

Chapter 1

PIRLS and TIMSS 2011: Overview

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Introduction

In March and April 2011, Irish primary pupils took part in two large international studies – PIRLS (Progress in International Reading Literacy Study) and TIMSS (Trends in International Mathematics and Science Study). The main results of the studies were released in December 2012, in three separate volumes covering reading (Mullis, Martin, Foy, & Drucker, 2012), mathematics (Mullis, Martin, Foy, & Arora, 2012) and science (Martin, Mullis, Foy, & Stancio, 2012). Each reported overall achievement outcomes in participating countries, and provided detailed country-by-country relationships between reading, mathematics and science achievement and many contextual variables.

In Ireland, a national report was published at the same time as the three international reports. Eivers and Clerkin's (2012a) report described the main achievement-related outcomes only, with a particular focus on achievement in Ireland. However, achievement data represent only a small part of the information gathered for PIRLS and TIMSS in 2011. Considerable contextual information was collected at the level of pupil, school and system. Further, Ireland had not taken part in an international study of a similar scale at primary level since 1995. Consequently, comparisons with other countries on non-achievement variables are also of interest, as is a more nuanced analysis of the performance of Irish pupils on the assessments.

This introductory chapter contextualises a set of thematic analyses of the Irish data from the PIRLS and TIMSS studies. Its function is to provide background information to the studies, to aid interpretation, and reduce repetition. With the exception of this introductory chapter, the chapters in this volume are largely independent of each other and can be read in any order. Those unfamiliar with the studies should begin here, at Chapter 1, which also contains a common core set of references to some key reports, most of which are drawn upon in subsequent chapters.

The remainder of this chapter is divided into six sections:

1. The key features of PIRLS and TIMSS, including study oversight and data collected.
2. The studies' administration in Ireland, including tests and questionnaires administered, and participation and response rates.
3. The main data sources used in this volume (including other relevant studies drawn on in some of the subsequent chapters).
4. A short guide to test scores and statistical terms.
5. A summary of Irish performance relative to international performance on the three domains of reading, mathematics and science.
6. An overview of the content of the thematic analyses in later chapters.



In this and subsequent chapters, the following acronyms are used:

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|----------------|---|
| PIRLS | Progress in International Reading Literacy Study |
| TIMSS | Trends in International Mathematics and Science Study |
| PT 2011 | The joint administration of PIRLS and TIMSS in 2011. |

Key features of PIRLS and TIMSS

As noted earlier, PIRLS and TIMSS are two large international comparative studies of achievement. First conducted in 1995, TIMSS takes place every four years, assessing the mathematical and scientific skills of pupils in Fourth grade and/or Eighth grade (equivalent to Fourth class and Second Year in Ireland). PIRLS, which was first conducted in 2001, takes place every five years and assesses Fourth grade only. In 2011, the cycles of PIRLS and TIMSS coincided, and 63 countries took part in TIMSS, 49 in PIRLS, and 34 (including Ireland) assessed the same Fourth grade pupils as part of a joint PIRLS and TIMSS. Ireland did not take part in Eighth grade TIMSS. Thus, all data reported in this volume refer to Fourth class (*Fourth grade*, in an international context) and to primary school only.

PIRLS and TIMSS are projects of the International Association for the Evaluation of Educational Achievement (IEA). Governance and management of the projects on behalf of the IEA is conducted by the TIMSS and PIRLS International Study Center, based in Boston College. Within each participating country, a national research centre manages and implements the study. In some countries the same centre managed both studies in PT 2011. In others, the studies were managed entirely separately, or with some shared functions. In Ireland, both studies were managed and implemented by the Educational Research Centre on behalf of the Department of Education and Skills (DES). In Ireland, as noted earlier, the same schools and same pupils were selected to participate in both studies – this is not the case in all countries. This means that Ireland is among the subset of countries in which it is possible to compare individual pupil performance across the three domains.

What is assessed?

The PIRLS and TIMSS tests are guided by assessment frameworks. The reading framework is described in Mullis, Martin, Kennedy, Trong and Sainsbury (2009) while the mathematics and science frameworks are outlined in Mullis, Martin, Ruddock, O'Sullivan and Preuschoff (2009). This section briefly summarises some key features of the frameworks, to facilitate understanding of the subsequent chapters. It also outlines how the theoretical assessment frameworks were represented as actual assessment materials.

The TIMSS assessment is based on two organising dimensions: **content** (the subject matter to be assessed) and **cognition** (the thinking processes expected of pupils as they engage with the content). For both domains (mathematics and science), cognition is divided into three processes: Knowing, Applying, and Reasoning. Content varies by domain, as the subject matter of the assessment is domain-specific. In mathematics, the content areas are Number, Geometric Shapes and Measures, and Data Display. In science, the content areas are Life Science, Physical Science, and Earth Science.

The PIRLS assessment is also based on two organising dimensions: **purpose** (*why* readers read a text) and **comprehension processes** (*how* readers process what they read). Purpose is divided into reading either for Literary Experience or to Acquire and Use Information. There are four comprehension processes: focussing on and retrieving explicitly stated information; making straightforward inferences; interpreting and integrating ideas and information; and, examining and evaluating content, language, and textual elements. These four processes are usually referred to as Retrieve, Infer, Interpret, and Evaluate.

Both PIRLS and TIMSS assess pupils using paper-and-pencil tests, presented in booklets and using a “rotated block design”. This means that there are multiple test booklets containing overlapping content. For example, a block of items (questions) might appear in the first half of one booklet, and in the second half of another. There were 13 different PIRLS and 14 different TIMSS booklets. As well as enabling broad topic coverage while keeping testing time relatively short, a rotated design helps to minimise pupil copying.

Including a short break in the middle, each PIRLS test takes about 90 minutes, divided into two 40-minute sections. Each TIMSS test takes about 85 minutes, divided into two 36-minute sections. Each half of the PIRLS test booklet contains a *test unit*, which comprises a number of questions asked about a common stimulus text. TIMSS items (questions) are primarily standalone items, although some are clustered around a common source (e.g., “Answer three questions about this chart”). In each TIMSS booklet, one half is composed of mathematics items and the other of science items. In some, science items were presented in the first half, while in others, the mathematics items were presented first. Both PIRLS and TIMSS include a mixture of multiple-choice (pupils pick one of four response options) and constructed-response items (pupils write an answer). Examples of some of the test items administered to pupils as part of the 2011 assessment are included in Chapters 7 (reading), 8 (mathematics) and 9 (science) of this volume.

Contextual information collected

PT 2011 collected considerable contextual information. The information collected fell into one of two categories: questionnaires completed by individuals, and national-level information, usually supplied by the national research centres.

Participant questionnaires

All questionnaires used in PT 2011 can be accessed in full from the TIMSS and PIRLS International Study Center’s website (<http://timssandpirls.bc.edu/timss2011/international-contextual-q.html>). Below is a summary of the questionnaires completed by participants in the studies (pupils, teachers, principals, and parents):

- **Pupil Questionnaire:**
Pupils answered questions about themselves and about resources in their home. Questions related to school included their experience of and attitudes to school, and attitudes to reading, mathematics and science.
- **School Questionnaire:**
Completed by the principal or his/her designate. Topics included school size, composition and location, teacher and pupil characteristics, instruction time and school climate and resources.
- **Teacher Questionnaire:**
Completed by the usual class teacher of each selected class group. Topics included teacher demographic characteristics, qualifications, engagement in continuing professional development, instructional time and classroom practices for reading, mathematics and science lessons.
- **Parent Questionnaire:**
Topics included parent demographic characteristics, home resources for reading, early literacy and numeracy activities, parental educational and occupational information, and parental attitudes to reading. Administered as part of PIRLS, Parent Questionnaire data are unavailable for countries that only took part in TIMSS.

System-level information

The following system-level information was supplied to the International Study Center, either directly from each national research centre, or through sources supplied by the national centres:

- **National Curriculum Questionnaire**

An online questionnaire summarising key characteristics of the national education system (e.g., school starting age), and domain-specific information (e.g., curriculum content areas). Data from the questionnaires were collated and used to provide system-level summary comparison information in the main international reports and in the PIRLS and TIMSS encyclopedias.

- **A national chapter for inclusion in the PIRLS encyclopedia**

The encyclopedia (Mullis, Martin, Minnich, Drucker, & Ragan, 2012) provides an overview of education systems in participating countries, collated from the national curriculum questionnaires. In addition, a chapter describing their national education system, teacher education, policies, instruction, and curriculum issues specific to reading was prepared by each country, including Ireland (DES, National Council for Curriculum and Assessment, & Eivers, 2012a).

- **A national chapter for inclusion in the TIMSS encyclopedia**

As with PIRLS, the TIMSS encyclopedia (Mullis, Martin, Minnich, Stancio et al., 2012) provides information about participating countries' education systems. It also includes a chapter for each country (including Ireland – DES, National Council for Curriculum and Assessment, & Eivers, 2012b) describing their national education system, with an additional focus on policies, instruction, and curriculum issues specific to mathematics and to science instruction.

- **Test-Curriculum Matching Analysis (TCMA)**

The TCMA is an item-by-item review of whether or not a topic might be expected to have been covered by most pupils by the end of Fourth grade, based on the intended curriculum. The TCMA was conducted for TIMSS items only. In Ireland, the analysis was conducted by subject experts based in St Patrick's College (Clíona Murphy for science, and Thérèse Dooley, Dolores Corcoran and Miriam Ryan for mathematics). The outcomes of the TCMA are summarised in the main international reports on mathematics (Mullis, Martin, Foy, & Arora, 2012) and science (Martin et al., 2012).

Administration of PT 2011 in Ireland

A total of 151 schools agreed to take part in the study (a school participation rate of 98% of initially sampled schools and 100% with replacements).¹ These schools were stratified with regard to school size, DEIS status,² language of instruction and gender mix and then randomly selected, in order to achieve a representative sample of pupils. Within the 151 schools, 221 Fourth class groups were selected to take part in the assessments. All selected classes participated, giving a class-level participation of 100%. The 221 classes contained a

¹ Full details about Irish participation and response rates are available in Eivers and Clerkin (2012b).

² The term "DEIS status" is used here and in other chapters to indicate participation in the School Support Programme (SSP) as part of the Delivering Equality of Opportunity in Schools scheme (DEIS). Schools participating in the SSP receive additional supports from the DES due to having large proportions of pupils from disadvantaged backgrounds.

total of 4825 Fourth class pupils, of whom 46 (almost 1%) were excluded from both assessments. Testing for PT 2011 took place over two mornings – not necessarily on successive days. Typically, Pupil Questionnaires were completed after testing on one of the allocated test days. Choice of test dates was a matter for each school, provided that:

- both dates fell within the Irish test window of March 21st to April 8th 2011.
- tests were administered in the order pre-assigned to the school (half of schools were asked to take PIRLS first, and half TIMSS first, to minimise test order effects).
- only one test per day was administered.
- the Educational Research Centre was informed of the chosen dates (this was necessary to facilitate the visits of national and international quality monitors to a subset of schools).

In one school, administration procedures were not fully adhered to for the TIMSS assessment.³ TIMSS test data were not accepted for this school, and the school was not included in the TIMSS dataset.

The response rate for the various tests and questionnaires ranged from 94% to almost 100%. The high levels of cooperation from pupils, parents and school staff, as reflected in the very high participation and response rates, mean that the data can be taken as representative of Fourth class pupils' achievements and experiences.

Main data sources for this volume

All of the thematic analyses in the following chapters are based on Ireland's datasets for PT 2011, with some reference to the three main international reports. Only limited use is made of the international databases. While each country had access to its own data since 2012, the full international databases were only released in February 2013, providing limited time for analysis.

Variables based on information in the Parent Questionnaire are available for PIRLS countries only, while variables from other sources can draw on *either or both* datasets. One source is generally sufficient, but both datasets are drawn on for some analyses. This is because, while the groups of countries participating in each study show considerable overlap, they are sufficiently different to warrant separate presentation in some cases. In contrast, the Irish datasets for PIRLS and TIMSS are almost identical. The notable difference is – as outlined earlier – that one school's data was excluded from TIMSS. Therefore, reporting of questionnaire data for Ireland draws from the fuller PIRLS dataset. For consistency, comparisons with selected individual countries who took part in both PIRLS and TIMSS generally make use of their PIRLS data sets, unless the analyses relate to mathematics or science achievement.

Additional data sources

As 2011 was the first time that PIRLS was conducted in Ireland, and only the second time that TIMSS was conducted, no PIRLS trend data and only limited TIMSS trend data are available for Ireland. However, five other important studies are drawn on frequently in the subsequent chapters, to provide a broader context for the PT 2011 data.

³ Poor adherence to the administration ordering, to test timing, and difficulties over choice of test language meant that the pupils' performance on TIMSS might not be an accurate reflection of achievement.

The five are:

- National Assessment of Mathematics Achievement – **NAMA**
(Shiel, Surgenor, Close, & Millar, 2006)
- National Assessment of English Reading – **NAER**
(Eivers, Shiel, Perkins, & Cosgrove, 2005)
- National Assessments of Mathematics & English Reading – **NA 2009**
(Eivers et al., 2010)
- Growing up in Ireland – **GUI**
(Williams et al., 2009)
- Programme for International Student Assessment – **PISA**
(Cosgrove, Shiel, Sofroniou, Zastrutzki, & Shortt, 2005; Eivers, Shiel, & Cunningham, 2008; Perkins, Cosgrove, Moran, & Shiel, 2012; Shiel, Cosgrove, Sofroniou, & Kelly, 2001)

Table 1.1 outlines some of the key features of each study. NAMA, NAER and NA 2009 are grade-based studies of mathematics and reading achievement among pupils in Irish primary schools. All were conducted by the Educational Research Centre on behalf of the Department of Education and Skills. GUI is a longitudinal study of the social, emotional and academic [mathematics and reading] development of two age-based cohorts of children (although only the 9-year-old cohort is of relevance here). It is conducted by a consortium of researchers from the Economic and Social Research Institute (ESRI) and Trinity College Dublin (TCD), overseen by the Department of Children and Youth Affairs (DCYA). PISA, which is under the aegis of the Organisation for Economic Co-operation and Development (OECD), is an international assessment of the reading, mathematics, and science achievement of 15-year-olds. It is conducted by the Educational Research Centre on behalf of the Department of Education and Skills.

Table 1.1: Summary characteristics of the main additional data sources drawn on in the thematic reports

Study	Domain(s)	Year(s)	Target group(s)	National / International	Agencies
NAMA	Maths	2004	4 th class	National	ERC/DES
NAER	Reading	2004	1 st and 5 th classes	National	ERC/DES
NA 2009	Maths & reading	2009	2 nd and 6 th classes	National	ERC/DES
PISA	Reading, maths & science	2000, 2003 2006, 2009	15-year-olds	International	OECD/ ERC/DES
GUI	Maths & reading	2007-08 2011-12 ⁴	9-year-olds 13-year-olds	National	ESRI/TCD/ DCYA

The references section of this chapter includes the main reports based on the five studies listed in Table 1.1, the three main PIRLS and TIMSS international reports, and the PIRLS and TIMSS encyclopedias. To avoid (quite considerable) repetition, subsequent chapters will cite these studies in the text, but not repeat them in the references section.

⁴ The two main “waves” of data collection for the 9-year-old cohort were as indicated in the table. As GUI is a longitudinal study, the 9- and the 13-year-olds shown are largely the same group of children.

Short guide to test scores and statistics

Most of the following chapters contain few complex statistical analyses. However, readers' understanding of some of the chapters could be enhanced if they have knowledge of some basic, but important, statistical concepts, summarised in Inset 1.1.

Inset 1.1: Key statistical concepts and terms

Test scores

PIRLS and TIMSS tests are scaled to have a mean score of 500 and a standard deviation of 100. An "average" pupil scores 500 on the test, and 68% of pupils score between 400 and 600 (i.e., a range of one standard deviation above/below 500). Because a 500:100 scale is used, a difference of a few scale points between two countries means little in practical terms.

Centrepoints

PIRLS and TIMSS always compare country performance against a scale centrepoint of 500, a point of reference that remains constant from assessment to assessment. It is the mean score from the *first* time the study was conducted. The overall reading scale centrepoint links back to 2001, and the mathematics and science overall scales link back to 1995. The average of the mean scores for participating countries changes from cycle to cycle (e.g., in 2011, the international average was below 500 for mathematics and science, and above 500 for reading). The International Study Center does not report cycle means, preferring to keep the focus on the centrepoints, which remain constant.

Population estimates and standard errors

PIRLS and TIMSS survey a sample of a population to *estimate* characteristics of the entire population. Thus, 4,500 Fourth class pupils were used to estimate the characteristics of all 62,000 Fourth class pupils in Ireland. A different sample of pupils would probably produce slightly different estimates. For this reason, some of the forthcoming chapters refer to a statistic called a *standard error*. It is an estimate of how accurately the sample mean reflects the population mean, with smaller standard errors indicating a more precise estimate.

Statistical significance

Some chapters refer to *significant* differences, meaning differences between groups that a statistical test has established is unlikely to be due to chance. A quick (and reasonably accurate) way to check if the difference between two mean scores is *significant* is to take each mean score and multiply the standard error by 2 to create two mean score bands. If one band does not overlap with another, the difference may be significant. Take, for example, means of 500 ($SE=2.5$) and 510 ($SE=3.0$). The band for the first mean is 495-505 (i.e., 500 ± 5) and for the second is 504-516. Because the bands overlap, the 10-point gap between the mean scores is not significant.

Correlation versus causation

PT 2011 was a cross-sectional (snapshot) study. Unlike some longitudinal studies, snapshot studies can show correlation between variables, but not causation. For example, liking reading and performing well on the reading test are correlated – pupils who enjoy reading tend to score above average on the reading test. However, this does not show *causation* (i.e., that liking *caused* the good test performance, or vice versa).

Weighted data

The data are weighted (statistically adjusted) to ensure that the contributions of some groups of pupils are not over- or under-represented. Two main elements are involved: a) a weight to correct for sampling bias, if any; b) a weight to correct for non-response (e.g., absenteeism).

Context Questionnaire Scales

Many context questionnaire items in PT 2011 have been combined into scales measuring a single underlying "latent" construct. Each such scale has a mean score across all participating countries of 10 and a standard deviation of 2. For example, Ireland had a mean of 10.1 on the *Students Confident in Science* scale, meaning that Irish pupils had average levels of confidence in their scientific skills.

Ireland's performance on PT 2011

Table 1.2 summarises Ireland's performance on PT 2011, showing (overall, and by gender) the national and international mean scores for reading, mathematics and science. Irish pupils performed above the international study centreponts of 500 on all three domains. Their best performance was on reading, followed by mathematics, then science. There were no significant gender differences in Ireland (or across TIMSS as a whole) for overall performance on mathematics and science. In contrast, girls performed much better on the reading assessment, in Ireland and in almost every country that took part in PIRLS.

Table 1.2: Mean Irish and international study average scores for reading, mathematics and science, overall and by gender

		Study centrepont	Mean scores 2011	
			Ireland	International
Reading	Overall	500	552 (2.3)	–
	Boys		544 (3.0)	504 (0.5)
	Girls		559 (2.9)	520 (0.5)
Maths	Overall	500	527 (2.6)	–
	Boys		529 (3.3)	491 (0.6)
	Girls		526 (3.7)	490 (0.5)
Science	Overall	500	516 (3.4)	–
	Boys		516 (4.6)	485 (0.6)
	Girls		516 (4.0)	487 (0.6)

Note: The main PIRLS and TIMSS international reports provide mean scores by gender for the 2011 cycle, but not overall mean scores for 2011. Country means are compared to the study centrepont only.

For reading, Irish pupils showed a particular strength on literary-type texts. This can be attributed to Irish girls performing extremely well on literary texts, while Irish boys performed at a similar level on literary and informational texts. Irish performance on reading will be discussed in more detail by Concannon-Gibney and Shiel in Chapter 7.

For mathematics content areas, Irish pupils performed best on Number, while Geometric Shapes and Measures was a relative weakness. In contrast, Irish pupils showed a reasonably balanced performance across the three science content areas, with no major areas of strengths or weaknesses. In the cognitive domains, Reasoning was a weakness for both science and mathematics, relative to overall Irish performance on each of these domains. Irish performance on mathematics will be discussed in more detail by Close in Chapter 8, while science performance will be discussed by Murphy in Chapter 9.

Overview of the thematic analyses

This chapter serves as an overview and introduction to a series of thematic reports based on Ireland's data from PT 2011. Although they address a diverse range of topics – from the broad structure of the education system to the level of an individual test question – they share some commonalities. Generally, topics were selected for one or all of the following reasons: high policy relevance; if the data for Ireland are somewhat atypical, relative to other countries; or, if the data conflict with “received wisdom”. For example, if Irish pupils or teachers scored well above or below average on a scale, or if a behaviour unexpectedly showed no relationship with achievement, then those variables would be prioritised for inclusion.

Other features that the thematic analyses have in common are:

- A consistent focus on Ireland's position relative to other countries, supported, where appropriate, by analyses of differences within Ireland.
- A focus on percentages of *pupils*, even when describing school and teacher characteristics, because the pupil is the unit of interest, not the school. For example, we might say "...16% of pupils attended schools located in heavily populated areas" rather than "...20% of schools were located in heavily populated areas".
- A common set of comparison countries, comprised of English-speaking countries and top-performing countries. In most cases, Ireland is simply compared against study averages, but where specific comparisons are made, they are usually restricted to the same set of key comparison countries as used in Eivers and Clerkin (2012a).

As noted, the chapters are largely standalone documents, and can be read in any order. Within this volume, they begin at the high, system-level, progress down to the individual item level, and end with a multi-level model of achievement that incorporates school-, class- and pupil-level data.

The first thematic chapter, written by Mary Lewis and Peter Archer, examines policy, provision, and structural characteristics of the Irish education system. They address issues such as curriculum, structure of the system, issues of the "school estate" such as size and location, and teacher certification. They also examine resources within schools, such as class libraries, and access to computers. In Chapter 3, Aidan Clerkin and Ann-Marie Creaven provide information on pupil engagement, outlining associated factors at both school and pupil level. Pupils' attitudes to school in general and to reading, mathematics and science in particular, are reviewed, as are teachers' reports of some of the difficulties they face in engaging pupils. They also examine pupils' reported experiences of bullying within school. In Chapter 4, Eemer Eivers discusses pupils for whom home and test language differed. She discusses the growth in number of such pupils and their uneven distribution within the Irish education system. The relationship between language and performance on the tests is considered, as are differences in the experiences, attitudes and home resources of "additional language" and English speaking pupils in Ireland.

In Chapter 5, Aidan Clerkin examines teachers and teaching, including teachers' qualifications and professional development, teaching practices, and collaboration with other teachers in the school. He also presents information relating to confidence in teaching, use of ICT, and teachers' working conditions. Chapter 6, by Eemer Eivers and Ann-Marie Creaven, examines home-school interaction. Issues include parental awareness about what happens in school, generally, and the extent to which schools and teachers inform parents about their own children. Parental volunteer and committee work are also considered.

After each cycle of PIRLS and TIMSS, a set of items used in the assessments are released for public review. Chapters 7 to 9 analyse some of these items in detail, drawing on context and curriculum to aid interpretation. In Chapter 7, Tara Concannon-Gibney and Gerry Shiel examine pupil performance on selected PIRLS items. They identify aspects of the items that may make them relatively easy or difficult for pupils in Ireland, and consider differences in the performance of Irish girls and boys on the selected items.

In Chapter 8, Seán Close examines, in the context of the TIMSS mathematics framework and the Irish primary school mathematics curriculum, a selection of released items where Irish pupils' performance was unusually high or low compared to overall Irish performance and international norms, or were peculiar to Ireland in terms of gender differences. In Chapter 9, Clíona Murphy reviews the released science test items, with particular reference to items for which Irish performance was notably different to the TIMSS

average. She also examines overlap between the Irish primary science curriculum and the TIMSS science framework.

In Chapter 10, Jude Cosgrove and Ann-Marie Creaven describe results of multilevel models of reading, mathematics, and science achievement. They consider the extent to which schools that took part in PT 2011 differ with respect to achievement, and then compare and contrast the results for the three domains. They examine the extent to which school characteristics are associated with achievement differences over and above pupil ones, and suggest specific areas for further research.

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