, as well as their attitudes towards learning mathematics and science. The findings outlined in this report point towards some noteworthy patterns in Irish students' attitudes. These patterns can be considered in terms of three broad findings, namely: (a) that students' attitudes become less positive between Fourth Class and Second Year; (b) that, in general, students hold more positive attitudes towards learning science than learning mathematics, particularly at Second Year; and (c) that some significant differences exist between the attitudes of boys and girls in Ireland towards mathematics and science.

TIMSS is a cross-sectional study of students' achievement and experiences related to learning and, as such, causal inferences cannot be made. It should also be noted that the attitudinal measures presented in this report rely on subjective self-reports, which are not error-free. Further, many factors are likely to contribute to the development of students' attitudes, including, among others, home environment, school culture and students' perceptions of societal norms. The relationships between attitudes and performance are likely to be complex and inter-related. The analyses in this report are bivariate, that is, they describe the relationship between two variables. This type of analysis does not directly take account of the inter-relationships between variables that are related to achievement or the possible recursive nature of relationships. Results should also be interpreted with consideration to structural and curricular differences across systems that participated in TIMSS. More detail on the education system of countries that took part in TIMSS 2015 can be found in the TIMSS encyclopaedia (Mullis, Martin, Goh & Cotter, 2016).

The main findings for students in Ireland and how these relate to the findings across TIMSS countries are discussed in relation to the three themes outlined above and the implications of these findings are discussed in more detail in the sections that follow.

Attitudes become less positive between Fourth Class and Second Year

In general, students in Ireland reported positive attitudes towards school. Over 90% of students at both Fourth Class and Second Year indicated that they feel they belong in their school, at least to some extent. In terms of school engagement, rates of regular absence from school are similar at Fourth Class and Second year, and are lower than the TIMSS averages at both grade levels. There is also very little variation in the rate of regular absence by gender at both Fourth Class and Second Year. However, mathematics and science achievement are negatively and significantly associated with absence from school, indicating that students with higher levels of absence from school are at significant risk of poorer school outcomes and that this risk is evident from primary level.

While students' attitudes in Ireland were generally positive, Fourth Class students tended to report more favourable attitudes towards school than did students at Second Year. Fourth Class students were much more likely to report a high sense of school belonging than students at Second Year, with about three-quarters of Fourth Class students indicating they have a high sense of belonging compared to less than half of Second Year students. Also, Fourth Class students in Ireland had a more favourable view of school than their international peers, while at Second Year, students in Ireland were less likely to report a high sense of belonging when compared to their

counterparts across TIMSS countries. The Wellbeing Policy Statement and Framework for Practice 2018 – 2023 (DES, 2019), which was introduced after the collection of the data in the current report, acknowledges the role of positive school climate and sense of belonging in school in promoting wellbeing and will be an important support going forward. The publication of the TIMSS 2019 data in December 2020 will offer an opportunity to explore students' sense of belonging in school in the context of this new strategy, albeit in the very stages of its implementation.

Similar patterns are evident when subject-specific attitudes are considered. The percentages of students who indicate that they like mathematics and science, are confident in these subjects, and view the teaching they receive during their mathematics and science lessons as engaging are all higher at Fourth Class than Second Year. Indeed, at least 95% of Fourth Class students indicated that the teaching they received in their mathematics and science lessons was engaging, while this was the case for just under 80% of Second Year students. Also, over 80% of Fourth Class students reported feeling confident in learning mathematics and science compared to about 60% at Second Year for both subjects.

This phenomenon is not unique to Ireland and is also observed across TIMSS countries, on average. However, the differences between Fourth and Eighth grade students are more notable in Ireland for some attitudes. Generally, Fourth Class students in Ireland had either similar or more positive attitudes towards mathematics and science than their TIMSS peers. In particular, Fourth Class students were more likely to report feeling confident in learning mathematics and were more likely to indicate that the teaching they received in their mathematics lessons was engaging, when compared to their counterparts in other TIMSS countries. Attitudes towards science among Fourth Class students were in line with the corresponding TIMSS averages, with similar proportions indicating that they like science, are confident in learning science and receive engaging teaching in their science lessons. On the other hand, among Second Year students, attitudes towards mathematics and science were either in line with the corresponding TIMSS averages or less positive. Similar percentages of students in Ireland and on average across TIMSS countries indicated that they value mathematics and are confident in learning mathematics and science. However, fewer Second Year students report that they like learning mathematics or science, or receive engaging teaching in these lessons, than the corresponding TIMSS averages.

In their report on STEM education in Ireland, the STEM education review group highlighted the importance of high levels of student engagement and enjoyment in STEM disciplines (The STEM Education Review Group, 2016). While the current TIMSS data predate the publication of the STEM Education Review Group report, the findings in the current report indicate that more needs to be done to ensure high levels of engagement and enjoyment at post-primary level in particular. It should also be noted that the data in this report also predate the introduction of the most recent junior cycle science curriculum (DES/NCCA, 2017) and the STEM Education Policy Statement 2017 – 2026 (DES, 2017). It will be useful to compare the findings in the current report with data from TIMSS 2019, which involves students at post-primary having experienced the new science curriculum and benefitted from other actions as part of the DES 2017-2026 STEM strategy.

Further, while the pattern of students' attitudes becoming less positive between Fourth and Eighth grades is not unique to Ireland, it is nonetheless important to consider these findings in relation to other Irish research which has found that students' attitudes towards science influence uptake of science subjects at upper-secondary level in schools in Ireland (Smyth & Hannan, 2006). If uptake of STEM subjects among students in Ireland is to be encouraged, students' enjoyment of and confidence in learning these subjects, as well as the value they place on them, needs to be emphasised. Similarly, it is important to consider the influence of the transition from primary to

post-primary school on students' attitudes. Smyth (2016) noted that a decline in academic self-image over the transition from primary to post-primary school was particularly evident among girls, students from lone-parent households and those who had a special educational need. The quality of friendship networks and student-teacher relationships were also found to be significantly associated with academic self-image, with those who received frequent praise from teachers developing a more positive academic self-image.

Differences in attitudes towards mathematics and science

Fourth Class students generally held similar attitudes towards mathematics and science. However, the pattern was somewhat different at Second Year.

At Fourth Class, the percentages of students who indicated they were very confident in learning mathematics and science were almost identical (37% and 38%, respectively). Similarly, Fourth Class students were about as likely to report the teaching they received in their mathematics and science lessons as very engaging (73% and 71%, respectively). However, large differences emerged when students were asked to indicate how much they *like* learning mathematics and science. Fifty-eight percent of Fourth Class students very much liked learning science compared to 38% for mathematics. A similar pattern was observed at the TIMSS average, although the difference in the percentages who like learning mathematics and science was less pronounced than in Ireland.

Second Year students were also much more likely to report that they very much liked learning science than to report the same for mathematics (33% compared to 14%). In fact, students in Second Year held more positive attitudes towards science than mathematics, generally. The proportion of Second Year students indicating they are very confident in science was ten percentage points higher than for mathematics (26% compared to 16%). Further, they were more likely to report that the teaching they received in science was very engaging (45%) than the teaching they received in mathematics (37%). The only area in which Second Year students showed a more positive attitude towards mathematics was in terms of how much they value the subject, with 89% of students indicating they value mathematics to some extent, compared to 73% for science.

The relatively low percentage of students in Ireland who report that they like learning mathematics is of concern. This is especially the case at Second Year where over half of students indicated that they do not like learning mathematics, which is considerably higher than the corresponding TIMSS average of 38%. In an evaluation of the impact of Project Maths on student performance it was noted that students seem to enjoy the learning and teaching methodologies encouraged by the Project Maths Development Team, but that time constraints may make it more difficult for teachers to implement these methods in practice (Shiel & Kelleher, 2017). While such teaching methods – for example, more interactive and discursive lessons, drawing more explicit connections to real-world applications, and greater focus on solving problems – may contribute to more positive attitudes among post-primary students, it should be noted that Fourth Class students were also much more likely to indicate that they do not like learning mathematics than to indicate the same for science. This suggests that fostering and maintaining engagement in and enjoyment of mathematics need to begin earlier, in the primary school years. The new primary mathematics curriculum, under development, emphasises the importance of nurturing positive dispositions towards mathematics which may have a positive impact on the extent to which children like learning mathematics (NCCA, 2017).

Further, while the generally positive attitudes towards science displayed among students in Ireland are to be welcomed and suggest enthusiasm for the subject, it is of concern that only 30% of Second Years highly value science (i.e., they view studying science as important for their daily life, future study and career). This proportion of students is considerably lower than the corresponding TIMSS average of 40%. The STEM Education Review Group cites several initiatives, such as those funded by Science Foundation Ireland and others, in promoting STEM-related careers, emphasising that both students and parents need to be made more aware of the transferable value and diversity of career opportunities available through STEM qualifications. Further, stronger links between science, mathematics and technology proposed in the Draft Primary Curriculum Framework (NCCA, 2020), may help students to see the relationship between these subjects and to understand the value of the scientific approach across domains and in real-life situations.

Gender differences in attitudes towards mathematics and science

While no significant differences were found between boys and girls in Ireland in terms of their performance on the mathematics and science assessments at either grade level, a number of gender differences have been observed in their attitudes towards mathematics and science. For example, boys in Ireland were significantly more likely than girls to report feeling confident in mathematics at both grade levels. While no significant gender differences were noted in terms of liking mathematics at Fourth Class, boys at Second Year were also significantly more likely than girls to report that they like learning mathematics.

Boys were more likely than girls to report that they like learning science at Fourth Class, although no significant gender differences in liking of science were observed at Second Year. Conversely, boys and girls did not differ in terms of their confidence in learning science at Fourth Class, but at Second Year, boys' confidence in learning science was significantly higher than that of girls.

Second Year girls and boys also differed in terms of the value they ascribed to mathematics and science. On average, boys in Ireland ascribed a signficantly higher value to mathematics than girls, while girls were found, on average, to value science more than did boys. At Fourth Class, girls in Ireland, compared to boys, also displayed more positive attitudes in relation to the teaching they received in their mathematics and science lessons, reporting that they find their mathematics and science lessons more engaging. In contrast, there was very little difference in the extent to which boys and girls at Second Year reported finding their mathematics and science lessons engaging.

Girls in Ireland held more positive attitudes towards school generally, as boys' sense of belonging to school was significantly lower than that for girls, at both grade levels. At Fourth Class, the average score on the sense of belonging scale for boys in Ireland is similar to the TIMSS average. The score for girls in Ireland is considerably higher than the TIMSS average for girls, suggesting that girls in Ireland hold particularly positive views of school.

The findings in this report on the differences between the attitudes of girls and boys (in Ireland and internationally) confirm those of previous studies. In particular, findings from PISA confirm more negative attitudes towards school among boys than girls and also that girls have lower confidence than boys in STEM subjects. Indeed, the results from PISA indicate that even high-achieving girls have lower confidence than their male counterparts in these subjects (OECD, 2015). The OECD report on gender equality in education (OECD, 2015) suggests that gender differences in attitudes towards school and learning become evident in adolescence. However, the findings from TIMSS show that some of the differences between boys and girls are apparent even among ten-year-olds.

Of particular concern is that boys have a significantly lower sense of belonging to school at Fourth Class. A large body of research indicates that boys are more likely to be less close with their teachers and to experience more conflict with them (Smyth, 2018), and also are more at risk of disengaging from school than girls, both during the transition from primary to post-primary school (Symonds & Galton, 2014) and thereafter. However, strong friendship and peer networks and positive relationships with teachers can play a protective role for students at risk of disengaging (Smyth, 2016). Therefore, the emergence as early as Fourth Class of a low sense of belonging, perhaps indicating a lack of sufficient quality interpersonal relationships at school, demands attention.

In order for countries to be able to foster strong mathematics and science achievement among their students, as well as continuing engagement in STEM subjects and careers in subsequent years, the persistent finding that differences between girls and boys in their attitudes towards mathematics and science are greater than the differences in their mathematics and science performance needs to be addressed. Where differences in attitudes towards mathematics and science between boys and girls in Ireland exist they tend to favour boys. For example, on average, boys have higher levels of confidence in learning mathematics at both grade levels, Fourth Class boys are more likely to like learning science, and Second Year boys have higher confidence in learning science and are more likely to value and like learning mathematics. The only areas where girls in Ireland display more positive attitudes are in terms of both the teaching they receive in their mathematics and science lessons at Fourth Class (which may be more reflective of attitudes towards their teacher then the subject matter) and the value they place on science.

Students' attitudes towards STEM subjects are influenced by, among other things, stereotypes relating to science, mathematics, and STEM-related careers, and the attitudes held by their peer group (Carli, Alawa, Lee, Zhao, & Kim, 2016; Plante, O'Keefe, Aronson, Fréchette-Simard, & Goulet, 2019; Raabe, Boda, & Stadtfeld, 2019). For example, students may adjust their orientation to STEM subjects over time depending on the attitudes held by their friends and other students in their classes (Raabe et al., 2019). The STEM Education Policy Statement 2017 – 2026 (DES, 2017) highlights the need to engage in STEM awareness campaigns and programmes, such as Smart Futures. Such programmes should aim to address the substantial gender imbalance in STEM disciplines (an issue identified by the STEM Education Review Group, 2016) and address stereotypes held by both boys and girls about science, mathematics, and STEM occupations, including those transmitted through instructional materials. Particular focus should also be placed on addressing girls' confidence levels in learning mathematics, given the findings in this report but also the high levels of anxiety around mathematics among girls in Ireland noted in PISA (Perkins et al., 2013).

The findings in this report have highlighted important patterns in students' attitudes towards school, as well as towards learning mathematics and science and the relationships between these variables and achievement. The main themes and findings in the report can be explored further using data from TIMSS 2019. The TIMSS 2019 international database will be published in December 2020 at the same time as the publication of the international report and initial national report for Ireland.

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